SANITARY WATERSHED SURVEY

for

RESERVOIR ONE, RESERVOIR A, OUTINGDALE WATER TREATMENT FACILITIES

Prepared by

El Dorado Irrigation District

Water Quality Division

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(Revision 1)

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El Dorado Irrigation District

SANITARY WATERSHED SURVEY
Reservoir One, Reservoir A, Outingdale
Water Treatment Facilities

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EXECUTIVE SUMMARY

The California Surface Water Treatment Regulation (SWTR) has specific monitoring requirements for utilities which provide drinking water from surface water sources. These monitoring requirements include those of the Sanitary Watershed Survey at least once every five years for every raw water source.

The Survey must be conducted in order to summarize the contaminant loadings so that the raw water is adequately treated for domestic use. The primary objectives of the Sanitary Watershed Survey are to maintain compliance with the SWTR, and to (1) evaluate necessary treatment based on bacteriological and turbidity loadings, (2) evaluate potential contaminant sources and activities, and (3) make recommendations for watershed management.

The El Dorado Irrigation District has previously submitted watershed survey reports for the Reservoir Seven, El Dorado Hills, and the Strawberry Water Treatment Plants. This report serves to complete the requirement for the Reservoir One, Reservoir A and Outingdale Water Treatment Plants. The significant points presented in this survey report are summarized below.

I. WATER TREATMENT

- The District raw water sources generally provide a high quality domestic supply for which some vulnerability exists based on historical land use, current land use, natural settings, and disasters.

- The District's water quality monitoring program continues to show compliance with State and Federal drinking water standards.

- Total coliform counts and raw water turbidities at both Reservoir One Water Treatment Plant (WTP) and Reservoir A WTP indicate that the present level of treatment at the facilities, 3-log *Giardia*/4-log virus treatment, is sufficient. This demonstrates a treatment level which achieves 99.9% *Giardia* removal.

- Total coliform and turbidity data at Outingdale plant indicates that the typical coliform values are greater than 1000 MPN/100 ml once or more per year, with typical values in the range of 110 MPN/100 ml. Considering this information, a 3.5-log removal of *Giardia*/4.5 virus removal is recommended. This demonstrates a treatment level which achieves 99.97% *Giardia* removal.

- The treatment process at the Reservoir A facility is that of direct filtration. For this reason daily production at the facility is limited to 43 mgd maximum per State Health Department requirements. Plant is capable of 54 mgd with State approval.

II. POTENTIAL CONTAMINANT SOURCES

- The primary sources of potential contamination in District watersheds comes from septic systems, stormwater run-off, abandoned mine runoff, forest fires, and grazing animals.

- The primary activities in District watersheds that can add to source water contamination include timber harvest, urbanization, pesticide application and recreation.

- Concerns regarding surface water contamination for District water systems are not limited to the raw water supply. The potential for contamination at these storage reservoirs is similar to any raw water supply.

III. RECOMMENDATIONS FOR WATERSHED MANAGEMENT

- In order to maintain the high level of water quality that currently exists, development of a program for watershed quality management is recommended.

- Watershed Quality Management can be most effectively attained through organization of a multi-agency Watershed Control Authority which is discussed in Chapter 5 of this document. Parties of the Control Authority should develop goals and control measures which assist in water quality management. Each organization's participation should include a meaningful investment of resources for these activities.

- Watershed Surveillance and Monitoring Programs must continue in order to properly evaluate Watershed Quality Management success. Monitoring frequency varies from continual in-line measurements to comprehensive annual testing, depending on the contaminant.

- Detailed reporting of water quality trends and surveillance observations should be conducted annually to assist District management and treatment plant operations. DOHS regulations require Sanitary Watershed Surveys reporting once every five years. The next SWSS deadline for District Watersheds is January 31, 2001.

CHAPTER I

INTRODUCTION

This chapter is intended to provide the reader with the objectives of Sanitary Watershed Surveys (SWSS), and a description as to how the SWSS for three District watersheds was conducted.

I. SANITARY SURVEY REQUIREMENTS.

The California Surface Water Treatment Regulation (SWTR) which was adopted by the State of California in 1989 requires that suppliers of potable domestic water from surface water sources conduct a sanitary survey of their watersheds by January 1, 1996 with updates every five years. The primary function of the survey is to summarize the contaminant loading on the watershed including bacteriological contaminants so that appropriate levels of treatment can be employed at District water treatment facilities. Secondary functions of the survey should be to identify potential contaminant sources that exist, or may soon exist within the watershed, and to make recommendations for appropriate watershed management practices.

This document is intended to fulfill the requirement for the surface water sources that are the supply for treatment plants at Reservoir One, Reservoir A and the Outingdale locations. The water source for Reservoir One is the El Dorado Canal, for Reservoir A is Jenkinson Lake and for Outingdale, the Middle Fork Cosumnes.

II. OBJECTIVES.

There are four main objectives of this watershed survey. They include 1) maintaining compliance with the SWTR requirements, 2) evaluation of treatment processes are adequate to reduce contaminants in the water supply, 3) evaluation of potential contaminant sources, and to make recommendations toward effective watershed management practices.

Table 1-1

ANALYTE	UNITS	PRIMARY STANDARD	SECONDARY STANDARD
ORGANICS			
1,1-Dichloroethane	ug/L	5	
1,1-Dichloroethylene	ug/L	6	
1,1,1-Trichloroethane	ug/L	200	
1,1,2-Trichloroethane	ug/L	5	
1,1,2,2-Tetrachloroethane	ug/L	1	
1,2-Dichlorobenzene	ug/L	600	
1,2-Dichloroethane	ug/L	0.5	
1,2-Dichloropropane	ug/L	5	
1,2,4-Trichlorobenzene	ug/L	70	
1,4-Dichlorobenzene	ug/L	5	
Benzene	ug/L	1	
Carbon Tetrachloride	ug/L	0.5	
cis-1,2-Dichloroethylene	ug/L	6	
Dichloromethane	ug/L	5	
Ethylbenzene	ug/L	700	
Monochlorobenzene	ug/L	70	
Styrene	ug/L	100	
Tetrachloroethylene	ug/L	5	
Toluene	ug/L	150	
Total 1,3-Dichloropropene	ug/L	0.5	
Total Trihalomethanes	ug/L	100	
trans-1,2-Dichloroethylene	ug/L	10	
Trichloroethylene	ug/L	5	
Trichlorofluoromethane	ug/L	150	
Trichlorotrifluoroethane	ug/L	1200	
Vinyl Chloride	ug/L	0.5	
Xylenes (Total)	ug/L	1750	
SEMI-VOLATILE ORGANICS			
2,4-D (Formula 40)	ug/L	70	
2,4,5-TP (Silvex)	ug/L	50	
Alachlor (Lasso)	ug/L	2	
Aldicarb sulfone	ug/L	2	
Aldicarb sulfoxide	ug/L	4	
Aldicarb (Temik)	ug/L	3	
Atrazine	ug/L	3	
Bentazon	ug/L	18	
Benzo(a)pyrene	ug/L	0.2	
Carbofuran (Furadan 4F)	ug/L	18	
Chlordane	ug/L	0.1	
Dalapon	ug/L	200	

Table 1-1 Cont.

ANALYTE	UNITS	PRIMARY STANDARD	SECONDARY STANDARD
Dibromochloropropane (Nemafum	ug/L	0.2	
Dinoseb	ug/L	7	
Diquat	ug/L	20	
Di(2-ethylhexyl)adipate	ug/L	400	
Di(2-ethylhexyl)phthalate	ug/L	4	
Endrin	ug/L	2	
Ethylene dibromide	ug/L	0.05	
Glyphosate (Roundup)	ug/L	700	
Heptachlor epoxide	ug/L	0.01	
Heptachlor (H-34)	ug/L	0.01	
Hexachlorobenzene	ug/L	1	
Hexachlorocyclopentadiene	ug/L	50	
Lindane	ug/L	0.2	
Methoxychlor	ug/L	40	
Molinate	ug/L	20	
Oxamyl (Vydate)	ug/L	200	
PCB's (Alachlors)	ug/L	0.5	
Pentachlorophenol	ug/L	1	
Picloram (Tordon)	ug/L	500	
Simazine	ug/L	4	
Thiobencarb	ug/L	70	1.0
Toxaphene	ug/L	3	
RADIOLOGICAL			
Radon 222	pCi/L		
Alpha	pCi/L	15	5
Beta	pCi/L	50	
INORGANICS			
Aluminum	ug/L	1000	200
Antimony	ug/L	6	
Arsenic	ug/L	50	
Asbestos	MFL	7	
Barium	ug/L	1000	
Beryllium	ug/L	4	
Cadmium	ug/L	5	
Chromium	ug/L	50	
Copper	ug/L		1000
Cyanide	ug/L	200	
Iron	ug/L		300
Lead	ug/L	15	
Manganese	ug/L		50

Table 1-1 Cont.

ANALYTE	UNITS	PRIMARY STANDARD	SECONDARY STANDARD
Mercury	ug/L	2	
Nickel	ug/L	100	
Nitrate as N	mg/L	10	
Nitrite as N	mg/L	1	
Selenium	ug/L	50	
Silver	ug/L		100
Thallium	ug/L	2	
Total Nitrite/Nitrate as N	mg/L	10	
Zinc	ug/L		5000
GENERAL PROPERTIES			
Apparent Color	Units		15
Chloride	mg/L		250-500
Fluoride	mg/L	1.4-2.4	4
MBAS (Foaming Agents)	mg/L		0.5
Odor Threshold	TON		3.0
pH*	Std Units		6.5-8.5
Specific Conductance	umho/cm		900-1600
Sulfate	mg/L		250-500
Total Filterable Residue	mg/L		500-1000
Turbidity			5
BACTERIOLOGICAL			
Total Coliform	P/A	>95%A	

The list of potential contaminants which concern the District includes bacteria, viruses, excess nutrients, harmful physical properties and chemical pollutants. The Safe Drinking Water Act (SDWA) includes maximum contaminant level goals for bacteriological contaminants such as giardia lamblia, viruses and Legionella, as well as for metals, nutrients, and other inorganic or organic pollutants. A list of the regulated contaminants are provided in Table 1.

Water treatment processes can reduce concentrations of contaminants, but there are costs and potential risks associated with each type of treatment. For this reason, the best available source water should be used and efforts towards conservative watershed management practices should be made.

III. CONDUCT OF THE STUDY

This report follows the procedures outlined in the Watershed Survey Guidance Manual prepared by the AWWA CA/NV Section for Source Water Quality. For the SWSS of the El Dorado Canal, Jenkinson Lake, and the Middle Fork Cosumnes watersheds various public agencies and publications were researched and are referenced in Appendix 1. Field surveys were conducted by utility vehicle, or on foot, and water quality parameters were regularly collected from discrete locations and analyses were conducted at the District and commercial laboratories.

IV. REPORT ORGANIZATION

This initial SWSS identifies and describes the watershed, and discusses the general conditions of the water supply in terms of quantity, reliability and general quality. The sources of possible contaminants are discussed, and compared with appropriate analytical measurements and general qualitative observations. Changes such as population growth or land use modifications are discussed and recommendations for watershed management practices are identified. Finally, an evaluation of actual water quality measurements is conducted for SWSS conclusions and recommendations.

CHAPTER II

WATERSHED AND WATER SYSTEM

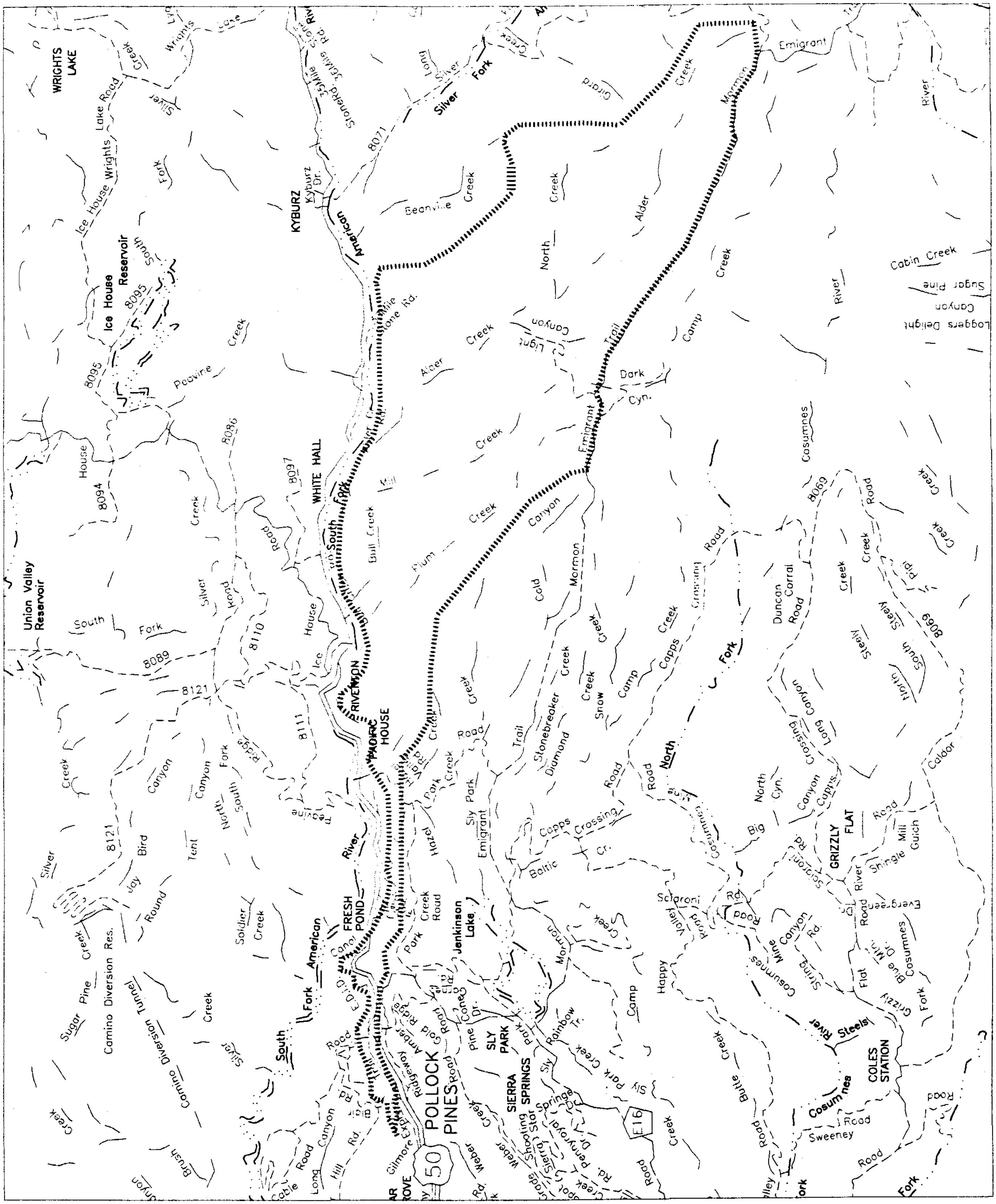
This chapter is intended to provide the reader with general information on the three watersheds which are the subject of this report and the supply systems which form the basis for more detailed information presented in the following chapters.

I. WATERSHED DESCRIPTIONS

The following sections should describe the general characteristics of each of the three watersheds, and their respective water bodies.

A. Reservoir One; El Dorado Canal Watershed

The American River Watershed Survey (ARWSS) was conducted by HDR Engineering for El Dorado irrigation District, and submitted to the State Department of Health Services in August of 1993. The watershed described in this report for Reservoir One Water Treatment Plant starts at a diversion of the South Fork American River known as the El Dorado Canal. The El Dorado Canal diverts water from the South Fork and ultimately supplies the Reservoir One Water Treatment Plant. Because the unique nature of the El Dorado Canal water conveyance structure creates its own set of watershed protection parameters, the State Department of Health Services determined that an addendum to the ARWSS would be necessary for the water supply to Reservoir One. A diversion dam located along the American River in Kyburz serves as a starting point for the El Dorado Canal which routes the water supply along the American River Canyon, through the town of Pollock Pines to the Reservoir One Water Treatment Plant via Forebay Reservoir. Figure 2-1 outlines this particular watershed subset, which heretofore shall be referred to as the El Dorado Canal Watershed (EDCWS).



LEGEND

DRAINAGE BASIN BOUNDARY

WATER FEATURE

SECONDARY ROADS

NOT TO SCALE

EL DORADO CANAL WATERSHED
JUNE 1996
FIGURE 2.1

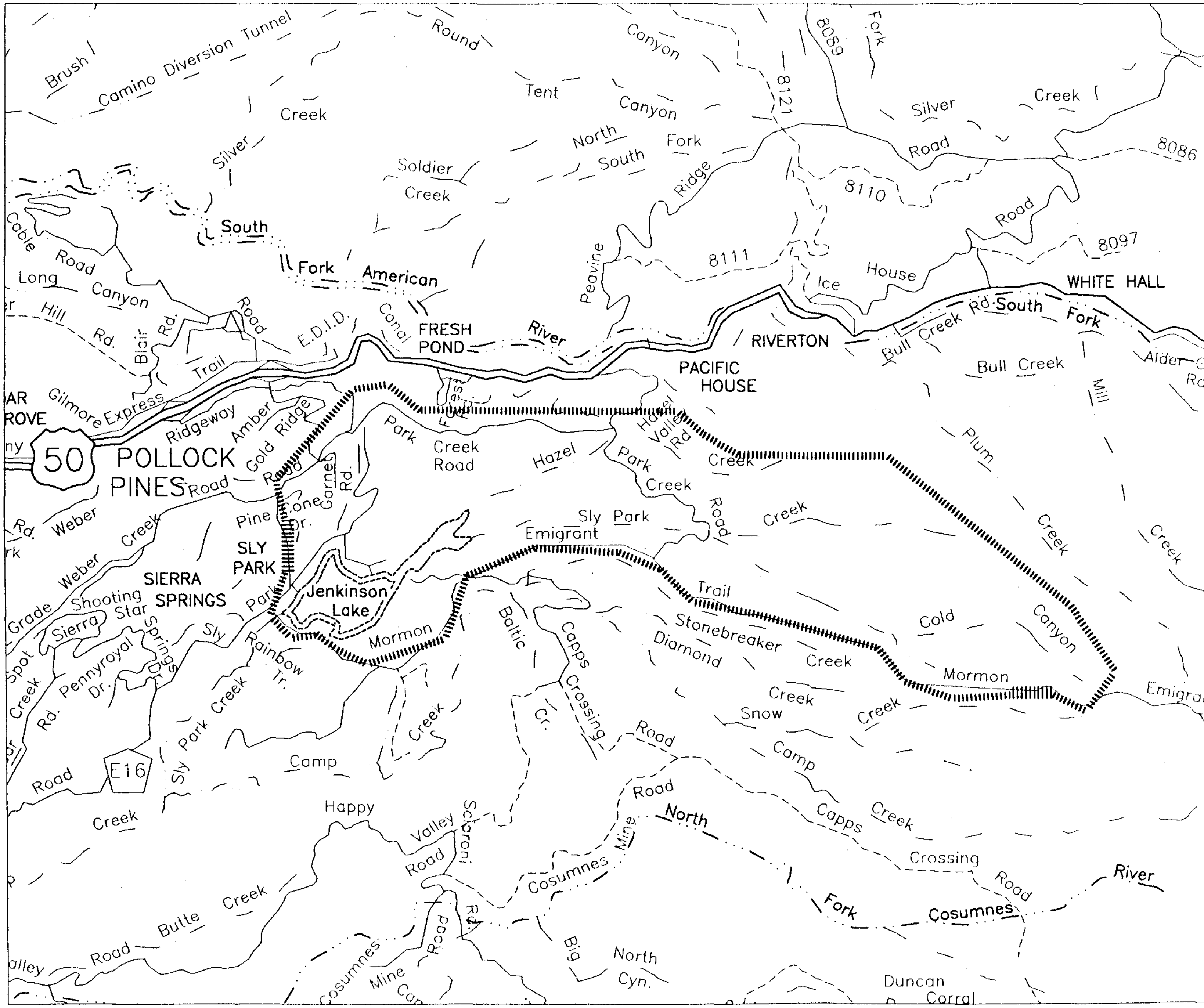
From the diversion dam at Kyburz to the Forebay Reservoir, the El Dorado Canal (EDC) consists of a conduit 21.9 miles long. Most of this diversion structure, which constitutes the unique nature of the EDCWS is made up of concrete lined ditch, wood flume, pre-cast concrete flume, pipe, siphon and tunnel sections, and is constructed along the steep south wall of the South Fork American River Canyon.

The El Dorado Forebay Reservoir is located at the base of the El Dorado Canal in Pollock Pines, at 3792 feet elevation. In addition to the powerhouse outlet and spillway located at the Reservoir is the outlet to the El Dorado Irrigation District ditch system. This earthen ditch system extends an additional 3.3 miles, and leads through the residential community of Pollock Pines, directly to Reservoir One Water Treatment Plant. A continuation of the ditch from Reservoir One supplies irrigation customers only.

B. Reservoir A; Jenkinson Lake Watershed

The Jenkinson Lake watershed is defined here as a manmade reservoir extending from the Cold Canyon tributary of Sly Park Creek to the Jenkinson Lake Dam. It includes both forks of Sly Park Creek and Hazel Creek. Jenkinson Lake is also fed by Camp Creek via a manmade diversion tunnel. A short section of Sly Park Creek conveys the Camp Creek diversion into Jenkinson Lake. In addition, there are numerous seasonal drainages into the reservoir. The characteristics of the Camp Creek watershed have been previously described for the State Department of Health Services in the 1992 SWSS for Reservoir 7, and will not be included in this report.

The watershed is approximately 16.5 square miles in surface area. The average width was found to be about 2.1 miles. It includes portions of Township 10 North Ranges 13 and 14 East. Figure 2-2 outlines this particular watershed subset, which heretofore shall be referred to as the Jenkinson Lake Watershed (JLWS).



LEGEND

DRAINAGE BASIN BOUNDARY

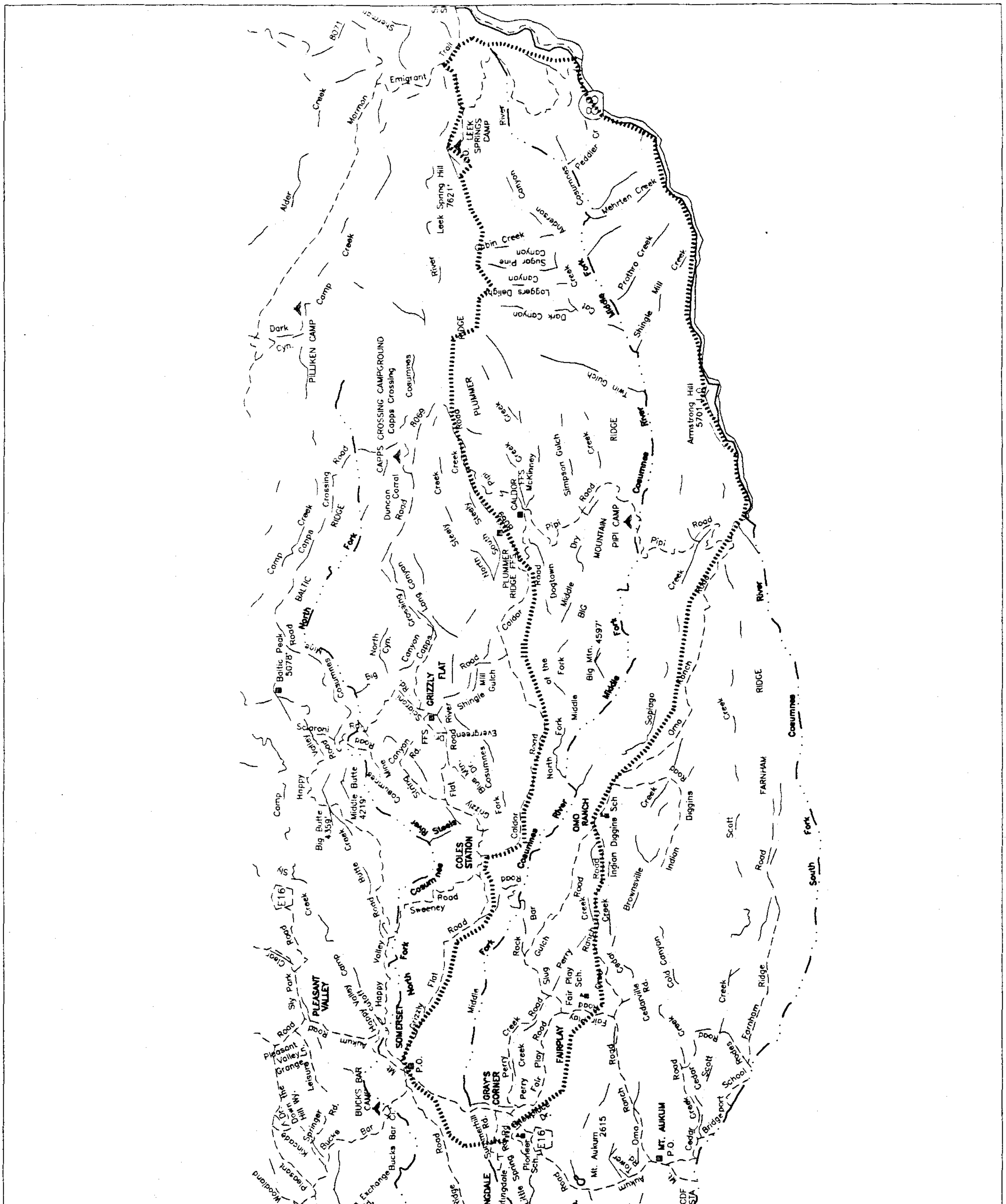
WATER FEATURE

SECONDARY ROADS

NOT TO SCALE

EID

JENKINSON LAKE WATERSHED
JUNE 1996
FIGURE 2.2



LEGEND

|||||||||||||||||||||	DRAINAGE BASIN BOUNDARY
— · · · — · · · —	WATER FEATURE
- - - - - - - - - -	SECONDARY ROADS

NOT TO SCALE

MIDDLE FORK
COSUMNES RIVER WATERSHED
JUNE 1996
FIGURE 2.3

C. Outingdale WTP; Middle Fork Cosumnes Watershed

The supply to the Outingdale Water Treatment Plant (WTP) extends from the easternmost drainages of the North Fork Cosumnes such as Anderson Canyon and Peddlar Creek to the intake structure located within the river as it passes through the small community of Outingdale. Multiple drainages to the Middle Fork Cosumnes throughout the watershed include Dogtown Creek, PiPi Creek, Shingle Mill Creek and McKinney Creek.

Figure 2-3 outlines this particular watershed, which will heretofore be referred to as the Middle Fork Cosumnes Watershed (MFCWS).

II. HISTORICAL LAND USE

Although historical records are not the primary concern of a SWSS, prior land use practices can shed some light on contaminants which could exist within the watershed. An example would be heavy metals from abandoned mine discharges which have the potential to affect the watersheds which are the subject of this report. All three watersheds have played a significant part in California Gold Rush History. Man's search for gold historically caused significant changes in watershed characteristics primarily due to the ravages of hard rock and hydraulic mining. Hydraulic mining has proven particularly destructive, altering forever the topography of the Mother Lode.

The first significant human land use impact to District watersheds followed the discovery of gold in 1848. After the news of gold spread world-wide, thousands of miners began pouring into the Mother Lode country. Development of agriculture, ranching and general commerce was a natural part of the increase in area population. Construction of ditches and other water conveyance structures for transport of water to the spawning communities became necessary. One of the most ambitious of these water conveyance structures became the El Dorado Canal of the EDCWS.

Growing Gold Rush communities included areas within the Jenkinson Lake Watershed. In the mid-1850's Jenkinson Lake Reservoir did not exist, but was the location of agriculture and grazing of the Sly Park Ranch. It also became the location of a logging and milling operation. Sly Park Mill was located close to what is now the second dam on Sly Park Creek. Purchase of the land by the United States Government Bureau of Reclamation and the use of its properties for the Central Valley Project led to the 1952 construction of two earthen dams and the origin of Jenkinson Lake.

More details on historical land use for El Dorado Canal Watershed, Jenkinson Lake Watershed and Middle Fork Cosumnes Watershed are included in Appendix 2 through 4.

III. CURRENT LAND USE

The regions of all three watersheds have been broadly described in terms of soil characteristics, vegetation and human use (ARWSS, 1993). These descriptions pertain to regions of the Forest/Recreational Zone and the Upland Agricultural Zone.

The Forest/Recreational Zone comprises the major acreage of the watershed, with primary land use for timber production, lumber harvest, wildlife habitat, and recreation. Large private logging corporations such as Georgia Pacific and Sierra Pacific Industries are significant contributors to the management of timber in these regions. Smaller logging operations are authorized on USDA Forest Service Lands. Recreational use in this Zone includes the use of trails and logging roads for motorized recreational vehicles, mountain bike excursions, horseback riding, hiking and cross-country running. Hunting is also allowed during certain times of the year.

The Upland Agricultural Zone comprises a region in which the soils are characteristically deep, reddish-brown in color, fertile, and quite permeable. Native vegetation tends toward mixed conifers, and agricultural use includes Christmas tree farming, but some soils are used for deciduous orchards.

A. EL DORADO CANAL WATERSHED

Along the 21.9 miles of the El Dorado Canal, the primary land use is that of logging, although camping and recreation especially in the upper end near Kyburz, is also common. The El Dorado Canal terminates at Forebay Reservoir in Pollock Pines. Pollock Pines is a residential community with some commercial and light industry. The 472 acre foot Forebay Reservoir serves as raw water storage facility for the District water treatment plant, for electrical power generation, and for non-body contact recreation. The outlet structure at Forebay which supplies the EID Main Ditch consists of a 36 diameter cast-iron pipe which allows a maximum discharge of 40 cfs.

The 3.3 mile long stretch of the Main Ditch from Forebay to Reservoir One is bordered by parcels which are used for private residences, Christmas tree farming and logging. Property owners, parcel size and land use is described on Table 2-1. Parcel locations are identified on Figure 2.4.

B. JENKINSON LAKE WATERSHED

Jenkinson Lake is a 41,033 acre foot water storage reservoir which serves as a raw water domestic supply and for recreation. Recreation use includes motorized boating as well as body contact sports, such as swimming, fishing, jet skiing and water skiing. The facilities surrounding the reservoir include nine campgrounds, capable of accommodating 140 campsites. Trails used for hiking, horseback riding, mountain biking and cross-country running surround the lake and are scattered throughout the watershed.

For the past several years a recreational survey has been conducted by District staff. This survey has included counts of people and boat traffic at the park. Users are tallied at the gate entrance only, and do not include walk-in visitors, or those that access the facilities through peripheral locations. Survey results for a six year period beginning in 1990 are provided in Table 2-2. Other park facilities include a tool shop, above-ground gas tank storage, a paint shop which house pit toilet cleaning tools and chemicals, and a campground office.

TABLE 2-1
OWNERSHIP/LAND USE
MAIN DITCH, FOREBAY TO RESERVOIR ONE

SITE NUMBER	ACREAGE	OWNERS	USE
1	4.92	TESTER	Unknown
2	20.55	ROBERTS	Christmas Trees
3	9.79	CHRISTIAN LIFE CNTR	Unknown
4	9.35	LEAHY	Unknown
5	0.79	ROSENBERG	Residential
6	0.77	LEMMING	Christmas & Apple Trees
7	0.44	MAC PHEE	Residential
8	0.44	WEIL	Residential
9	0.24	CRAIG	Residential
10	150.00	HARRIS	Christmas & Apple Trees
11	0.82	MASTERS	Residential
12	0.773	MILLAR	Residential
13	1.544	LUKASKI	Residential
14	2.04	SCHINDEL	Residential
15	12.50	MARCO	Unknown
16	2.965		Unknown
17	14.50	SANDERS	Unknown
18	0.37	DES ROSIERS	Residential
19	6.40	MARINI	Unknown
20	10.00	CESARIO	Small Orchard
21	2.00	WHELDEN	Small Orchard
22	11.60	OAKLAND BOY SCOUTS OF AMERICA	Unknown
23	10.35	SMITH	Christmas Trees
24	8.60	FOX	Unknown
25	12.07	STEELE	Unknown
26	3.87	VANDERPOOL	Residential
27	25.94	SMITH	Garden
28	1.52	BARNES	Residential
29	2.49	ANDERSON	Residential
30	2.01	FLYNN	Residential
31	1.00	POE	Residential
32	1.00	CHRISTIANSEN	Residential
33	2.22	HERNANDEZ	Residential
34	1.00	EDWARDS	Residential
35	1.07	ARMOUR	Residential
36	1.50	RATH	Residential
37	0.94	GREEK	Residential
38	2.00	MILLER	Residential
39	1.08	WENDT	Residential
40	1.00	MILLER	Residential
41	2.00	SOUZA	Residential
42	2.00	JOHNSON TRUST REV	Residential
43	2.02	CONNER	Residential
44	1.00	O CONNER	Residential
45	0.11	LEE	Residential

TABLE 2-2
People and Boat Counts
Sly Park Recreation Area

YEAR	PEOPLE	BOATS
1990	194,333	11,947
1991	178,000	12,531
1992	171,000	14,435
1993	150,000	10,805
1994	177,500	13,400
1995	140,000	14,300

Apart from recreation, JLWS supports a significant residential community in Pollock Pines. Timber harvest on USDA Forest Service Lands and private properties frequently take place along acreage which drains to Jenkinson Lake, thereby having the potential to impact watershed acreage.

C. MIDDLE FORK COSUMNES WATERSHED

The MFCWS is the most sparsely populated watershed of concern to the EID. With a population density of less than 16 persons per square mile (DOT, 1994), water quality problems typically associated with urbanization have little impact. Within two miles of the Outingdale Water Treatment Plant intake, however, there is one significant road crossing, at the Mt. Aukum Road bridge.

There are no organized recreational facilities located along the Middle Fork Cosumnes. However, accessible portions of the river are often used for camping, fishing and swimming. A popular swimming hole is also located along the Middle Fork Cosumnes, underneath the Mt. Aukum bridge. Between the bridge and the Outingdale Treatment Plant intake are a number of residential lots, some of which include a few livestock such as horses and goats as well as small agricultural plots. Timber harvest on USDA Forest Service Lands as well as private properties also impact watershed acreage.

IV. OWNERSHIP

Property in all three subject watersheds discussed is to a great extent publicly owned. Public entities included are the USDA Forest Service, US Bureau of Reclamation, and the El Dorado Irrigation District. Large parcels also belong to private corporations or industries such as Georgia Pacific, Pacific Gas and Electric Company and Sierra Pacific Industries.

A. EL DORADO CANAL WATERSHED

Ownership of the diversion structure at Kyburz, the El Dorado Canal, and the El Dorado Forebay is currently that of PG&E. However, the power utility is in the process of selling these properties to the El Dorado Irrigation District.

Between Forebay and the Reservoir One water treatment plant, the water supply ditch for which EID has easement rights is surrounded by private property, varying in lot size from 3.87 acres to 150 acres. Out of these 45 parcels, 31 are allowed to draw water from the canal for agricultural

use. This includes the 150 acre Harris Ranch, and the 20.55 acre Roberts Christmas Tree farms. Road crossings include two main road concrete bridge structures at Pinewood Lane and Blair Road. The parcel map which identifies parcels, property owners and locates the major road crossings is provided in Figure 2.4.

B. JENKINSON LAKE WATERSHED

The acreage immediately surrounding Jenkinson Lake are currently owned by the US Bureau of Reclamation (USBR). The recreational facilities known as Sly Park which surround the Lake are operated by the El Dorado Irrigation District. The District is currently evaluating the feasibility of purchasing Jenkinson Lake. The properties outward from Sly Park belong to a combination of the US Forest Service, Georgia Pacific Corporation and small private land holdings. A map which identifies private vs. US Forest Service land holdings within the JLWS is provided in Figure 2.5.

Public transportation roadways that lie adjacent to the reservoir include Sly Park Road, Mormon Immigrant Trail (also known as Iron Mountain Road) and the park road which provides access to the Sly Park boating dock and other recreational facilities. All of these roads are paved. Small, unpaved utility roads are also found at various locations surrounding the reservoir.

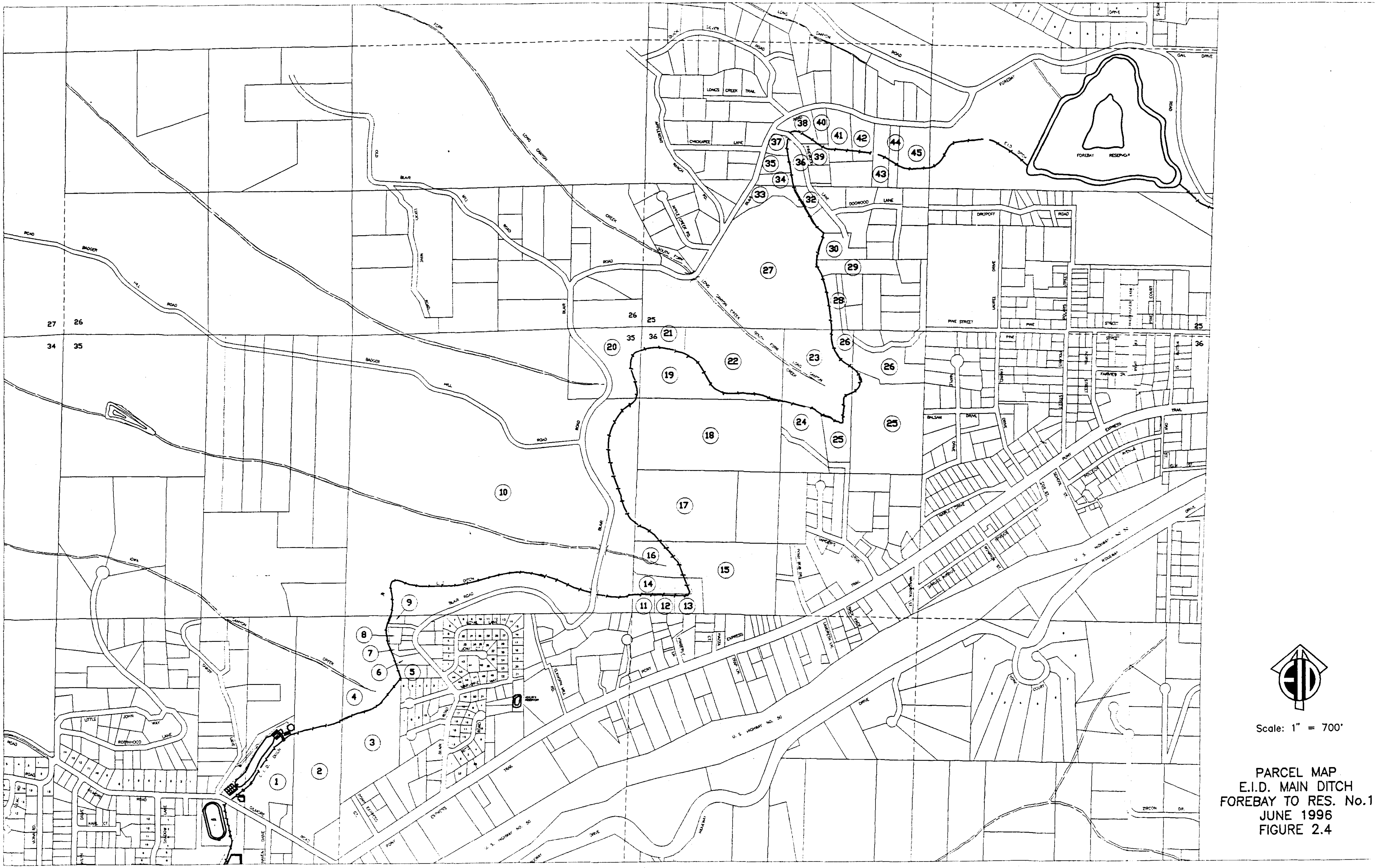
C. MIDDLE FORK COSUMNES

Property ownership alongside the Middle Fork Cosumnes is primarily that of the USDA Forest Service and private entities. The river flows between steep canyon walls, which do not allow ready access. However, there are some steep, switch-back roads and constructed bridge crossings. Mt. Aukum Road is the one significant publicly-owned highway which crosses over the river about one mile upstream of the water plant intake. Below this bridge the river forms a pool, which has become a popular swimming hole.

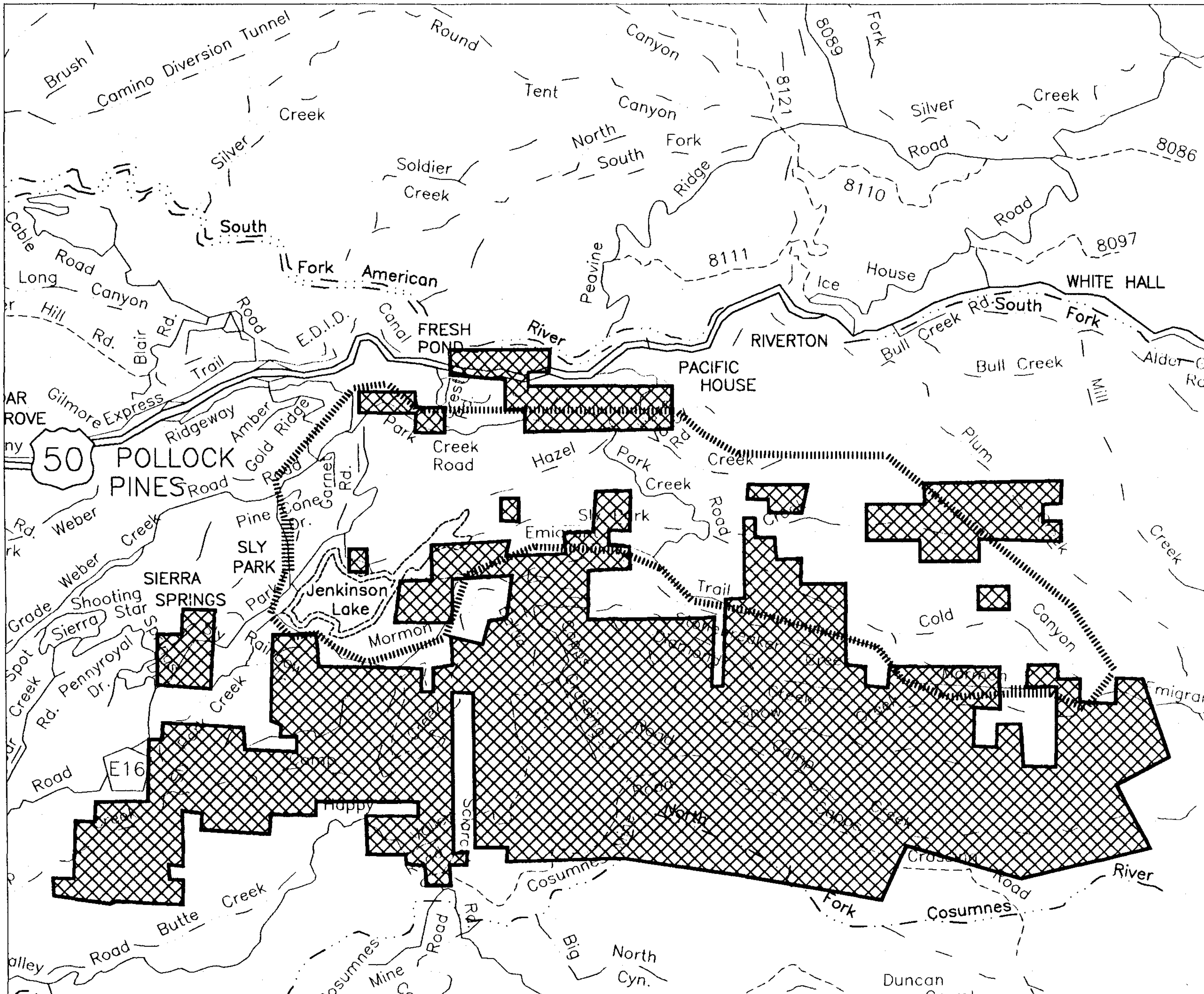
V. POPULATION CENTERS

Communities within all three watersheds are small, and significantly rural. The most densely inhabited community within the subject areas is that of Pollock Pines. Urbanization effects on watershed from Pollock Pines is relevant to EDCWS and JLWS water supplies. For all practical purposes, the population surrounding Jenkinson Lake increases significantly during summer months due to recreational use and camping facilities. The population of Pollock Pines is 15,542 (El Dorado County DOT, 1994), with the majority of the commercial properties located within watershed boundaries. All residents use septic systems for domestic wastewater disposal, with the exception of pit toilets which are in use at the campground facilities.

Pertinent only to the EDCWS is the town of Kyburz, which maintains a year-round population of 250. Camping facilities at Sand Flat Campground support 29 sites, which are located immediately upstream of the diversion dam intake to the El Dorado Canal. All



PARCEL MAP
E.I.D. MAIN DITCH
FOREBAY TO RES. No.1
JUNE 1996
FIGURE 2.4



LEGEND

DRAINAGE BASIN BOUNDARY

WATER FEATURE

SECONDARY ROADS

PUBLIC LANDS

NOT TO SCALE

JENKINSON LAKE WATERSHED
U.S. FOREST SERVICE
vs PRIVATE LAND
JUNE 1996
FIGURE 2.5

ditch access and bridges over the canal between the diversion dam and Fresh Pond are designed for foot traffic and deer crossing with the exception of a vehicle traffic bridge on Hazel Valley Road. Logging trucks comprise a significant portion of the traffic on this bridge.

The town of Fresh Pond is a very small residential community located within the EDCWS boundaries. Some deciduous orchards are located here, as well as an electrical utility (Sacramento Municipal Utility District) maintenance yard. Westward from Fresh Pond, the canal passes underneath Old Carson Road and Highway 50, and leads westward toward Forebay Reservoir in the town of Pollock Pines.

Figure 2.6 provides a map for the conveyance structures of the 21.9 mile section from Kyburz to Forebay Reservoir. The map includes details regarding roads and canal bridges, crossings, and water diversion structures are indicated on this map. Between Forebay Reservoir and the water treatment plant, EDC passes through rural/residential lots in the community of Pollock Pines, and under paved or dirt roads which bridge the ditch.

The communities that impact the Outingdale Plant water supply consist of the small towns of Outingdale and Somerset with a total population of 1800 (El Dorado County DOT, 1994) persons.

VI. NATURAL SETTING

Aspects of the natural settings of all watersheds can have a profound impact on water quality and supply. Differences in terrain can describe differences in the potential for natural disaster. Soil, geology, vegetation and wildlife similarly will impact characteristics of the water supply.

EL DORADO CANAL
KYBURZ TO FOREBAY
JUNE 1996
FIGURE 2.6

A. Topography

1. EL DORADO CANAL WATERSHED

The El Dorado Canal Watershed (EDCWS) encompasses the southern slope of the South Fork of the American River Canyon from Kyburz to Forebay Reservoir. It ranges in elevation from 6800 feet at the upper end of the Alder Creek watershed to 3600 feet at Reservoir One Water Treatment Plant in Pollock Pines. The terrain generally slopes gently to moderately in the watershed area, with the exception of the areas immediately adjacent to the EDC and some of the tributaries feeding the American River, where steep slopes, cuts and benches, and rocky outcrops are common.

Tributaries to the EDCWS subsequent to the Diversion Dam in Kyburz include Carpenter Creek, Alder Creek, Mill Creek, Ogilby and Esmeralda Creeks. Water from Ogilby and Esmeralda Creeks are at times diverted into the EDC via structures that were constructed for this purpose. Maximum and minimum elevations of each of these creeks, and the total change in elevation per linear mile of creek up to the point of joining with the EDC are listed in Table 2-3.

TABLE 2-3
TRIBUTARIES TO EL DORADO CANAL WATERSHED

NAME	MAXIMUM ELEVATION (FT.)	MINIMUM ELEVATION (FT.)	AVERAGE CHANGE IN ELEVATION FT. /PER MILE
CARPENTER CREEK	5720'	4000	573'
ALDER CREEK	6800'	3840'*	293'/mile
MILL CREEK	5680'	3840'	360'/mile
PLUM CREEK	5800'	3800'*	317'/mile
OGILBY CREEK	4600'	3760'	336'/mile
ESMERALDA CREEK	4440'	3800'	338'/mile

*Indicates the presence of a siphon or other creek bypass

Because of the steepness of portions of the American River and associated creek canyons, the potential for erosion and landslides exists. Some of the potential damage associated with landslides includes blockage of the ditch, siltation, damage to roads, canals, flumes, and pipelines, and impacts on human safety. Landslide conditions have, in fact, seriously impacted the EDCWS supply. For the period of time between 1976 and 1995, a total of 18 rock or mud slides have required special canal maintenance. At times waterflow has been completely obstructed.

2. JENKINSON LAKE WATERSHED

The Sly Park Creek Watershed as a tributary to the JLWS consists of the southern slope of the Iron Mountain Ridge and the northern slope of Baltic Ridge. It ranges in elevation from 5600 feet at the upper end of Cold Canyon to 3400 feet at Jenkinson Lake. The terrain generally slopes gently to moderately in the watershed area, with the exception of the areas immediately adjacent to Sly Park Creek and North Sly Park Creek where steep slopes, cuts and benches, and rocky outcrops are common.

Sly Park Creek also receives water from Camp Creek via a diversion tunnel located above Jenkinson Reservoir. Camp Creek is a major tributary to the Middle Fork Cosumnes, and its watershed characteristics have been discussed in detail in the SWSS conducted by EID for Reservoir Seven Watershed. Total annual diversions from Camp Creek into Jenkinson Reservoir for the past five years are tabulated in Table 2-4.

Tributaries to the SPCWS include Sly Park Creek, North Sly Park Creek, and Hazel Creek which terminate in Jenkinson Lake. Maximum and minimum elevations of each of these creeks, and the total change in elevation per mile of creek up to the point of entering Jenkinson Reservoir are listed in Table 2-5.

TABLE 2-4

CAMP CREEK DIVERSIONS INTO SLY PARK RESERVOIR
Acre Feet / Month

Mon/Yr	1995	1994	1993	1992	1991
Jan	12,582.97	144.50	5,967.90	191.05	72.12
Feb	2,218.94	308.06	3,032.21	1,454.90	131.40
Mar	705.33	1,511.72	0.00	2,598.80	1,771.40
Apr	0.00	1,279.00	0.00	2,394.78	3,903.00
May	47.60	1,114.89	3,787.65	380.10	3,451.05
Jun	4,092.79	97.29	2,933.30	0.00	996.69
Jul	132.89	0.00	0.00	0.00	0.00
Aug	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	0.00	0.00
Oct	0.00	0.00	0.00	0.00	0.00
Nov	131.41	225.70	33.62	1.56	129.52
Dec	851.60	901.70	97.59	961.71	245.22
Totals	20,763.53	5,582.86	15,852.27	7,982.90	10,700.40

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SOURCE: Sly Park Reservoir Daily Operation Reports

TABLE 2-5
JENKINSON LAKE WATERSHED TRIBUTARIES

NAME	MAXIMUM ELEVATION FT.	MINIMUM ELEVATION FT.	AVERAGE CHANGE IN ELEVATION FT./ PER MILE
SLY PARK CREEK	5400'	3600'	253'
NORTH SLY PARK CREEK	5120'	3920'	444'
HAZEL CREEK	4560'	3560'	294'

Because of the relative steepness of portions of the Sly Park Creek canyon and associated creek canyons, the potential for erosion and landslides exists. Some of the potential damage associated with landslides includes stream blockage, siltation, damage to roads, canals, flumes, and pipelines, and impacts on human safety.

3. MIDDLE FORK COSUMNES

The eastern and central portions of the Middle Fork Cosumnes River Watershed consists of the southern slope of Plummer Ridge, all of Cat Creek Ridge, Big Mountain Ridge, and Gold Note Ridge, and the northern slopes of Peddlar Hill and Barney Ridge. The western portion consists of the northern and southern slopes of the North Fork Cosumnes River Canyon. It ranges in elevation from approximately 7,200 feet at the upper end of the Anderson Ridge in the east, to approximately 1,600 feet in the North Fork Cosumnes River Canyon, approximately one half mile west of Outingdale. The terrain generally slopes gently to moderately in the watershed area, with the exception of the areas immediately adjacent to the river, and to some of its tributaries, where steep slopes, cuts and benches, and rocky outcrops are common.

Tributaries to the Middle Fork include Dogtown Creek, Sopiago Creek, Middle Dry Creek, McKinney Creek, Shingle Mill Creek, Prothro Creek, Mehrten Creek, and Peddlar Creek. Maximum and minimum elevations of each of these creeks, and the total change in elevation per linear foot of creek up to the point of joining with the Middle Fork Cosumnes River are listed in Table 2.6.

TABLE 2-6
MIDDLE FORK COSUMNES WATERSHED TRIBUTARIES

NAME	MAXIMUM ELEVATION FT.	MINIMUM ELEVATION FT.	AVERAGE CHANGE IN ELEVATION FT/MILE
DOGTOWN CREEK	5280'	2880'	214.3'
SOPIAGO CREEK	4320'	2720'	170.2'
MIDDLE DRY CREEK	5200'	3760'	261.8'
MCKINNEY CREEK	5600'	4400'	260.9'
SHINGLE MILL CREEK	6000'	4320'	579.3'
PROTHRO CREEK	6160'	3560'	896'
MEHRTEN CREEK	5920'	5040'	733'
PEDDLAR CREEK	6400'	5280'	933'

Because of the extreme steepness of portions of the Middle Fork Cosumnes River and associated creek canyons, the potential for erosion and landslides exists. Some of the potential damage associated with landslides includes stream blockage, siltation, damage to roads and pipelines, and impacts on human safety.

B. Geology

Watershed geology can have a significant impact on water quality parameters. Fault zones which affect earth movement can lead to natural disasters. The presence of granite and serpentine in significant quantities could lead to the potential for radioactive contaminants or asbestos. Sulfides and other deposits can lead to acid mine drainages or trace amounts of heavy metals in the water supply.

1. EL DORADO CANAL WATERSHED

The majority of the EDCWS is located in terrain underlain by the granodioritic rocks of the Sierra Nevada Batholith, and by Paleozoic metamorphic rocks. The western and central portion of the Paleozoic metamorphics is identified as the Shoo-fly Complex, which consists of highly deformed early-to-middle Paleozoic miogeoclinal deposits, composed mainly of quartzofeldspathic schist and gneiss, quart-mica schist, and phyllite. The eastern portion has been mapped as undifferentiated Paleozoic metamorphics, and consists of miogeoclinal deposits, with gabbroic intrusive rocks and marine formations of limestone and dolomite forming a minor constituent of the basement rock.

A significant portion of the basement rock has been covered by more recent (Cenozoic Age) volcanic rocks of the Valley Springs and Mehrten Formations. The Valley Springs Formation consists of stream channel and alluvial deposits, derived mainly from rhyolitic volcanic rocks, but also includes ash flows and welded tuffs. The Mehrten Formation consists mainly of more recent mud flow deposits derived from andesitic rocks.

Shallow unconfined groundwater in the area occurs in streamside alluvium and in the weathered zone above fresh bedrock, while deeper, confined groundwater is found in porous layers within Tertiary age volcanics and in joints and fractures in un-weathered bedrock. Groundwater levels in both zones generally fluctuate with the seasons. In general, groundwater enters and is stored within fractures in the bedrock. The quantity and nature of fractures varies between the different bedrock types. Each bedrock has a unique potential for groundwater infiltration, retention and discharge. Discharged water from the unconfined weathered zone and from the joints and fractures in the bedrock is a source of seepage into the canal, and recharge for the tributaries which are at times diverted to it.

The major mineral deposit in the general watershed area is gold, which is found as both load deposits in bedrock and as Tertiary-age placer deposits. In general, the potential exists for gold and other mineral bearing deposits in the watershed to be rich in iron and sulfides.

Few faults, and none which have displayed evidence of Quaternary age activity, have been identified in the EDCWS. Therefore, the potential for hazards associated with earthquakes appear to be minimal, except for earthquake-induced ground shaking, landslides or debris slides. These are most likely to occur in the steeper river and creek canyons. The potential for volcanic hazards in the EDCWS appears to be minimal.

The most significant potential geologic hazard present in the watershed appears to be that of landslides. The potential for landslides is greatest in the steep gorges of the American River Canyon and its tributaries. Landslide-related damages have occurred in this vicinity in the recent past, and are possible in the future. Slides which affect the El Dorado Canal between Kyburz and Forebay Reservoir have the potential to cut off the water treatment plant supply for months.

2. JENKINSON LAKE WATERSHED

The majority of the Jenkinson Lake area has been mapped as containing the Cenozoic-age Mehrten Formation, which consists mainly of volcanic mudflow deposits derived from andesitic rocks. Paleozoic metamorphic rocks are found exposed, to a lesser extent, throughout the watershed. The western portion of the Paleozoic metamorphics is identified as the Shoo-fly Complex, which consists of highly deformed early-to-middle Paleozoic miogeoclinal deposits, composed mainly of quartzofeldspathic schist and gneiss, quart-mica schist, and phyllite. The central and eastern metavolcanics have been identified as undifferentiated Paleozoic metamorphics, which also consist of miogeoclinal deposits. A few isolated exposures of Mesozoic granodioritic rocks of the Sierra Nevada Batholith and Quaternary alluvial deposits are also found in the watershed.

A minor amount of the basement rock has been covered by more recent, Cenozoic Age, volcanic rock of the Valley Springs Formation. The Valley Springs Formation consists of stream channel and alluvial deposits, derived mainly from rhyolitic volcanic rocks, but also includes ash flows and welded tuffs.

Shallow, unconfined groundwater in the area occurs in streamside alluvium and in the weathered zone above fresh bedrock, while deeper, confined groundwater is found in porous layers within Tertiary-age volcanics and in joints and fractures in un-weathered bedrock. Groundwater levels in both zones generally fluctuate with the seasons. In general, groundwater enters and is stored within fractures in the bedrock. The quantity and nature of fractures varies between the different bedrock types, thus each bedrock unit has a unique potential for groundwater infiltration, retention and discharge. Discharged water from the unconfined weathered zone and from the joints and fractures in the bedrock is a source of recharge for the Sly Park Creek and other tributaries of the watershed.

The major mineral deposit in the general watershed area is gold, which is found as both load deposits in bedrock and as Tertiary-age placer deposits. In general, the potential exists for gold and other mineral bearing deposits in the watershed to be rich in iron and sulfides.

Few faults, and none which have displayed evidence of Quaternary age activity, have been identified in the SPCWS. Therefore, the potential for hazards associated with earthquakes appears to be minimal, except for earthquake-induced ground shaking, landslides or debris slides. These are most likely to occur in the steeper river and creek canyons. The potential for volcanic hazards in the SPCWS appears to be minimal.

The most significant potential geologic hazard in the watershed appears to be landslides. The potential for landslides is greatest in the steep gorges of the Sly Park Creek and its tributaries.

3. MIDDLE FORK COSUMNES WATERSHED

The majority of the Middle Fork Cosumnes is located in terrain underlain my Mesozoic granitic intrusive rocks of the Sierra Nevada Batholith, consisting chiefly of granodiorite, which is exposed in much of the eastern and western portions of the watershed. Approximately 10% of the watershed area, located in the central portion, is underlain by Shoo-fly Complex metamorphic rocks, which consist of highly deformed early to middle Paleozoic miogeoclinal deposits, composed mainly of quartzofeldspathic schist and gneiss, quartz-mica schist, and phyllite. Minor exposures of the Upper Paleozoic to Lower Mesozoic Calaveras Complex are also found in the central portion of the study area. The Calaveras Complex consists of, typically, thinly bedded argillite and massive metasiltstone, with minor amounts of chert, and a very minor amount of limestone, all of which are found within the borders of the watershed.

A significant portion of the basement rock has been covered by more recent volcanic rocks of the Tertiary Mehrten Formation, which consists mainly of mud flow deposits, with some stream channel deposits, derived from andesitic rocks. This rock type is encountered from the eastern end to the west central part of the watershed. A small amount of the Tertiary Valley Springs Volcanics and Quaternary alluvial deposits also cover some of the basement rock.

Shallow, unconfined perched groundwater in the area occurs in streamside alluvium and in the weathered zone above fresh bedrock, while deeper, confined groundwater is found in porous layers within Tertiary-age volcanics and in joints and fractures in un-weathered bedrock. Groundwater levels in both zones generally fluctuate with the seasons. In general, deeper groundwater enters and is stored within fractures in the bedrock. The quantity and nature of fractures varies between the different bedrock types, thus each bedrock has a unique potential for groundwater infiltration,
retention and discharge. Discharged water from the unconfined weathered zone and from the joints and fractures in the bedrock is a source of recharge for the Cosumnes River and its tributaries.

The major mineral deposit in the MFCRWS is gold, which is found as both load deposits in bedrock and as Tertiary age placer deposits. In general, the potential exists for gold and other mineral bearing deposits in the watershed to be rich in iron and sulfides.

Few faults, and none which have displayed evidence of Quaternary age activity, have been identified in the Middle Fork Cosumnes watershed. Therefore, the potential for hazards associated with earthquakes appear to be minimal, except for earthquake-induced ground shaking, landslides or debris slides. These are most likely to occur in the steeper river and creek canyons.

The potential for volcanic hazards in the MFCRWS appears to be minimal. The most significant potential geologic hazard present in the watershed appears to be landslides. The potential for landslides is greatest in the steep gorges of the Cosumnes River canyon and its tributaries.

C. Soils

1. EL DORADO CANAL WATERSHED

The soil types existing in the EDCWS are quite diverse, because of the variety of soil forming factors, such as geology, topography, and vegetation. The most common soil series found at elevations below 4,500 feet in the watershed are Cohasset, Aiken, and McCarthy on volcanics, Sites, Josephine, and Mariposa on metamorphics; and Musick and Chaix on granitics. In general, these soils have a relatively high water-holding capacity because of greater soil depth (40 to 60 inches) and finer textured subsoils. The Josephine and Mariposa series tend to be shallower (15 to 30 inches).

The most common soils found at elevations above 4,500 feet in this watershed are the McCarthy and Ledmount series on volcanics, and Chaix and Pilliken on granitics. These soils are moderately deep (24 to 36 inches) with coarse texture throughout, except for the Ledmount series, which tends to be shallow (less than 20 inches).

The potential for soil erosion is based on the combined effects of precipitation, slopes, and soil type. The relative erosion potential of the watershed has been established by the Soil Conservation Service (SCS) and the U.S. Forest Service (USFS), assuming that a protective cover of vegetation is not present. The scale of erosion hazard classification used by the SCS and USFS includes *slight, moderate, high,* and *very high* categories. Soil erosion potential of the soils found in the watershed below approximately 4,500 feet has been classified as *low* to *moderate* on slopes less than 35 percent, but *high* on slopes over 35 percent, if cleared of vegetative cover, as is done during construction or logging activities. Soil erosion potential of the soils found in the watershed above approximately 4,500 feet has been classified as greater than for soils at the lower elevations, being *moderate* on slopes of less than 30 percent, but *high* to *very high* on slopes of over 30 percent, if cleared of vegetative cover.

2. JENKINSON LAKE WATERSHED

The soil types existing in the SPCWS are quite diverse, because of the variety of soil forming factors, such as geology, topography, and vegetation. The most common soil series found at elevations below 4,500 feet in the watershed are Cohasset, Aiken, Crozier, Iron Mountain and McCarthy developed on volcanic rocks; Josephine and Mariposa developed on metamorphic rocks. In general, these soils have a relatively high water-holding capacity because of greater soil depth (40 to 60 inches) and finer textured subsoils. The Josephine and Mariposa series tend to be shallower (15 to 30 inches).

The most common soils found at elevations above 4,500 feet in this watershed are the McCarthy and Ledmount series, developed on volcanic rocks. These soils are moderately deep (24 to 36 inches) with coarse texture throughout, except for the Ledmount series, which tends to be shallow (less than 20 inches).

The potential for soil erosion is based on the combined effects of precipitation, slopes, and soil type. The relative erosion potential of the watershed has been established by the Soil

Conservation Service (SCS) and the USDA Forest Service, assuming that a protective cover of vegetation is not present. The scale of erosion hazard classification used by the SCS and USFS includes *low, moderate, high,* and *very high* categories. Soil erosion potential of the soils found in the watershed below approximately 4,500 feet has been classified as low to moderate on slopes less than 35 percent, but *high* on slopes over 35 percent, if cleared of vegetative cover, as is done during construction or logging activities. Soil erosion potential of the soils found in the watershed above approximately 4,500 feet has been classified as greater than for soils at the lower elevations, being *moderate* on slopes of less than 30 percent, but *high* to *very high* on slopes of over 30 percent, if cleared of vegetative cover.

3. MIDDLE FORK COSUMNES

The soil types existing in this watershed are quite diverse, because of the variety of soil forming factors, such as geology, topography, and vegetation. The most common soil series found at elevations below 4,500 feet in the watershed are Cohasset, Aiken, and McCarthy, developed on volcanic rocks; Sites, Josephine, and Mariposa, developed on metamorphic rocks, and Musick, Ahwahnee, Holland, Shaver, and Chaix, developed on granitic rocks. In general, these soils have a relatively high water-holding capacity because of greater soil depth (40 to 60 inches) and finer textured subsoils. The Josephine and Mariposa series tend to be shallower (15 to 30 inches).

The most common soils found at elevations above 4,500 feet in this watershed are the McCarthy and Ledmount series, developed on volcanic rocks, and Chaix and Pilliken, developed on granitic rocks. These soils are moderately deep (24 to 36 inches) with coarse texture throughout, except for the Ledmount series, which tends to be shallow (less than 20 inches).

The potential for soil erosion is based on the combined effects of precipitation, slopes, and soil type. The relative erosion potential of the watershed has been established by the Soil

Conservation Service (SCS) and the U.S. Forest Service (USFS), assuming that a protective cover of vegetation is not present. The scale of erosion hazard classification used by the SCS and USFS includes *slight*, *moderate, high*, and *very high* categories. Erosion potential of the soils found in the watershed below approximately 4,500 feet has been classified as *low* to *moderate* on slopes less than 35 percent, but high on slopes over 35 percent, if cleared of vegetative cover, as is done during construction or logging activities. Soil erosion potential of the soils found in the watershed above approximately 4,500 feet has been classified as greater than for soils at the lower elevations, being *moderate* on slopes of less than 30 percent, but *high* to *very high* on slopes of over 30 percent, if cleared of vegetative cover.

D. Vegetation

The main vegetative types found in all three subject watersheds are oak woodland and mixed conifer. Certain areas of the American River Canyon from Riverton to below Kyburz and adjacent uplands were burned in the Cleveland fire of October 1993, and constitute a separate vegetation classification. The effects of this and earlier fires will be discussed in the natural disasters section.

A wide variety of conifers, hardwoods, brush, and grasses grow in the watershed. The major conifers include douglas firs, ponderosa pines, incense cedars, sugar pines, and Jeffrey pines. Hardwoods consist of blue and black oaks, with lesser amounts of canyon live oaks, tan oaks, big leaf maples, and Pacific madrones. Understory vegetation generally contains manzanita, buckbrush, redberry, California coffeeberry, western mountain mahogany, deerbrush, poison oak, and annual grasses.

All vegetative types provide protection from erosion and habitat for wildlife. In the El Dorado Canal watershed, oak woodlands are very important wildlife habitat and are used by more species than conifers. Deer, bear, wild turkeys, and grey squirrel rely heavily on the oak woodlands.

E. Wildlife

The watersheds have a diverse habitat for wildlife, and contains a wide variety of species, including mammals, birds, reptiles, fish, and amphibians. Common mammal species found in the watershed include California mule deer (black deer), bear, mountain lions, bobcat, coyote, skunk, weasel, beaver, raccoon, jack rabbit, cotton-tail rabbit, porcupine, opossum, ground squirrel, marmot, and gopher. Of these, many are carriers of Giardia organisms.

Some of the more common species of birds found in the watershed are the mountain chickadee, Stellar's jay, Clark's nutcracker, robin, red shafted flicker, sparrow, and acorn woodpecker. Commonly found raptors include golden eagles, red-tailed hawk, and great horned owl. Reptiles found in the watershed include the rattlesnake, mountain king snake, gopher snake, garter snake, and rubber boa.

Information obtained from the El Dorado National Forest, Tahoe National Forest, California Fish and Game Department, and trappers working for County Agricultural Commissioners Offices for the watershed revealed that the only wildlife counts that are currently made are on deer, although sightings of certain species of special interest have been recorded by the El Dorado National Forest. These species include the spotted owl, goshawk, coopers hawk, bald eagle and martin.

According to the USFS, the primary deer population during winter range is that of the Pacific Deer Herd (mule deer). Population estimates of the deer herd by the Department of Fish and Game indicate that the size has varied between 3,600 and 6,000 in recent years. The increase in the mountain lion population, which has occurred since the passing of the 1991 Proposition 118 may be having a diminishing affect on the mule deer population. The deer tend to congregate along streambeds. In order to accommodate this population, bridges have been constructed at various locations along the El Dorado Canal.

VII. EXISTING HYDROLOGY

This section is intended to describe the hydrologic characteristic of the watersheds, including seasonal rainfall, forms of precipitation, stream flow and reservoir characteristics.

All three subject watersheds have steep-walled slopes that modify climate and hydrology by affecting exposure to sunlight and by virtue of rapid changes in elevation. Slope direction and angle are important factors in the determination of watershed hydrology. South-facing slopes receive the highest rates of solar insolation during summer months and a much greater amount than north-facing slopes during the winter months. Western slopes receive their peak insolation during warm afternoons so they are subjected to higher rates of desiccation than the cooler eastern slopes which reach peak insolation in the morning hours.

Slopes of all orientations at the same altitude receive approximately the same quantity of precipitation, but insolation creates longer growing seasons and higher ground temperatures on the south- and west-facing slopes. However, evapotranspiration of soil moisture occurs early on the south-facing and west-facing slopes and continues throughout most of the year, inhibiting soil and vegetative development and variety. On the north- and east-facing slopes lower evapotranspiration serves as an enhancement to soil development. The majority of the slopes of the El Dorado Canal watershed which supplies Reservoir One are north-facing, while slopes along the Middle Fork Cosumnes are north and south facing.

A. Precipitation Patterns

As much as 99 percent of the annual precipitation falls on the area watershed between October and April. Early season precipitation is generally absorbed by soil that has been depleted of moisture during the previous summer. During later winter storms, surface run-off is greatest.

If rain or periodic snowmelt are prolonged, soils at lower elevations approach saturation and excess soil moisture drains downslope into tributary streams. It is during this period where the potential for mudslide damage is the greatest, in particular to the man-made conveyance structures of the El Dorado Canal.

Rain and snow melt-water will enter unfrozen soil in the autumn more rapidly than frozen winter soil. Stream-flows are maintained by low elevation snowmelt, surface runoff, drainage of soil moisture near stream channels, and discharge of groundwater via springs located in fractured or porous bedrock.

Most of the air masses that approach the Sierra are maritime; relatively warm and high in moisture content. Winter temperatures often oscillate around the freezing point causing the snowpack surface to alternately freeze and thaw. These factors combine to produce a mature snowpack that is very dense and wet. Rainfall data collected by the weather station at Sly Park Reservoir for the period from 1990 through 1995 is provided in Table 2.7. Table 2.8 presents snow depth and water content data, measured at Ice House snow course, elevation 5300 feet.

While storms become less frequent in the spring, snowpack density increases as it melts and stream-flow continues to increase from increasing snowmelt. Also, warm, late season storms can melt large amounts of snow producing large spring stream-flows, high flood potentials and mud slides into all subject watersheds.

Moisture percolating through the soil to the surface of granitic rocks moves downslope along the rock surfaces and drains into the joints, replacing water that drains from the formation during the dry season. Seasonal springs and seeps often develop along the lower margins of soil-covered granite rock slopes, although the flow is usually restricted to the wet season and shortly afterward.

TABLE 2-7

WATER DELIVERY REPORT

1990 - 1995

MONTHLY RAINFALL TOTALS

in Inches

	1995		1994			1993			1992			1991			1990		
MONTH	Camino	Sly Park	Folsom	Camino	Sly Park	Folsom	Camino	Sly Park	Folsom	Camino	Sly Park	Folsom	Camino	Sly Park	Folsom	Camino	Sly Park
JAN	18.55	20.95	1.66	3.41	3.58	8.66	13.37	15.70	2.10	2.77	2.74	0.81	0.65	0.73	4.19	6.17	7.34
FEB	1.46	1.70	n/a	4.84	8.39	5.99	10.02	11.44	7.52	10.20	10.63	2.93	4.21	2.64	3.52	7.87	4.34
MAR	12.06	20.81	n/a	0.28	0.54	3.48	7.05	8.32	2.80	5.16	6.67	11.46	13.94	18.70	1.16	2.72	4.04
APR	6.44	9.18	n/a	2.71	3.29	0.66	1.88	3.19	1.59	1.23	0.97	0.38	1.57	1.91	1.16	2.42	2.79
MAY	4.34	5.63	n/a	1.82	1.98	1.32	3.00	4.46	0.00	0.00	0.00	0.55	2.70	3.25	3.42	3.98	5.42
JUN	3.20	2.34	n/a	0.10	0.00	0.57	1.06	1.95	1.06	1.11	1.52	0.50	2.87	1.51	0.00	0.00	0.00
JUL	0.00	0.01	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.00	0.00	0.08	0.09
AUG	0.00	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.37	0.08	0.00	0.00	0.00	0.00
SEP	0.00	0.00	n/a	0.35	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.00	0.00	0.14
OCT	0.00	0.00	n/a	1.34	1.82	0.96	1.89	2.78	1.42	3.51	3.52	2.16	4.29	4.79	0.39	1.34	0.93
NOV	0.43	0.64	n/a	9.69	12.07	2.86	3.39	2.54	0.19	0.68	0.70	0.59	1.79	2.47	1.26	1.26	1.86
DEC	7.29	10.39	n/a	7.15	7.48	2.91	4.65	4.73	7.52	11.58	14.75	2.72	2.87	2.96	1.60	0.94	1.29
TOTAL	53.77	71.65	1.66	31.69	39.78	27.41	46.31	55.11	24.20	36.28	41.51	22.48	35.05	39.01	16.70	26.78	28.24

INFORMATION SOURCE:
Folsom - U.S. Bureau of Reclamation weather station at Folsom Dam
Camino - Irrigation Management System weather station at Camino/Fruitridge
Sly Park - Operations & Maintenance weather station at Sly Park Reservoir

COMMENTS:
Camino - Feb 1990 rainfall estimated on 2/16 and 2/17 due to heavy snowfall.
Dec 1994 rainfall data was not available from 12/24 to 12/31. Snowfall, which is not recorded as rainfall, also affected the monthly total.
Sly Park - Over 73 inches of snowfall was recorded during Jan 93, over 85 inches in Feb 93 and 9 inches in Mar 93.
Folsom (n/a) - The U.S.B.R. Weather Station at Folsom Dam has been discontinued and data is no longer available.

The snowmelt and rainfall that has infiltrated into the soil mantle during the winter and spring largely comprises the soil moisture supply and groundwater replenishment for the year. The soil moisture slowly moves downslope through the soil mantle, supplying the vegetation with moisture to satisfy evapotranspiration requirements. Soils on the upper slopes usually drain earlier in the season, while the soils on lower slopes receive this moving water for a longer period, enabling more vegetative growth and reproduction.

Meadows can accumulate moisture from direct snowpack melt, infiltration from snowmelt and rainfall runoff from upslope and from downslope water movement within the soil mantle. Meadows represent important water storage areas in the drainage basin which slowly release water to surface streams. In many places in the basin, dry stream channels can be observed upstream from meadows, with stream flows emerging below the meadows. During the low-flow periods, these meadows are an important supplemental source of surface flows.

B. Stream Flow Characteristics

The rate of flow is affected by natural conditions such as the amount of precipitation, run-off, evapotranspiration contributions via tributary streams. Watershed flow for the EDC, apart from natural disasters, is a matter of human control at the intake structure near Kyburz and at the Forebay Reservoir diversion to the EID canal. The normal maximum flow in the canal near Forebay, due to all contributing factors, approaches 165 cfs. Recorded water deliveries to the EID canal from Forebay are listed by PG&E by monthly invoice to EID, and are provided on Table 2.9. Maximum flow is about 40 cfs. Small obstructions to flow are caused routinely by freezing of water, particularly in the conveyance structure. Small slides of trees, mud, rock, and vandalism can similarly hamper stream flow. Natural disasters have, and will, affect the watershed stream flow by creating damage to the water conveyance structures. Disaster events such as the 1992 Cleveland Fire, or the 1995 mudslide, damages a portion of the vulnerable flume structures.

Recorded raw water deliveries from Jenkinson Lake (Sly Park Lake) to Reservoir A are provided on Table 2.10. Although stream flow measurements of the Middle Fork Cosumnes at Outingdale have not been recorded, water plant records for the water treatment facility from December 1995 through January 1996 indicate an average monthly production of 1.13 million gallons.

TABLE 2-8
SNOW DEPTH AND WATER CONTENT
AS MEASURED AT ICE HOUSE SNOW COURSE
ELEVATION 5300'

DATE	SNOW DEPTH (Inches)	WATER CONTENT (Inches)	DENSITY IN INCHES (In. water/In. Snow)
1/30/89	29.6	10.7	0.361
2/27/89	27.8	10.8	0.388
4/01/89	5.5	2.7	0.491
5/01/89	0	0	----
1/30/90	16.7	2.9	0.174
2/27/90	23.6	7.9	0.335
4/02/90	0	0	----
5/01/90	0	0	----
2/02/91	1.6	0.5	0.312
2/25/91	0	0	----
5/29/91	36.2	10.5	0.290
4/28/91	0	0	----
1/31/92	5.6	1.7	0.304
2/25/92	14.2	5.5	0.387
3/30/92	1.0	0.4	0.040
5/01/92	0	0	----
1/30/93	38.0	13.6	0.358
3/01/93	61.2	21.8	0.356
3/29/93	19.9	10.2	0.513
4/27/93	0	0	----
1/31/94	12.5	2.8	0.224
2/28/94	23.3	8.1	0.348
3/29/94	1.0	0.4	0.400
4/27/94	3.5	0.9	0.257
1/30/95	36.7	14.0	0.381
2/27/95	21.4	9.9	0.463

TABLE 2-9

MONTHLY WATER DELIVERY REPORT
1990 - 1995
FOREBAY RAW WATER
in Acre Feet

MON/YR	1995	1994	1993	1992	1991	1990
JAN	496.00	612.00	22.00	492.00	385.00	604.00
FEB	270.00	470.00	197.00	520.00	543.00	547.00
MAR	261.00	784.00	290.00	514.00	592.00	604.00
APR	429.00	1,100.00	253.00	696.00	737.00	593.00
MAY	280.00	1,500.00	29.00	1,790.00	1,170.00	1,230.00
JUN	90.00	2,360.00	34.00	2,350.00	2,060.00	1,870.00
JUL	39.00	2,440.00	61.00	2,230.00	2,390.00	2,430.00
AUG	1,770.00	2,440.00	61.00	2,450.00	2,450.00	2,400.00
SEP	1,360.00	2,050.00	54.00	1,100.00	1,340.00	1,280.00
OCT	92.00	847.00	45.00	69.00	886.00	821.00
NOV	39.00	500.00	28.00	19.00	769.00	1,020.00
DEC	276.00	548.00	131.00	16.00	629.00	728.00
YTD TOTAL	5,402.00	15,651.00	1,205.00	12,246.00	13,951.00	14,127.00
ENTITLEMENT	15,080.00	15,080.00	15,080.00	15,080.00	15,080.00	15,080.00
% USED	35.82%	103.79%	7.99%	81.21%	92.51%	93.68%

INFORMATION SOURCE:
Monthly invoice received from PG&E reflecting prior month's diversions.

COMMENTS:

Feb/Apr 1993 - Res One operated on a limited basis from 02/03/93 to 04/30/93 by treating natural creek flows coming into Forebay.

May 1993 - Res One resumed operations by using water pumped from the new lift station at Res A. The deliveries from May to December are minimum diversions necessary to serve ditch customers between Forebay and Res One.

Dec 1993 - Res One resumed normal operations with the restoration of PG&E's El Dorado Canal on 12/22/93.

Mar 1995 - Res A became the lead plant over Res One in order to maximize Sly Park diversions while the reservoir is spilling. This change in operational strategy caused a higher than normal delivery for Sly Park and a lower than normal delivery for Forebay.

Apr 1995 - PG&E shut down the El Dorado Canal because of a mud slide on April 6, 1995.

May/Jun 1995 - Res One continues normal operations, despite the canal outage, by utilizing the natural creek flows coming into Forebay. On 06/26 Res A began pumping raw water to Res One for diversion into the Main Ditch, or treatment and distribution to piped system.

Aug/Sep 1995 - PG&E resumed limited operation of the canal on 08/03 in order to meet EID demands. The canal was shut down again the last week of September for repairs to the section damaged by the mud slide. Repairs estimated for completion in December.

Dec 1995 - The El Dorado Canal was restored and Res One began normal operations again on 12/16/95.

Table 2-10

MONTHLY WATER DELIVERY REPORT
1991 - 1996
SLY PARK RAW WATER
in Acre Feet

MON/YR	1996	1995	1994	1993	1992	1991
JAN	438.35	413.56	540.09	911.33	614.89	855.32
FEB	317.36	493.89	386.28	331.83	444.52	506.80
MAR	394.72	696.20	472.44	371.79	368.93	453.07
APR	517.69	555.38	581.12	772.90	463.54	379.68
MAY		884.30	781.50	2,232.00	1,533.80	645.21
JUN		2,386.81	2,013.30	2,898.40	1,993.81	1,567.36
JUL		3,822.20	3,294.59	4,844.06	2,241.93	1,605.23
AUG		2,967.32	2,955.41	4,649.17	2,423.26	1,939.96
SEP		2,193.75	1,816.88	3,928.72	2,483.28	2,300.98
OCT		2,429.79	1,134.56	2,606.77	2,371.02	2,483.15
NOV		1,803.01	545.47	1,783.90	1,080.83	619.35
DEC		956.05	402.65	1,022.51	948.16	615.00
YTD TOTAL	1,668.12	19,602.26	14,924.29	26,353.38	16,967.97	13,971.11

INFORMATION SOURCE:

Sly Park Reservoir Daily Operations Report maintained by Operations & Maintenance.

COMMENTS:

Oct 1992 - Sly Park Reservoir also served the communities of Pollock Pines and Camino due to the Cleveland Fire (see Page 4 comments). Sly Park raw water was delivered to Res A and pretreated. A portion of this water was pumped to Res 1 for final treatment and distribution. The remainder was treated at Res A for distribution. A small portion of Sly Park water was fully treated at Res A and pumped to Union Hill Reservoir in Pollock Pines via Res 2/2A, and Moose Hall and Sportsman pump stations.

Dec 1993 - Sly Park no longer serves Pollock Pines and Camino, except in emergencies, due to the restoration of PG&E's canal.

Mar 1995 - Res A became the lead plant over Res 1 in order to maximize Sly Park diversions while the reservoir is spilling. This change in operational strategy caused a higher than normal delivery for Sly Park and a lower than normal delivery for Forebay.

Jun 1995 - Sly Park Reservoir began serving the communities of Pollock Pines and Camino due to an outage of PG&E's canal, which normally delivers raw water to Forebay Reservoir. (See comments on Page 4)

Dec 1995 - PG&E's canal is restored and Sly Park water is no longer delivered to Res 1.

C. Water Supply Obstruction/Natural Disasters

Freezing of the canal water itself can be a problem, affecting flow and delivery of water supply to lower elevations. Temperatures which hover around 20° F for 36 hours or more generally signals conditions that will cause freezing along the canal. Frazzle ice and/or anchor ice will develop in the EDC which must be broken up mechanically. Previous methods of breaking ice along the canal includes the efforts of 20 to 25 canal tenders. Current procedures involve the use of motorized aluminum boats equipped with scraper blades. This allows smaller crews of two or three individuals to keep water flowing in winter months. Generally speaking, the period of icy conditions along the EDC extends from late November to mid-February.

Other obstructions which have caused a disruption to flow on the conveyance structure have occurred, not only due to routinely anticipated maintenance problems, but also due to severe destruction caused by natural disasters such as mud slides or forest fires. These disruptions have occurred at least 14 times within the period between 1982 and 1992, causing a stop in water supply to Forebay for approximately 990 days. A history of these El Dorado Canal failures, the cost and time required to restore flow is listed in Table 2-11.

D. Storage Reservoir Characteristics

Two of the three subject watersheds include raw water storage reservoirs. The characteristics of these reservoirs can have a significant impact on the quality of the water retrieved from them. These two reservoirs are the Forebay Reservoir in the EDCWS and the Jenkinson Lake reservoir for the JLWS.

1. EL DORADO CANAL WATERSHED

The El Dorado Forebay Reservoir is located at elevation 3792 in Pollock Pines along the North Fork of Long Canyon which is a tributary canyon to the South Fork American

TABLE 2-11

EL DORADO CANAL - DAYS OF OUTAGE BY CAUSE (1952 - 1995)

Date	1995 Cost	Fire	Debris	Ice	Snow	Leak	Vandalism	Storm	Tree	Rock	Landslide	Earthquake	Flood
	($5000/Day)												
										9			
Jan 13, 1952	$70,000				14								
Jan 14, 1952	$25,000				5								
Aug 18, 1952	$5,000										1		
Oct 30, 1953	$10,000					2							
Nov 7, 1953	$5,000					1							
Nov 24, 1955	$5,000				1								
Dec 22, 1955	$150,000							30					
Jan 27 1956	$10,000								2				
Mar 7, 1957	$100,000										20		
Apr 4, 1958	$65,000								13				
Feb 12, 1959	$50,000								10				
Feb 6, 1960	$1,250										0.25		
Dec 22, 1964	$110,000										22		
May 30, 1966	$30,000										6		
Mar 11, 1967	$85,000								17				
Dec 13, 1967	$70,000			14									
Jan 16, 1968	$1,250										0.25		
Dce 16, 1968	$105,000										21		
Jan 18, 1969	$10,000										2		
May 9, 1969	$60,000										12		
Jan 22, 1970	$1,500									0.33			
Jan 24, 1970	$1,250							0.25					
Dec 16, 1970	$1,250							0.25					
Jan 6, 1971	$60,000			12									
Dec 6, 1971	$1,250									0.25			
Apr 3, 1972	$1,250									0.25			
Jan 12, 1973	$1,250		0.25										
Jan 15, 1973	$1,250		0.25										
Aug 18, 1973	$40,000	8											
Feb 11, 1975	$25,000										5		
Mar 21, 1975	$10,000								2				
Jan 5, 1976	$1,250					0.25							
Jan 10, 1976	$1,250									0.25			
Feb 8, 1976	$1,250					0.25							
Feb 13, 1976	$1,250									0.25			
Jan 18, 1977	$1,250			0.25									
July 30, 1977	$1,250					0.25							
Aug 14, 1978	$1,250									0.25			
Jan 14, 1980	$30,000										6		
Aug 11, 1980	$1,250									0.25			

TABLE 2-11 continued

Aug 23, 1980	$1,250						0.25						
Nov 14, 1981	$70,000										14		
Dec 3, 1981	$15,000										3		
Feb 15, 1982	$10,000										2		
Apr 1, 1982	$30,000								6				
Sept 24, 1982	$1,250									0.25			
Jan 24, 1983	$2,500										0.5		
Mar 4, 1983	$165,000										33		
Apr 9, 1983	$7,000,000										390		
Jun 24, 1983	$15,000								3				
May 10, 1984	$1,250					0.25							
Nov 12, 1985	$300,000												
Feb 16, 1986	$600,000										120		
Sept 7, 1986	$20,000	4											
Dec 28, 1990	$50,000			10									
Feb 16, 1992	$15,000									3			
Sept 29, 1992	$16,000,000	425											
Dec 10, 1994	$5,000			1									
Jan 10, 1995	$80,000										90		
Mar , 1995	$70,000										14		
May 2, 1995	$750,000										165		
Total # of Days	1524	437	0.5	37.25	20	4	0.25	30.5	53	14.08	927	0	0
% of Total Days		28.7%	0.0%	2.4%	1.3%	0.3%	0.0%	2.0%	3.5%	0.9%	60.8%	0.0%	0.0%
Total # of Events	61	3	2	5	3	6	1	3	7	10	21	0	0
% of Total Events		4.9%	3.3%	8.2%	4.9%	9.8%	1.6%	4.9%	11.5%	16.4%	34.4%	0.0%	0.0%
Avg # of Days	25	145.67	0.25	7.45	6.67	0.67	0.25	10.17	7.57	1.41	44.14	0.00	0.00
Total Cost	$26,352,750	$16,060,000	$2,500	$186,250	$100,000	$20,000	$1,250	$152,500	$265,000	$25,250	$9,240,000	$0	$0
% of Total Cost		60.9%	0.0%	0.7%	0.4%	0.1%	0.0%	0.6%	1.0%	0.1%	35.1%	0.0%	0.0%
Avg Cost	$432,012	$5,353,333	$1,250	$37,250	$33,333	$3,333	$1,250	$50,833	$37,857	$2,525	$440,000	$0	$0
Max. Cost	$16,000,000	$16,000,000	$1,250	$70,000	$70,000	$10,000	$1,250	$150,000	$85,000	$45,000	$7,000,000	$0	$0

Note:
1) Cost of repairs estimated using $5000/day of outage unless actual data available
2) Minimum outage time used was .25 days although some outages were less

jsk:canlhist.wb1

River. The Forebay Dam is a homogenous, compacted earthfill embankment constructed on a foundation of well stripped, extensively weathered phyllites and meta-sandstones. The dam is 91 feet high and 836 feet long. Its upstream slope is 3:1 and its downstream slope is 2.5:1. The crest is 15 feet wide and is at elevation 3804 feet.

The spillway to Long Canyon Creek is located seven feet below the dam crest near the left abutment. It is comprised of an ungated, rectangular reinforced concrete channel 20 feet wide that discharges into a gunite-lined open channel.

An outlet to the PG&E Powerhouse is provided by one of three power outlet conduits located in a cut through the right abutment under the dam. The upstream ends of the two left-hand conduits were sealed by installation of steel-dished heads, and the conduits were never used. The active power conduit through the dam is a 60-inch diameter steep pipe encased in concrete. The pipe exits at the dam at a steep slope and continues to the power house.

The ultimate capacity of Forebay to the top of the flashboards in the spring through summer is 472 acre feet. One foot of flashboard is removed during the winter. However, the Forebay normally operates around 415 acre feet to allow some buffer storage capacity in the event of a powerhouse trip off-line. This provides about 3-4 hours repair time before inflow from the El Dorado Canal would have to be cut to avoid spilling Forebay. In the winter months, the Forebay is normally maintained about 393 acre feet.

The portion of Forebay capacity which is used for Main Canal delivery (without pumping over an earthen divider within the Forebay) is the storage portion above about 250 acre feet. This should leave 165 acre feet for useable storage, although some has been known to have been displaced by sediment. The last soundings of the Forebay, which took place around 1984, indicated about 75-acre feet of storage were displaced from sediment deposition. This displacement of capacity due to sediment deposition has most likely increased within the last decade.

The outlet from Forebay Reservoir to the EID Canal (and ultimately to the Reservoir One Water Treatment Plant) is located at the left abutment at about elevation 3781. It consists of a 36-inch diameter cast iron pipe with concrete cutoff collars. The pipe has a small submerged, ungated intake structure near the upstream groin of the embankment. The intake is provided with a sloping steel grizzly type trash rack. This small outlet is normally under a head of only about 18 or 19 feet. At the downstream groin of the dam, the 36-inch pipe, where it is controlled by two 18-inch gates in tandem. The upstream valve is a manually operated guard valve. The downstream valve is operated by an electric motor that is float-controlled by the water surface elevation in the canal.

2. JENKINSON LAKE WATERSHED

Jenkinson Lake is a high quality raw water source characterized by low pH (6.5 to 6.6), alkalinity (25 to 30 mg/l), and hardness (15 to 20 mg/l). Turbidity values range from less than one NTU during dry weather conditions to over 8 NTU during storm events. Peak turbidity episodes seem to correspond with storms following dry periods, when large areas of exposed beach are susceptible to erosion into the reservoir. Raw water iron and manganese concentrations frequently exceed 0.3 to 0.4 mg/l during the year, with values of 0.6 to 0.8 mg/l following lake turnover in the fall, which can last for several weeks. Organic content is generally low, although algae blooms can occur during prolonged hot, dry weather.

The main dam on Sly Park Creek is an earthen dam, 184 feet high with a crest length of 920 feet. A second dam, ½ mile northwest of the main dam, is 115 feet high with a crest length of 670 feet. Approximately 1,555,000 cubic feet of earth and rock fill material was used to construct the dams and create Jenkinson lake Reservoir.

The Reservoir A WTP is supplied from Sly Park Dam through a 48-inch diameter pipeline that extends for about two miles to the plant. The pipeline has a single intake near the bottom of Jenkinson Lake. Flow in the pipeline is regulated by a hydraulically operated, 24-inch square slide gate located in an open channel in an all-weather building adjacent to the dam.

Historically, the slide gate was manually adjusted several times each day in response to varying flow demands in the distribution system. In 1990, the gate was provided with automatic controls so that it could be positioned remotely from the plant. The slide gate is controlled from the level in Reservoir A, with allowable high and low alarm/shutdown values selected on a daily basis by the system operator.

VIII. WATER SUPPLY SYSTEMS

This section is intended to provide a brief summary of the water supply system history, its service areas and water sources, as well as the method of managing water supplies when shortages or disasters occur.

A. History

1. EL DORADO CANAL WATERSHED

It has been stated that there is no similar country in the world that can "boast of a finer water supply than El Dorado County" (Paolo Sioli, 1883). Prompted primarily by the voracious water supply needs of the California Gold Rush, elaborate ditch and canal systems were constructed everywhere in the Mother Lode, including along the subject watersheds. The El Dorado Canal, in fact, is a man-made water conveyance structure, originally pioneered by Placerville resident John Kirk and the El Dorado Water and Deep Gravel Mining Company in the 1870's.

After changing ownership several times throughout the decades, the project was acquired by Pacific Gas and Electric Company (PG&E) in 1928, for the area from Kyburz to Forebay Reservoir. The ditch section below Forebay Reservoir in Pollock Pines was purchased by the successor to the El Dorado Irrigation District. This ditch system, which is currently owned and maintained by the District, delivers water to the Reservoir One Treatment Plant 3.3 miles west of the Forebay.

The El Dorado Irrigation District is in the process of purchasing the PG&E Water Supply and Hydroelectric Project, known as Project 184. Change in ownership will occur sometime during 1996.

2. JENKINSON LAKE WATERSHED

What is now known as Jenkinson Lake and Sly Park Recreation Area is the result of the United States Department of the Interior Bureau of Reclamation Central Valley Project. Two earthen dams which created Jenkinson Lake out of high mountain meadows began construction in the 1950's. Now the Reservoir and park area covers what used to be two small valleys, formerly known as Sly Park Meadow and Hazel Valley. These two valleys had fairly open floors with edges of which were steep and heavily wooded. The intent of the project was to provide for supplementary water to be used in irrigation and domestic water needs for communities served by the El Dorado Irrigation District.

Original plans for dam construction began in 1922 by the El Dorado Water Corporation. Lack of funding and water rights decisions by the California State Supreme Court, caused delays in the project. However, through the US Bureau of Reclamation, construction of the two earthen dams, as well as water supply diversion from Camp Creek, was completed in 1955.

Due to the insufficient supply of water from Sly Park Creek alone, it was necessary to construct the diversion tunnel from Camp Creek. The Camp Creek Diversion Tunnel, spillway, outlet works, and cut-off walls consumed approximately 10,600 cubic yards of concrete. A conveyance structure, known as the Sly Park-Camino Conduit, was constructed at that time for delivery of water from the reservoir to irrigable areas. The Camino Conduit is now used for delivery of treated water from Reservoir A to Reservoir One.

One additional water diversion structure was built in 1980 to bring water from the El Dorado Canal. The structure is known as the Hazel Creek Tunnel, but was abandoned in 1980 after less than one year of use.

3. MIDDLE FORK COSUMNES WATERSHED

Of the three subject watersheds discussed in this report, the Middle Fork Cosumnes is the one water supply that is a natural, uncontrolled source of supply. Although multiple ditch systems from the Cosumnes River were constructed during the Gold Rush era to supply water to Amador and Sacramento counties, the Middle Fork Cosumnes is a natural drainage of the Sierra Nevada foothills.

With the intention of providing potable water supply to the small community of Outingdale, a 44,000 gallon water storage tank was built. The intake location has remained essentially the same, although the El Dorado Irrigation District constructed a new water treatment plant and storage tank in 1993.

IX. TREATMENT FACILITIES AND PLANT PROCESSES

A. El Dorado Canal Watershed

The treatment process used by the Reservoir One treatment plant is conventional filtration, which is listed as an approved technology in the Surface Water Treatment Rule. In a letter addressed to the District by the State Department of Health Services in November of 1991, (Appendix 5), Reservoir One is considered to meet the required Giardia and virus reduction efficiencies assuming that it can continue to meet the filtration performance standards. Reservoir One filtered turbidity measurements are meeting the requirements imposed by the State.

Other treatment processes that have been identified as requiring improvement by the State at Reservoir One include a method to remove solids from the waste backwash water prior to recycling.

B. Jenkinson Lake Watershed

The treatment process used by the Reservoir A treatment plant is direct, in-line filtration, which is not an approved treatment technology. However, due to the fact that the raw water supply has been historically of good bacteriological quality, and the watershed has no known significant sanitary hazards associated with *Giardia*, the turbidity data for the plant can be used in lieu of particle size analysis data for assuming removal efficiency. The data must demonstrate that at least an 80% reduction of the raw water turbidity is achieved. At some point in the future, however, EID will most likely be required to meet the Surface Water Treatment Rule and construct pretreatment facilities at Reservoir A.

The WTP was designed for a flow rate of 54 mgd (83 cfs/summer), correlated to expected raw water conditions. Corresponding filtration rates are 2 gpm/sq ft and 7.5 gpm/sq. ft. The plant was designed to be expanded by about 50 percent, for a future flow rate of 81 mgd (125 cfs/summer). In addition, the plant was designed for the future inclusion of a pretreatment process such as roughing filters to reduce solids loading to the filters.

Following completion of plant construction, the California State Department of Health (DOHS) adopted regulations in response to the Federal Surface Water Treatment Rule, which was promulgated in 1989. The Health Department regulation do not recognize in-line filtration as an equivalent treatment process to either the direct filtration or conventional treatment processes. The addition of a prefiltration treatment process such as flocculation basins, contact clarifiers, or roughing filters may be required in order to operate at capacity. Because of the lack of pretreatment Reservoir A WTP has been down-rated by DOHS to 43 mgd (66 cfs) during the summer, which corresponds to an allowable filtration rate of 6 gpm/sq ft.

In order to satisfy system demands, the WTP treats a wide range of flows which vary from about 5 mgd in the winter to over 63 mgd in the summer. Thus, the summer peak system demand has exceeded the original plant design capacity by about 16 percent, and the DOHS rated plant capacity by over 46 percent.

Other treatment processes that have been identified as requiring improvement, include modifying the method of recycling filter backwash water, and improvement of chlorine contact times. The DOHS has indicated that log removals will need to be verified either by a tracer study verification of CT values or by a particle size analysis. An alternative would be the installation of plant pretreatment, or incorporation of a baffle wall in the Reservoir A chlorine contact basin to impede the process of short circuiting.

The State has also identified problems in the plant reliability as follows: 1) Reservoir effluent alarms do not have the ability to cause an automatic plant shut down; 2) Chlorination equipment is not equipped with devices to warn of low and high vacuum failures or other types of chlorination failures; 3) A by-pass to plant-treated water storage unit does not exist and will need to be constructed in the event of contamination to this uncovered reservoir.

The major raw water quality problem appears to be the buildup and sudden release or organic or bacterial slimes from the raw water supply line, which severely limits filter performance and the levels of soluble iron and manganese in Jenkinson Lake, especially during seasonal lake turnover events.

C. Middle Fork Cosumnes

The Outingdale Treatment plant intake structure consists of a flex hose with a 55-gallon drum on the end with screen on the cutouts. The pump station can deliver approximately 70-80 GPM to the Water Treatment Plant, which is located approximately 1200 feet from the water intake structure.

The State Department of Health Services in 1991 had identified the plant as using an in-line filtration process which is not an approved technology, stating that an inability to meet the filtration performance standards. In 1993 plant improvements put into place by the EID, corrected the treatment process to that of conventional filtration.

X. DISTRIBUTION SYSTEM CHARACTERISTICS

This section is intended to provide an understanding of the complex service area characteristics for the District, as well as the intricacies involved in water supply delivery and treated water storage facilities.

A. Service Area Boundaries

Service area boundaries for the El Dorado Irrigation District are quite complex in that there is considerable mixing of treated water supply from both Reservoirs One, A and occasionally Reservoir 7 as well. Reservoirs A and One together provide water for a significant portion of what is known as the Main El Dorado System, totaling about 22,000 service connections at this time. Each facility supplies a small service area in the vicinity of the water treatment plant. Together their water supply co-mingles at storage Reservoirs 2 and 2A, and customers located below these reservoirs on the El Dorado Main receive a blend of the two waters. Customers located along the Pleasant Oak Main receive water primarily from Reservoir A. During short intervals the supply has also included treated water from Reservoir 7, of the North Fork Cosumnes Watershed.

Communities which receive water exclusively from Reservoir One only include Pollock Pines and Camino, and are identified on Figure 2.7. Communities which receive water exclusively from Reservoir A only include Sly Park Hills, Pleasant Valley and occasionally Diamond Springs, El Dorado, Logtown and Shingle Springs. These customer service areas are located on Figure 2.8.

Over the past five years, the supply of water to Reservoir One has proven to be the most vulnerable, due to forest fires and mudslides which have destroyed sections of the El Dorado Canal water conveyance structure.

During these periods of disaster, Reservoir A becomes the lead plant for the District Water Supply Systems. In order to accommodate this, Sly Park raw water has been delivered to Reservoir A and pre-treated, then portions of this water is pumped to Reservoir One for final treatment and distribution. Such was the case after the Cleveland Fire of October 1992 destroyed 1.25 miles of wooden flume distributed over about five miles along the El Dorado Canal. It was not until December of 1993 that Reservoir One resumed normal operations due to final restoration of the flume by PG&E.

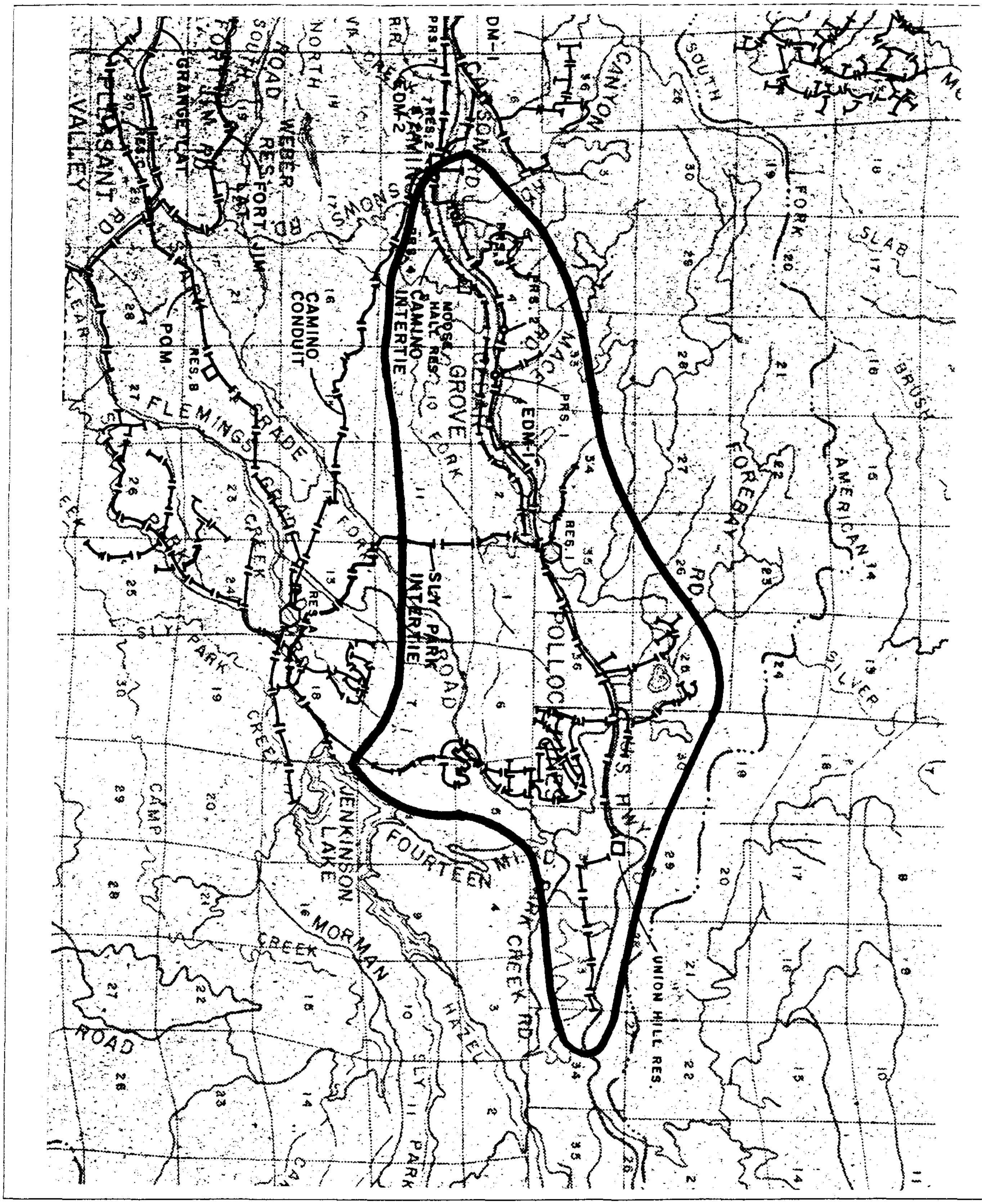
This type of operation has also been done in an effort to maximize District water supplies. This was the case in March of 1995 when heavy winter rains caused Jenkinson Reservoir to fill to capacity and was spilling over. The operation strategy was implemented.

Another PG&E Canal outage occurred in 1995 due to a mudslide in May, although tributaries to the El Dorado Canal below the location of the slide allowed for raw water delivery to Reservoir One. Repairs on this section located at Flume 27/28 of the canal were completed in October of the same year.

The Outingdale Water Treatment Plant service area consists of 175 service connections, all located within 370 acres of the Water Treatment Plant. A system map for the Outingdale Service Zone is provided in Figure 2.9.

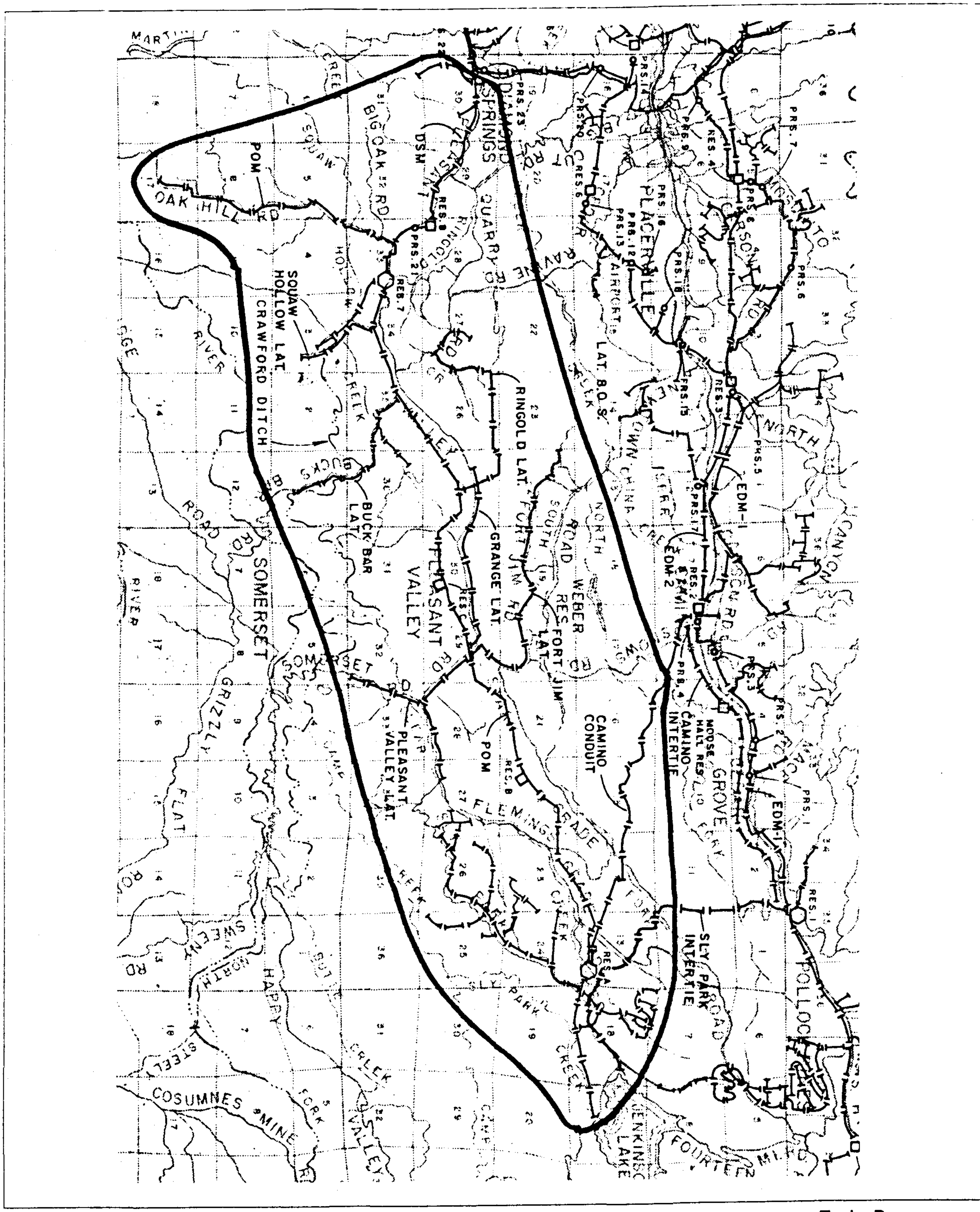
B. Treated Water Storage Facilities

Due to the extensive geographical area served by the water distribution system (EID Main System), which includes water supplied by both Reservoirs One and A, a number of treated water storage facilities are in use. These include six tanks, and 22 storage reservoirs. Table 2.12 provides a list of these storage facilities. Their geographic locations is provided on Figure 2.10.



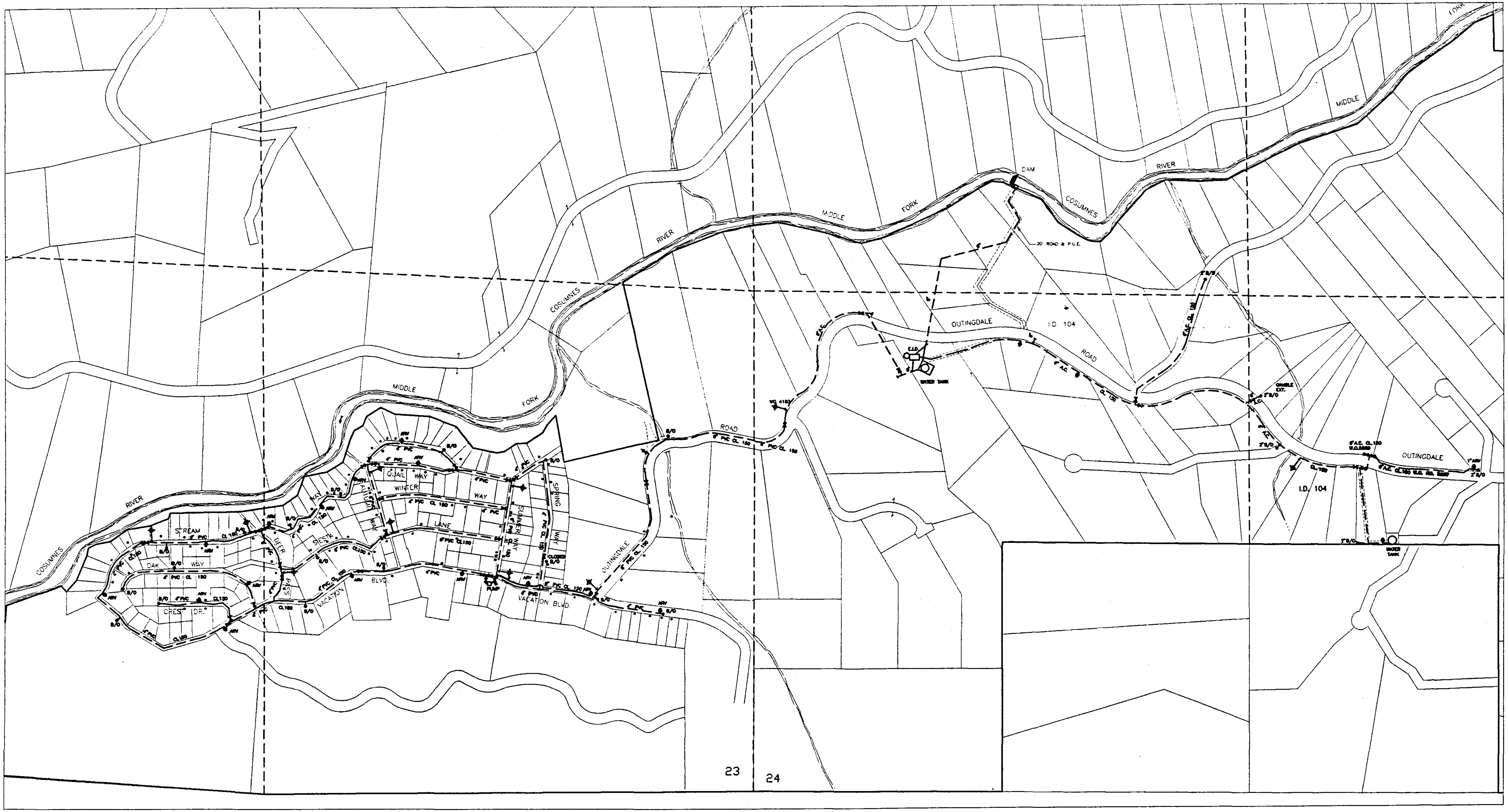
Scale: 1" = 7500

E. I. D.
WATER DISTRIBUTION SYSTEM
EXCLUSIVE TO RESERVOIR 1
JUNE 1996
FIGURE 2.7



NOT TO SCALE

E. I. D.
WATER DISTRIBUTION SYSTEM
EXCLUSIVE TO RESERVOIR A
JUNE 1996
FIGURE 2.8



Scale: 1" = 500'

E. I. D.
WATER DISTRIBUTION SYSTEM
OUTINGDALE WTP

JUNE 1996
FIGURE 2.9

Of the 22 storage reservoirs, seven have been covered with hypalon floating covers, of which the State Department of Health Services has been critical (See Appendix 6). The EID Engineering Department is investigating method of remediation for the covered reservoir design, and is considering hard cover alternatives to those that remain unprotected. Of the remaining drinking water storage reservoirs, Sly Park Hills is currently being replaced with a tank. Others are scheduled for covering or by-pass, to take place approximately within the next 10 years.

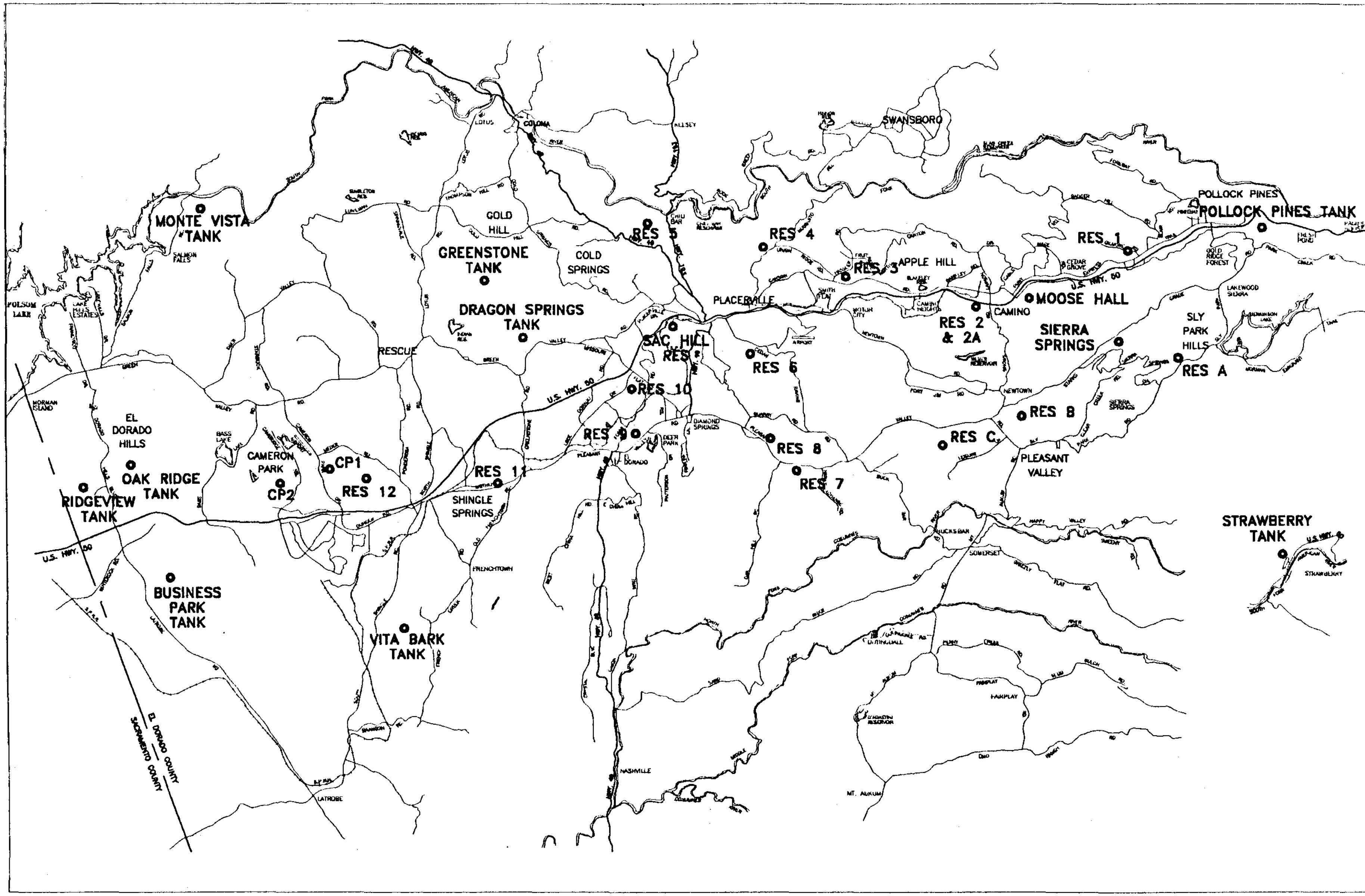
Treated water storage facilities are not generally the focus of a Sanitary Watershed Survey with respect to the intent of public health protection. However, it should be considered appropriate in the sense that the water supply is exposed and has the potential for contamination through animals, vandalism, leaves and other organic matter. Nine of these reservoir also lack concrete lining and bypasses which makes them particularly vulnerable to contamination. For this reason, timely attention to the lining and covering project is essential.

The Outingdale System does not face this level of difficulty. There are two storage tanks in Outingdale. The lower tank at the plant was installed in 1993. Recent correspondence indicates that the upper storage tank is deteriorating and is in serious need of replacement.

Table 2.12

EID Treated Water Storage Facilities (Active)
Reservoir One, A & Outingdale Systems

FACILITY NAME	VOLUME (AF)	TYPE	SYSTEM
A	7.0	Concrete lined/uncovered	Reservoir One & A
B	4.5	Hypalon lined/covered	Reservoir One & A
C	4.5	Hypalon lined/covered	Reservoir One & A
1	8.5	Hypalon lined/covered	Reservoir One & A
2	10.0	Concrete lined/uncovered	Reservoir One & A
2A	14.0	Earthen/uncovered	Reservoir One & A
3	7.2	Earthen/uncovered	Reservoir One & A
4	4.8	Earthen/uncovered	Reservoir One & A
5	2.7	Earthen/uncovered	Reservoir One & A
6	21.3	Earthen/uncovered	Reservoir One & A
7	15.5	Earthen/uncovered	Reservoir One & A
8	4.4	Earthen/uncovered	Reservoir One & A
9	2.5	Earthen/uncovered	Reservoir One & A
10	6.7	Earthen/uncovered	Reservoir One & A
11	14.9	Hypalon lined/covered	Reservoir One & A
12	20.0	Earthen/uncovered	Reservoir One & A
CP1	3.1	Concrete lined/uncovered	Reservoir One & A
CP2	4.6	Concrete lined/uncovered	Reservoir One & A
Moose Hall	2.5	Hypalon lined/covered	Reservoir One & A
Sacramento Hill	2.0	Earthen/uncovered	Reservoir One & A
Sly Park Hills	3.0	Current tank installation	Reservoir A
Pollock Pines	8.0	Hypalon lined/covered	Reservoir One & A
Baumhoff	0.29	Steel tank	Reservoir One & A
Dragon Springs	0.55	Steel tank	Reservoir One & A
Rancho del Sol	0.18	Steel tank	Reservoir One & A
Outingdale #1	0.15	Concrete tank	Outingdale
Outingdale #2	0.14	Steel tank	Outingdale
Sierra Springs	0.15		Reservoir A



NOT TO SCALE

E.I.D.
TREATED WATER
STORAGE FACILITIES
JUNE 1996
FIGURE 2.10

CHAPTER 3

POTENTIAL CONTAMINANT SOURCES IN THE WATERSHEDS

This chapter is intended to describe the methods used for field surveys, and to provide information regarding potential contaminant sources based on survey findings. Discussion includes a summarization of District vulnerability as well as the potential for changes in contaminant loadings in the future.

I. SURVEY METHODS

A variety of methods have been used for all three subject watersheds in order to obtain information on potential contaminants. Field surveys conducted by District staff have taken place primarily on foot. This has been particularly necessary for the El Dorado Canal and the Jenkinson Lake Watersheds, where road access is difficult and the public land ownership and easements make foot access possible. United States Department of Geological Survey (USGS), United States Forest Service (USFS) and community road maps were also used to obtain information regarding population centers and significant roadways within the watersheds. Records at pertinent public agencies have also been consulted, such as the USFS and County Departments of Agriculture and Environmental Management in addition to those of the El Dorado Irrigation District.

II. SURVEY FINDINGS

Findings of the survey process indicate that the primary sources activities for contamination that currently exist in the watersheds are septic systems, storm water run-off (including sedimentation), timber harvesting, abandoned mine runoff, spills from roadways, recreational use, and pesticide application. The following sections of this Chapter will describe these contaminants and the activities which produce them.

A. Wastewater Contaminants

The key contaminants associated with septic systems or other domestic wastewaters are pathogenic organisms, nutrients and oxygen demanding substances. Bacteriological contaminants from the waste stream which most often cause gastrointestinal disease include fecal coliform, *giardia*, *cryptosporidium* and viral contaminants such as salmonella. Coliform bacteria is considered to be only a general indicator of wastewater contamination, while actual human pathology is associated with *giardia, cryptosporidium* and viruses.

1. *GIARDIA*

Giardia is an enteric flagellated protozoan that is known to cause human illness. Cysts can be routinely recovered from raw sewage and in waters receiving wastewater treatment plant effluents. *Giardia* cysts are also carried by many species of wild and domesticated animals which prevail in these areas and naturally visit rivers and lakes for their drinking water source.

Water in the area watersheds has great potential for serving as a carrier for *giardia* cysts, which are known to remain viable for more than two months in cold water (Meyer and Jarroll, 1980). It's prevalence in the Reservoir One water supply canal, as well as in Jenkinson Lake and Cosumnes River can be assumed because of the parasite's high survival rate in cold waters, because of the fact that in most of these areas, sanitation facilities are scarce and carriers of the organism are a significant portion of the wildlife population. In a study of *Giardia* occurrence in the Sierra Nevada from 1984-1986, which included Desolation Wilderness in El Dorado County, *Giardia* cysts were found with regular occurrence, although in low quantities. Major symptoms of giardiasis include cramps and diarrhea, low-grade fever, cholera-like symptoms and even death, especially in immuno-deficient individuals.

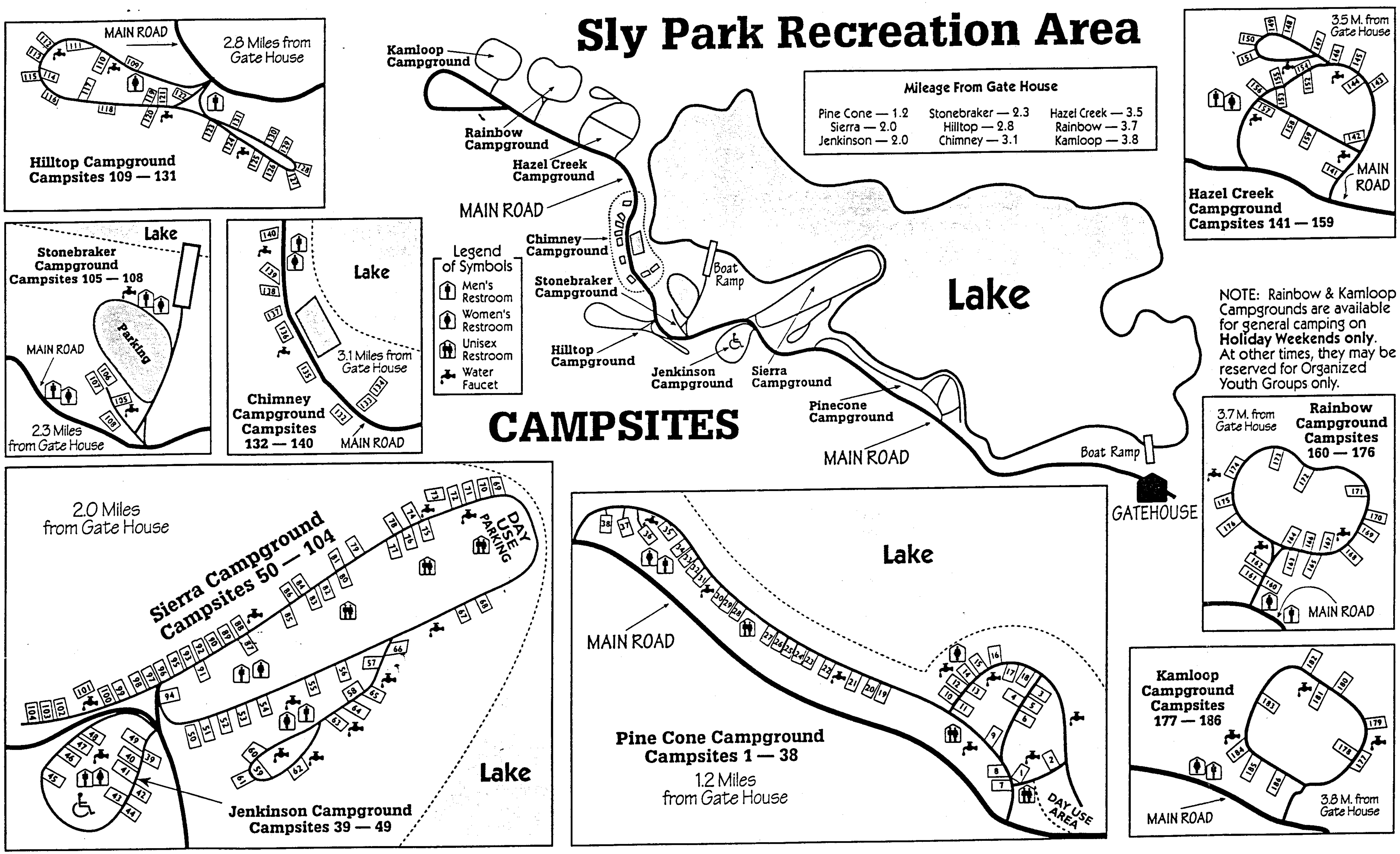
2. *CRYTOSPORIDIUM*

Cryptosporidiosis is caused by the parasite *Cryptosporidium parvum* and has been associated as a pathogen for human disease since 1976. The oocysts can remain viable outside the body for two to six months in a moist environment, and the infective dose is quite low. Some drinking water utilities in California have conducted investigative studies on the prevalence of *Cryptosporidium* in their watershed. Reported levels ranged from up to 5.3 oocysts/100 liters in treated drinking water, and up to 13.2 oocysts/100 liters in untreated water supplies. Symptoms of Cryptosporidiosis are similar to those of giardiasis, ranging in severity from mild to severe, and requiring hospitalization.

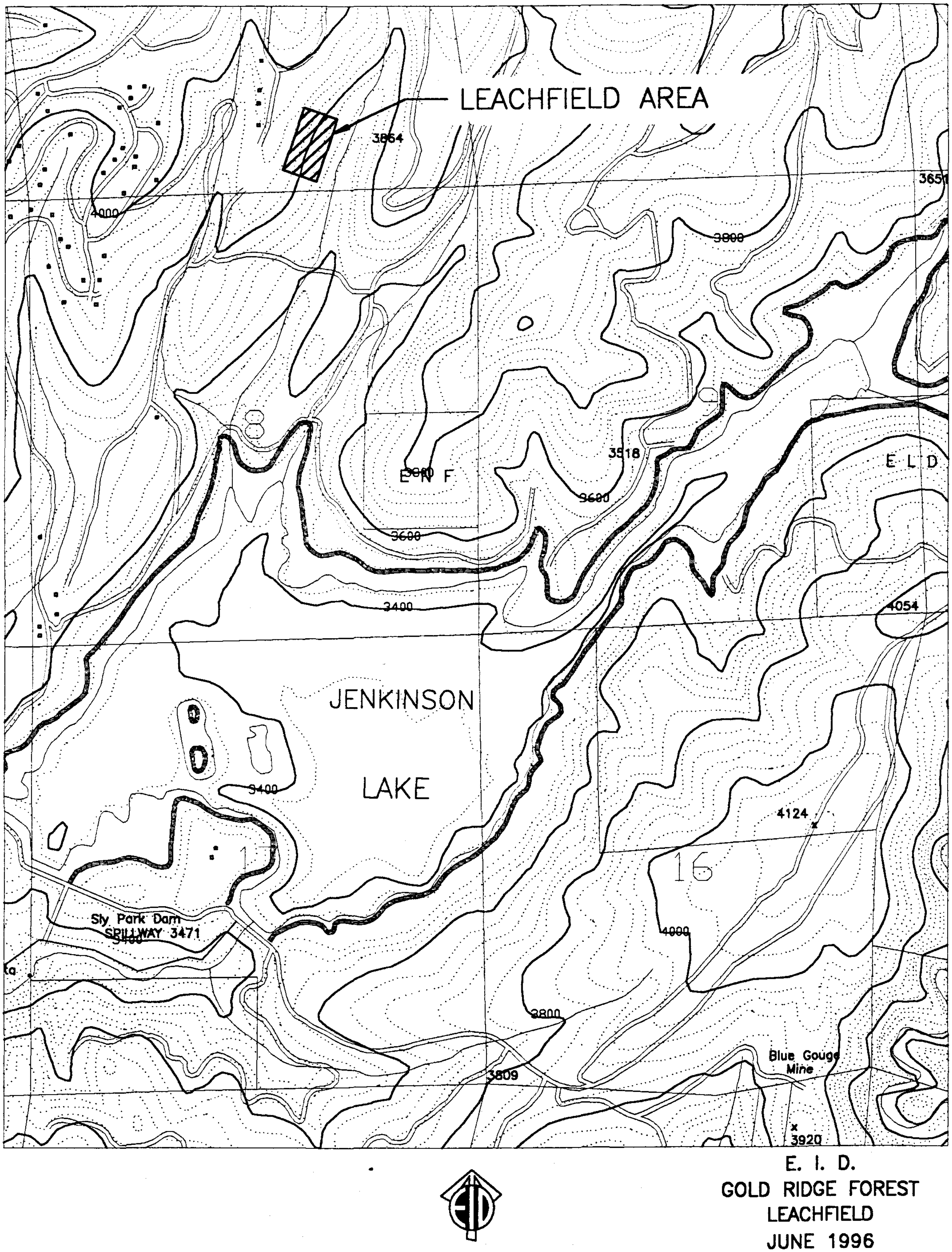
Wastewater contamination in drinking water supply can be introduced via point or non-point sources contamination. There are no industrial or domestic wastewater treatment facilities upstream of the three water plant intakes. Therefore, there are no known direct effluent discharges, spray field, or evaporation pond operations that affect these watersheds. Similarly, none of the watersheds have wastewater collection systems other than multi-unit septic systems which might be a source of sewer spill contamination problems.

Domestic waste in the area is primarily treated through septic system leach fields, which do have the potential for impacting water quality. All three subject watersheds have these systems within a one-mile radius of the treatment plant intake. In addition, the Jenkinson Lake watershed has several vaulted bathroom facilities located in the campgrounds which surround the lake. Figure 3.1 displays the locations of campground and public restroom facilities located nearby to Jenkinson Lake.

One community leach field system, in the Gold Ridge Forest subdivision, is located within the Jenkinson Lake Watershed. This system services 39 domestic residences and is operated by the El Dorado Irrigation District. A copy of the Waste Discharge Permit for



CAMPGROUND AND SANITARY FACILITIES
JENKINSON LAKE
JUNE 1996
FIGURE 3.1



E. I. D.
GOLD RIDGE FOREST
LEACHFIELD
JUNE 1996
FIGURE 3.2

this system is located in Appendix 7, and its location is identified on Figure 3-2. In addition to routine piezometer readings taken at the leach field, a seasonal drainage to the Jenkinson Lake is monitored for total coliforms routinely by the District. There have been no identified incidences of septic system failure from Gold Ridge Forest leach field.

Urbanization of the watershed is a primary cause of non-point source coliform contamination. A direct relationship between the bacteriological density of a watershed and population density in the watershed area was identified in 1974 by L.G. Wilhelm, (Effective Watershed Management, AWWA 1991). The study included data from 13 watersheds located mostly in Utah and the Pacific Northwest, and showed that an increase in coliform bacteria concentrations could be related to an increase in population densities with a correlation coefficient of 0.95. A large portion of the bacteriological contribution from urbanization enters the waterway via stormwater run-off. Other pollutants that are generally carried into the water supply via stormwater are discussed in Section II B of this Chapter.

Recreational use of the watersheds increases with urbanization, and is one mechanism for water contamination from human waste. The Jenkinson Lake watershed is a high use recreational area, providing camping, boating, and body contact sports such as swimming and water skiing. All of these activities allow for entry of human excrement into the water supply. While body contact sports are not actively promoted in the El Dorado Canal Watershed, or the Middle Fork Cosumnes watershed, accessibility certainly makes this sort of contamination likely.

Another source of microbiological contamination of source water supply is through infection via domesticated or wild animals. *Cryptosporidium*, for example, has been found not only in feces of domesticated animals such as cattle, sheep, goats or swine, but also in deer, raccoon, foxes, coyotes, beavers, muskrats, rabbits and squirrels. All of these animals have been identified has inhabitants of El Dorado County watersheds.

B. Stormwater Runoff

None of the subject watersheds can be considered to be significantly urban. However, the effects of population on the water quality is still apparent in stormwater runoff from residences and commercial/light industry. In general, there are two major changes to water bodies that can occur because of urbanized stormwater. These changes are 1) changes in stream hydrology, and 2) increase in pollutant loadings.

The hydrologic effect of urbanization to water bodies results primarily from the decrease of impermeability of surface areas. As more and more development takes place, more and more permeable soils are covered with pavement or building structures. Rainfall and non-storm event drainage is generally diverted to creeks and water bodies rather than being absorbed into area soils. This results in increased peak discharges and total volume discharged as well as greater run-off velocity.

Contaminants common with urban run-off other than bacteriological contaminants, include sedimentation, nutrients, pesticides and those associated with road drainages. Sedimentation in waterways cause not only a decrease in water supply, but also can lead to excessive deposits of nutrients which promotes algae growth. Phosphorous and nitrogen are considered to be the major contributors to this form of eutrophication.

The primary impact of road drainages are those of heavy metals, such as cadmium, lead, copper, or zinc, and other toxics such as petroleum hydrocarbons from motor oil or fuel waste, salts and elevated biochemical oxygen demand (BOD). These are the pollutants associated with combustion products, automobile use, and road de-icing materials. The accumulation of these toxics from stormwater run-off has not been found to be a widespread problem (Nonpoint Source Impact Assessment, WPCF 1990) but could be considered a problem via their introduction into the food chain.

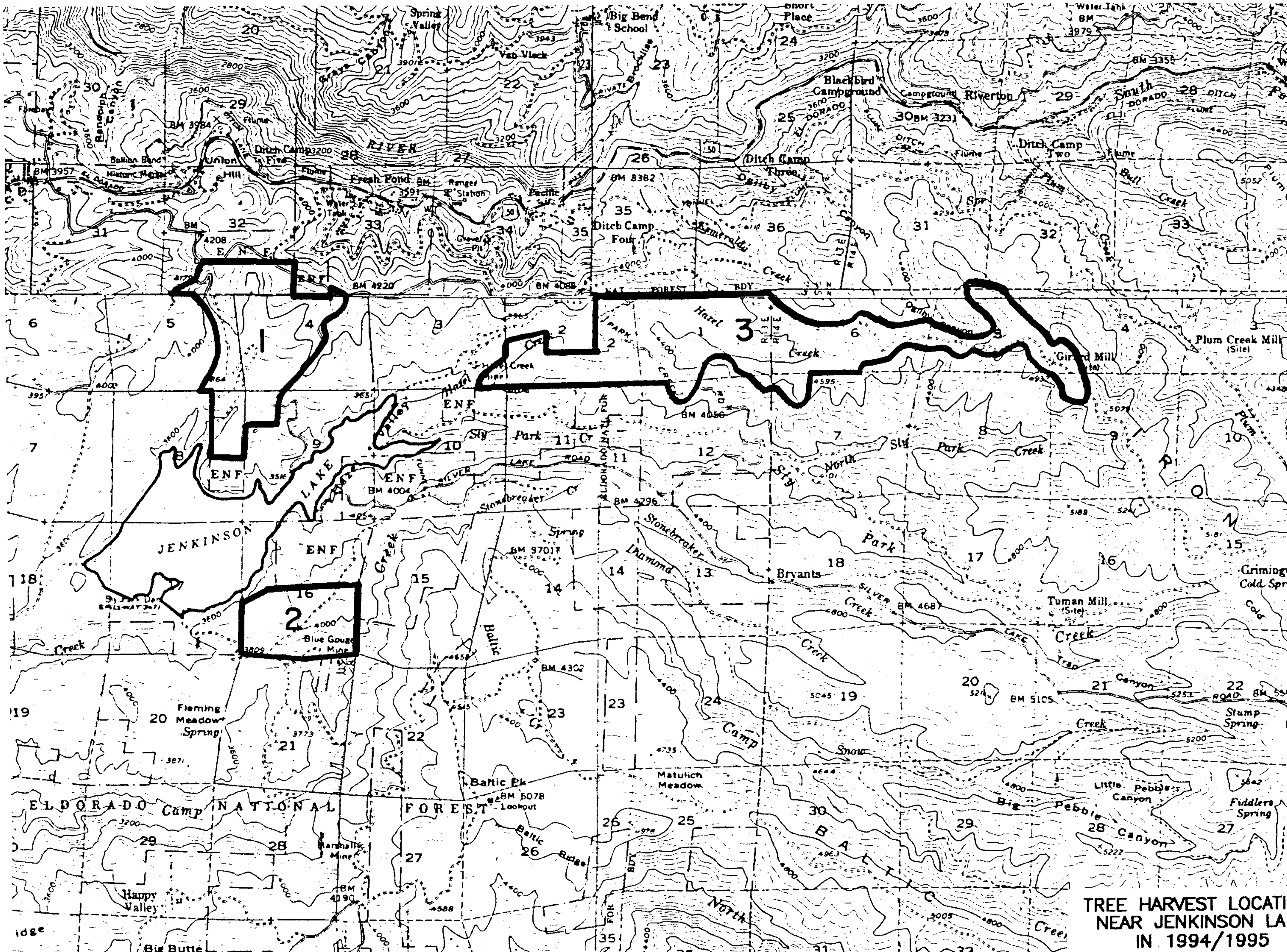
There are currently no urban run-off control measures that take place within subject watersheds, other than road drainages designed exclusively for the purpose of maintaining roads. Stormwater run-off monitoring and management will ultimately become the responsibility of the El Dorado County Department of Environmental Management through State and Federal regulations.

C. Timber Harvest

The primary agricultural product found within the area watersheds is timber. Significant acreage within each watershed are either owned by private timber harvest industries, or by the El Dorado National Forest, which issues timber harvest permits for individual use. General areas for authorized timber harvest projects that took place near the Jenkinson Lake watershed during 1994 and 1995 are included on Figure 3-3.

Timber harvest has many necessary activities which can effect the watershed and river systems. These activities include the construction of access roads, tree removal, preparation of the site for reforestation, and use of pesticides for weed control, tree disease, insects and animal pest control. Along with the dirt roads that are necessary to access the trees for harvesting, skid trails and cleared areas for equipment and log storage, must be constructed. After trees are felled, trunks are cleared of limbs and cut apart into logs to be removed. Gathering and moving these logs requires heavy equipment, most of which is done by heavy tractors which cause considerable soil disturbance. Removal of logs by cable or helicopter causes less damage to the land, but are seldom used. Other timber harvest practices that impact water supplies include thinning, prescribed burning and reforestation.

Mismanagement of these activities has the capability of devastating watersheds, by filling small drainages with debris, ruining aquatic habitats with siltation, altering natural runoff patterns and destroying vegetation. This will impact water quality by adding total solids



TREE HARVEST LOCATIONS
NEAR JENKINSON LAKE
IN 1994/1995
JUNE 1996
FIGURE 3.3

and nutrient loadings to the water which affects evapotranspiration rates, changes channel morphology, and reduces dissolved oxygen of the water. Dissolved oxygen is a measure of water health, and its depletion will lead to eutrophication, with high levels of surface algae and considerable amounts of decaying matter underneath.

D. Grazing and Non-grazing Animals

The watersheds are a diverse habitat for wildlife, and contain a wide variety of grazing species, including California mule deer (black deer), bear, mountain lions, bobcat, coyote, skunk, weasel, beaver, raccoon, jack rabbit, cotton-tail rabbit, porcupine, opossum, ground squirrel, marmot, and gopher, Of these, many are carriers of *Giardia* organisms, and all tend to locate near water supplies.

Water contaminants such as *Salmonella* are also carried by various bird species. Some of the more common species of birds found in the watershed are the mountain chickadee, Stellar's jay, Clark's nutcracker, robin, red shafted flicker, sparrow, acorn woodpecker, and wild turkey. Commonly found raptors include golden eagles, red-tailed hawk, and great horned owl.

Information obtained from the El Dorado National Forest, Tahoe National Forest, California Fish and Game Department, and trappers working for County Agricultural Commissioners Office for the watershed revealed that the only wildlife counts that are currently made are on deer. According to the USFS, the primary deer population during winter range is that of the Pacific Deer herd (mule deer). Population estimates of the deer herd by the Department of Fish and Game indicate that the size has varied between 3,600 and 6,000 in recent years (ARWSS 1993). The increase in the mountain lion population, which has occurred since the passing of the 1991 Proposition 118, may be having a diminishing affect on the mule deer population.

Apart from the bacteriological and viral contaminant loading that can be caused by grazing animals, is the hazard of soil displacement and sedimentation. Problems associated with these are the same as those discussed in Wastewater Contaminants and Timber Harvest Sections of this chapter. Soil displacement becomes particularly detrimental in the case of herd animals, such as cattle. Grazing allotments are granted by the El Dorado National Forest to cattlemen in specified areas on public lands. At least one grazing allotment area is located above Plum Creek, which is a tributary to the American River below the diversion structure to the EDCWS. Plum Creek is not currently diverted to the canal system.

E. Pesticide Application

Pesticide/herbicide use within the subject watersheds is primarily residential, timber harvest management and some agricultural application. Agricultural crops in area watersheds outside of timber harvest include Christmas Tree farms, two of which are located directly along the El Dorado Canal Watershed within 3.3 miles of the treatment plant intake. Small acreage farming of fruit crops, such as apples and pears, are also common as discussed in Chapter 2.

Chemical pesticides, typically used for these agricultural purposes include Glyphosate (Roundup), Hexazinone, Triclopyr and Dalapon. A brief description of these industrial pesticides including their mobility in soil and water, pervasiveness, and their effect on human health, is provided below. Monitoring for these contaminants has been conducted in the Sly Park Watershed by the El Dorado Irrigation District since 1990, as well as by the USDA Forest Service.

1. GLYPHOSATE

Glyphosate, also known as Roundup, Rodeo and Pondmaster, is a broad-spectrum non-selective systemic herbicide. It is widely used on annual and perennial plants, as well as crop and non-crop acreage. Generally formulated as an isopropylamine salt, it can be described as an organophosphorous compound. This herbicide is poorly absorbed from the digestive tract and is largely excreted unchanged by mammals. EPA has stated that there is sufficient evidence to conclude that glyphosate is not carcinogenic to humans. It has been shown to be relatively non-toxic, but may cause eye irritation.

Glyphosate is readily absorbed by most soils, especially those with high organic content, so that little is expected to leach from the applied area. The time it takes for half of the product to break down ranges from 1 to 174 days, primarily through microbial degradation. Because glyphosate is so tightly bound to the soil and product breakdown is fairly rapid, little is transferred by rainwater to the water supply. However, the herbicide could be transported to water when attached to soil particles in instances of erosion run-off.

Once it reaches water, glyphosate is strongly absorbed to suspended organic and mineral matter and is broken down primarily by microorganisms. Its half-life in pond water ranges from 12 days to 10 weeks. Monitoring for the herbicide by EID, conducted in 1994 and 1995, did not indicate detectable glyphosate at any of the raw water intake locations.

2. HEXAZINONE

Hexazinone is also known as DPX 3674 and Velpar. It is a triazine herbicide used against many annual, biennial and perennial weeds as well as some woody plants, mostly in non-crop areas. The herbicide works by inhibiting photosynthesis in the target plants, and rainfall or irrigation water is needed before it becomes activated. With respect to health concerns, Hexazione is only very mildly toxic, but can cause severe and irreversible eye irritation.

Biodegradation, photodecomposition, and dilution are the prime mechanisms for decreases in Hexazinone concentration. Half of the applied herbicide is lost in soil after one to six months depending on the climate and soil type. Biodegradation of the product, which is its primary route of degradation results in the release of carbon dioxide. Sunlight can also break down the compound (photodegradation) at a rate that depends on light intensity and exposure.

The El Dorado National Forest conducts Hexazinone monitoring along all watersheds in their herbicide use areas. In a memo written by Robert Smart, District Ranger of the USDA Forest Service (July 27, 1993) to the El Dorado Irrigation District Manager, it is indicated that the highest concentration found in subsidiary streams in herbicide treatment areas was 16 ppb, and the EPA Maximum Contaminant Level (MCL) limit for the substance is 200 ppb.

3. TRICLOPYR

The trade names for herbicides containing Tricolopyr are Garlon, Turflon, Access, Redeem, Crossbow, Grazon and ET. Some applications of the product classified as Restricted Use Pesticides (RUP), to be purchased and used only by certified applicators. It's primary health concerns are those of skin and eye irritation.

A pyridine, Triclopyr is a selective systemic herbicide used for control of woody and broadleaf plants along rights-of-way, in forests, on industrial lands and on grasslands. Unlike a similar product 2,4,5-T which has been banned in the United States, there is no possibility of Dioxin impurities occurring in Triclopyr.

Triclopyr is not strongly absorbed to soil particles, has the potential to be mobile, and is fairly rapidly degraded by soil microorganisms. The half-life in soil is from 30 to 90 days, depending on soil type and environmental conditions, with an average of about 46 days. The half-life of one of the breakdown products (Trichloro-pyridinol) ranges from 8-279 days and more typically less than 90 days. Longer half-lives can occur in cold or arid conditions.

Breakdown by the action of sunlight is the major means of Triclopyr degradation in water. The half-life is 10 hours at 25 degrees C.

4. DALAPON

Some trade names for Dalapon (2,2-Dichloropropionic acid) include Dowpon, Basinex P, Devipon, Gramevin, Denapon, Liropon, Unipon, Dalapon-Na, Revenge, Alatex, Ded-Weed, DPA, Dalacide, and Radapon.

Dalapon is an herbicide and plant growth regulator used to control specific annual and perennial grasses, such as quackgrass, Bermuda grass, Johnson grass, as well as cattails and rushes. It is selective, meaning that it kills only certain plants, while sparing nontarget types of vegetation. It is used on various fruits, and in public and domestic sites, forestry, home gardening, and in or near water to control reed and sedge growth. Dalapon is applied both as a pre-emergent and a post-emergent herbicide.

Dalapon and all of its known breakdown products, dissolve easily in water. They are readily washed from cells and tissues. Because Dalapon is insoluble in organic solvents and lipids, it does not build up in animal tissue. The California State Health Department has established a Maximum Contaminant Level (MCL) level of 200 micrograms per liter (ug/l) for Dalapon in drinking water. Consumption of Dalapon at high levels well above the MCL level over a long period of time has been shown to cause changes in kidney and liver weights in animal studies.

Dalapon does not readily bind, or adsorb, to soil particles. As little as 20% of applied Dalapon may adsorb, and in clay and clay loam soils, there may be no adsorption. Since it does not adsorb to soil particles, Dalapon has a high degree of mobility in all soil types and leaching does occur.

Biodegradation and photodegradation are the main routes of Dalapon disappearance from soils. In spite of its high mobility, Dalapon movement in soil is usually prevented by rapid breakdown into naturally-occurring compounds by soil microorganisms. Degradation depends on soil type, temperature, and moisture and the herbicide is not detectable below the first six inches of soil. Higher temperatures and increased soil moisture speed up degradation. At higher temperatures, Dalapon can also be degraded by ultraviolet light from the sun.

In water Dalapon dissolves readily, and disappears via microbial degradation, hydrolysis and photolysis. Microbial degradation tends to be the most active form of its breakdown in water. In the absence of microbial degradation, the half-life of Dalapon by chemical hydrolysis is several months at temperatures less than 77° F (25° C). Hydrolysis is accelerated with increasing temperature and pH.

During EID quarterly monitoring, one instance of trace concentration of Dalapon, measured below the laboratory method detection limit was found in Reservoir One watershed.

Although less information is available regarding their application, the Hazardous Material Inventory at El Dorado County Offices indicates that other herbicides/pesticides that are at least stored in the watersheds include Guthion, Diazinon, Abate and Pyrethrum.

5. GUTHION

Common names for Guthion (Azinphasmethye) include Cotnion-methyl, Gusathion, Methyl Guthion, Bay 17147, Carfene, Gusathion-M and Bay 90-27. Guthion (Azinphos-methyl) is a highly persistent, broad spectrum insecticide. It is also an acaricide, toxic to mites and ticks, and a molluscicide, poisonous to snails and slugs. It is an organophosphate and is used primarily to guard against leaf-eating insects and is registered for use on a wide variety of fruit, vegetable, nut, and field crops, as well as on ornamentals, tobacco, and forest and shade trees.

Guthion is one of the most toxic of the organophosphate insecticides. It is highly toxic by inhalation, dermal absorption, ingestion, and eye contact. Like all organophosphate chemicals, azinphos-methyl is referred to as a "cholinesterase inhibitor." It damages the normal functioning of cholinesterase, an enzyme essential to the proper working of the nervous system. Individuals with a history of reduced lung function, convulsive disorders, or recent exposure to other cholinesterase inhibitors will be at increased risk from exposure to Guthion.

For humans, ingestion of Guthion in amounts above 1.5 mg/day can cause severe poisoning with symptoms such as dimness of vision, salivation, excessive sweating, stomach pain, vomiting, diarrhea, unconsciousness and death. Repeated or prolonged exposure may result in the same effects as acute exposure. Other effects may include impaired memory and concentration, disorientation, severe depression, irritability, confusion, headache, speech difficulties, delayed reaction time, nightmares, sleepwalking and drowsiness or insomnia.

Although there are no valid studies on the way that Guthion metabolizes, one study did suggest that it is rapidly detoxified in the body.

The acute toxicity data on freshwater fish indicate that azinphos-methyl has moderate to very high toxic effects, depending on the species tested. Most values were in the very highly toxic range (less than 100 ug/l). The longer the time that fish are exposed to this material, the larger the number of expected fish deaths.

The disappearance of Guthion from soil is more rapid in the surface layers (0-2.5 centimeters deep) than it is in the next deeper layer (2.4-7.5 cm). This disappearance of the insecticide results from microbial degradation, degradation by ultraviolet light from the sun, hydrolysis in the presence of the water, and volatilization when it is exposed to air at ordinary temperatures.

Estimates vary on how quickly it disappears from the soil. Derivatives of this material were not found in field soil after four years. Field studies on the potential for Futhion to break down and dissipate in soil demonstrate that it is not persistent, and is 90% degraded within 30 days. A separate study on the persistence of different formulations and concentrations in sandy soil showed that undiluted insecticide can remain in soil for up to four years.

In water, Guthion is subject to degradation by sunlight and microorganisms, with a half-life of up to two days. Biodegradation is probably the most important degradation process in natural waters, and volatilization is unlikely. Chemical hydrolysis is probably important only in alkaline waters.

6. DIAZINON

Trade names of this product include Knox Out, Spectracide and Basudin. Diazinon may be found in formulations with a variety of other pesticides such as Pyrethrins, Lindane and Disulfoton.

Diazinon is a non-systemic organo-phosphate insecticide used on home gardens and farms to control a wide variety of sucking and leaf eating insects. It is used on fruit trees, vegetable crops, corn and on horticultural plants. It is also an ingredient in pest strips. Diazinon also has veterinary uses against fleas and ticks.

The symptoms associated with Diazinon poisoning in humans include weakness, headaches, tightness in the chest, blurred vision, non-reactive pinpoint pupils, salivation, sweating, nausea, vomiting, diarrhea, abdominal cramps, and slurred speech. Death has occurred in some instances from both dermal and oral exposures at very high levels.

Metabolism and excretion rates for diazinon are rapid. The half life of the pesticide in animals is about 12 hours. The product is passed out of the body through urine and in the feces. The metabolites account for around 70% of the total amount excreted.

Diazinon seldom migrates below the top 1.3 centimeters (½ inch) in soil but can stay biologically available for six months under conditions of low temperature and low moisture. The average time for 50% degradation in soil is two to four weeks. Bacterial enzymes can speed the breakdown of diazinon and have been used in treating emergency situations such as spills. The breakdown rate is also highly dependent on the acidity of water. At highly acidic levels, one half of the compound disappeared within 12 hours while in a neutral solution, the pesticide took six months.

7. ABATE

Trade names for products containing Abate include Abat, Abathion, Biothion, Bithion, Difennthos, Ecopro, Temephos, Nimitox, and Swebate. The compound may also be found in mixed formulations with other insecticides. Abate is an non-systemic organophosphorus insecticide used to control mosquito, midge and black fly larvae. It is used in lakes, ponds and wetlands. It also may be used to control fleas on dogs and cats and to control lice on humans.

Formulations of the pesticide were used in cisterns and other potable water sources in some locations in the United States for the control of mosquito larvae. Subsequent tests on the residents that had used the water sources showed no observable effects in the exposed individuals.

Symptoms of acute exposure may include nausea, salivation, headache, loss of muscle coordination, and difficulty breathing. However, humans have ingested 256 mg/kg for five days and 64 mg/kg for four months without any symptoms or detectable effects. At the higher dose the volunteers in the study all refused to take the dose any longer because of the obnoxious taste.

In other mammals, temephos produces signs and symptoms typical of cholinesterase inhibition at moderate levels of exposure (500 mg/kg). Death does not occur unless very large doses of the compound are administered.

There is only a minimal amount of information available about the fate and behavior of Abate in the environment. Current evidence suggests that the compound has a low persistence. Weekly applications at twice the normal application rates on pond water resulted in the rapid disappearance of the compound from the water and from the sediments. At even higher application rates to pond water there were still only traces of the compound detected one week after application.

8. PYROCIDE

Other names for Pyrocide include Pyrothrin, Alleviate, Pynamin, d-trans Allethrin, D-Trans, Bioallethrin, MGK 264, Esbiothrin, and All-Ethrin.

Pyrocide is used almost exclusively in homes and gardens for control of flies and mosquitoes, and in combination with other pesticides to control flying or crawling insects. The purified d-transisomer is more toxic to insects and is used for control of crawling insects in homes and restaurants.

Pyrocide is slightly to moderately toxic by dermal absorption and ingestion. Short-term dermal exposure to allethrin may cause itching, burning, tingling, numbness, a feeling of warmth, with no dermatitis. Exposure to large doses by any route may lead to nausea, vomiting, diarrhea, hyperexcitability, incoordination, tremors, convulsive twitching, convulsions, bloody tears, incontinence, muscular paralysis, prostration and coma. Persons sensitive to ragweed pollen are at increased risk from exposure to allethrin.

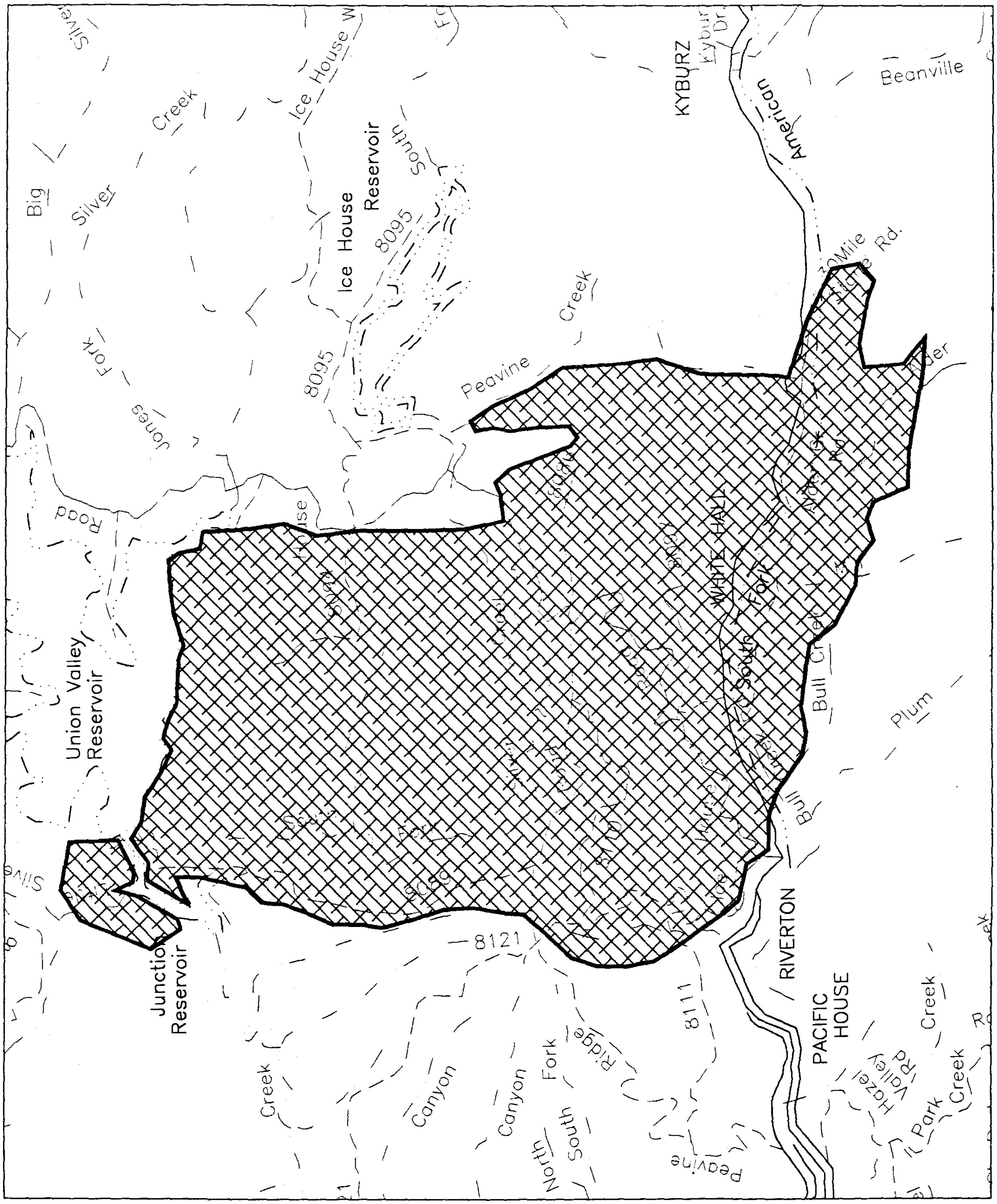
In pond waters and in laboratory degradation studies, concentrations decrease rapidly due to sorption to sediment, suspended particles and plants. Microbial and photodegradation also occur.

Other herbicides used within area watersheds, and primarily within those of the Jenkinson Lake watershed and the El Dorado Canal Watershed include, Direx, Surfactants, Protocol, Simitrol, Goal. Poison gopher bait is occasionally used by El Dorado National Forest in reforestation process in order to impede animal damage to budding forests.

F. Forest Fires

Because they are heavily forested all three subject watersheds are subject to large scale forest fires. The affects on water quality by a forest fire occur mostly through indirect causes. If any direct cause of a fire were to occur, it would be in the form of introduction of turbidities and other pollutants through the airborne dispersal of ashes and other burn products. It may also occur in the form of incidental spraying of fire retardant chemicals on the surface of the body of water.

Indirect affects of forest fires are changes in water temperature due to removal of the tree canopy and the introduction of pollutants through increased sedimentation. Both of these are ultimately caused by a reduction of vegetation in the vicinity of the stream, river or lake. The absence of vegetation impacts watershed health mostly by increasing the potential for soil erosion. Timing of the forest fire is critical to it's effect on the watershed in that late season fires, which are the most typical, leave a barren landscape at the start of the rainy season. Massive land movement (landslides) are the potential hazard under these circumstances. These occurrences have had a severe impact on the EDCWS, where flume outages which can last for several months are the net result of mudslides. Loss of the tree canopy intensifies the diurnal temperature fluctuations of the water, and have an effect on the survival of aquatic organisms accustomed to living in the watershed. One such disaster is known as the Cleveland Fire occurred on the El Dorado Canal Watershed in October, 1992. Figure 3.4 identified the area of impact in the EDCWS caused by the Cleveland Fire. During instances such as the Cleveland Fire, air drops of fire retardants have been used. One standard fire retardant, is known as NOIBN, with active ingredient GUAR Gum, Diammonium Phosphate, and Sodium O-Phenylphenate Tetrahydrate. GUAR Gum is listed on the EPA Toxic Substance Control Act List and has been shown to cause bladder tumors when fed in exaggerated doses to rats, however, risks from normal environmental exposures are considered negligible. Decomposition products include ammonium, phosphates and sulfates.



LEGEND

DRAINAGE BASIN BOUNDARY

WATER FEATURE

SECONDARY ROADS

AREA BURNED IN FIRE

NOT TO SCALE

IMPACT AREA OF
THE CLEVLAND FIRE
JUNE 1996
FIGURE 3.4

Storm water run-off in drainages to the American River were tested for phosphorous and sulfates after the Cleveland Fire. Specific drainages included a drainage near Ice House Road, at Alder Creek, Sand Flat, and near Alioto's Restaurant. In all cases the phosphorous level was at or below 0.04 ppm. All sulfate samples were non-detect. The highest levels for these analytes were found at a drainage to the El Dorado Canal from Hazel Valley Road, which was believed to be unaffected by the Cleveland Fire. The phosphorous level at this location was 0.63 ppm and is more than likely to have been caused by storm water run-off from Hazel Valley Road.

G. Mining

There are over 15,000 abandoned mines in California, which have no identifiable owners or have owners with very limited resources. Approximately 160 large abandoned mines in the State have
a high potential to discharge drainage and impact water quality. Abandoned mine drainage which is low in pH, forms when metallic sulfides, such as pyrite, are exposure to air and water. Because metal sulfides are not usually isolated from air and water at abandoned mines, acid drainage pollution is very difficult to stop or control. Abandoned mercury mine drainage, while not acidic, can also impair beneficial uses.

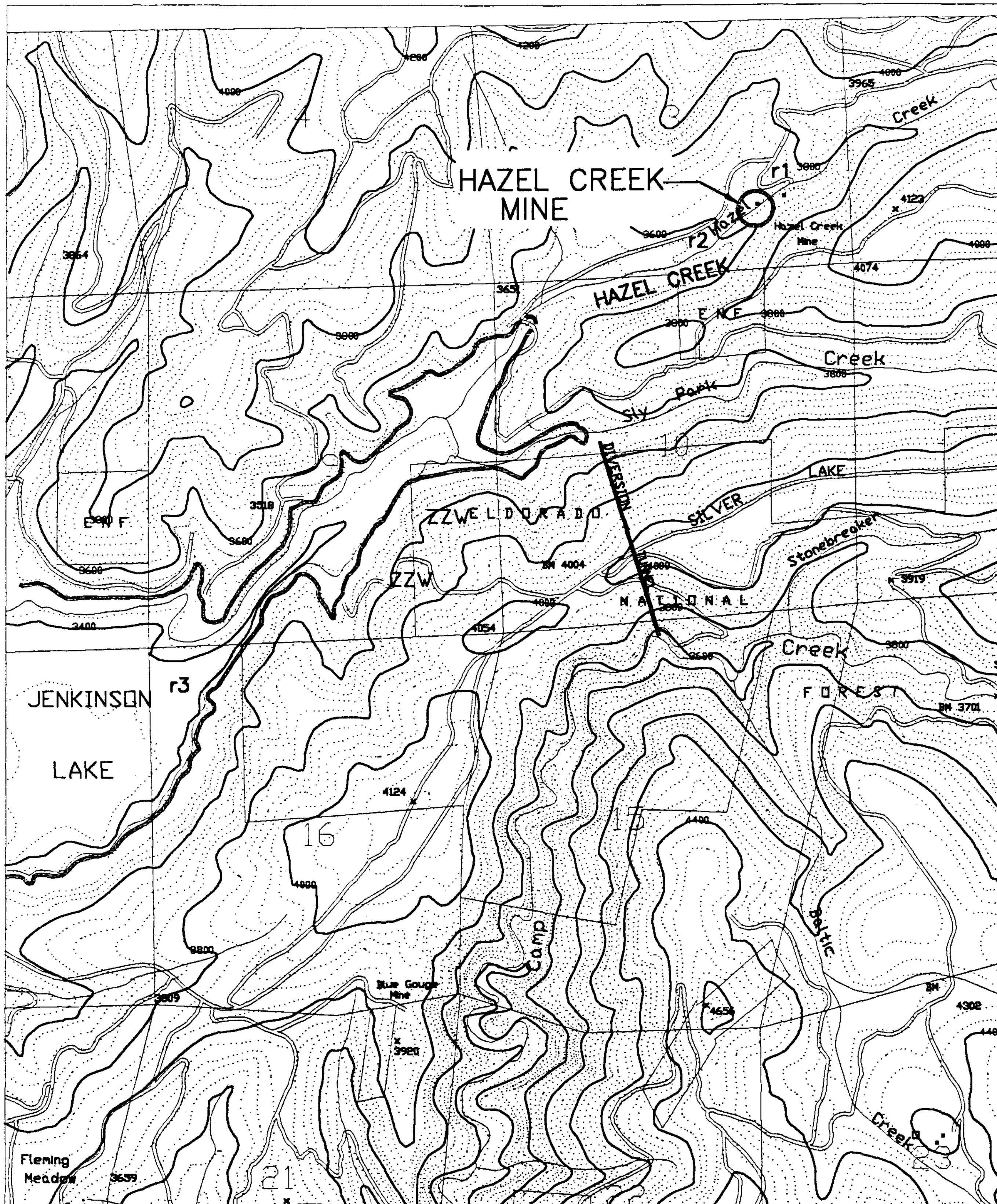
Abandoned mine drainage adversely impacts water quality by lowering pH and adding dissolved metals which affect aquatic life. Based on studies by the Central Valley Regional Water Quality Control Board, 21 of 31 streams receiving drainage from abandoned mines monitored during dry periods were impacted by one or more metals exceeding chronic toxicity objectives. All three subject watersheds are located within the Mother Lode, where mining for many substances, particularly gold, has been pervasive from the late 1800's through to the present.

Active and abandoned mines are located in multiple locations throughout each watershed, including the Hazel Creek Mine within the Jenkinson Lake drainage basin. Hazel Creek Mine properties are owned by Georgia Pacific Industries who has also recently acquired mineral rights. The mine had been inactive for many years until 1981, when a special use permit allowed for some gold mining in a shaft known as the Squirrel Hunters Ledge. Apparently not achieving success, the miners, Mineral Strategies, Inc., have since filed for bankruptcy. The site is currently under remediation with the property owner, Georgia Pacific Industries.

Hazardous materials that have been identified particular to the Hazel Creek Mine site include zinc, lead, iron, cyanide, and petroleum products. Low pH from mine leachates were also identified in a 1984 report written by Ken Ball of the State Department of Fish and Game. Georgia Pacific has been active in remediation of the abandoned mine location. Regulatory oversight is being managed by Dave Johnston from the El Dorado County Department of Environmental

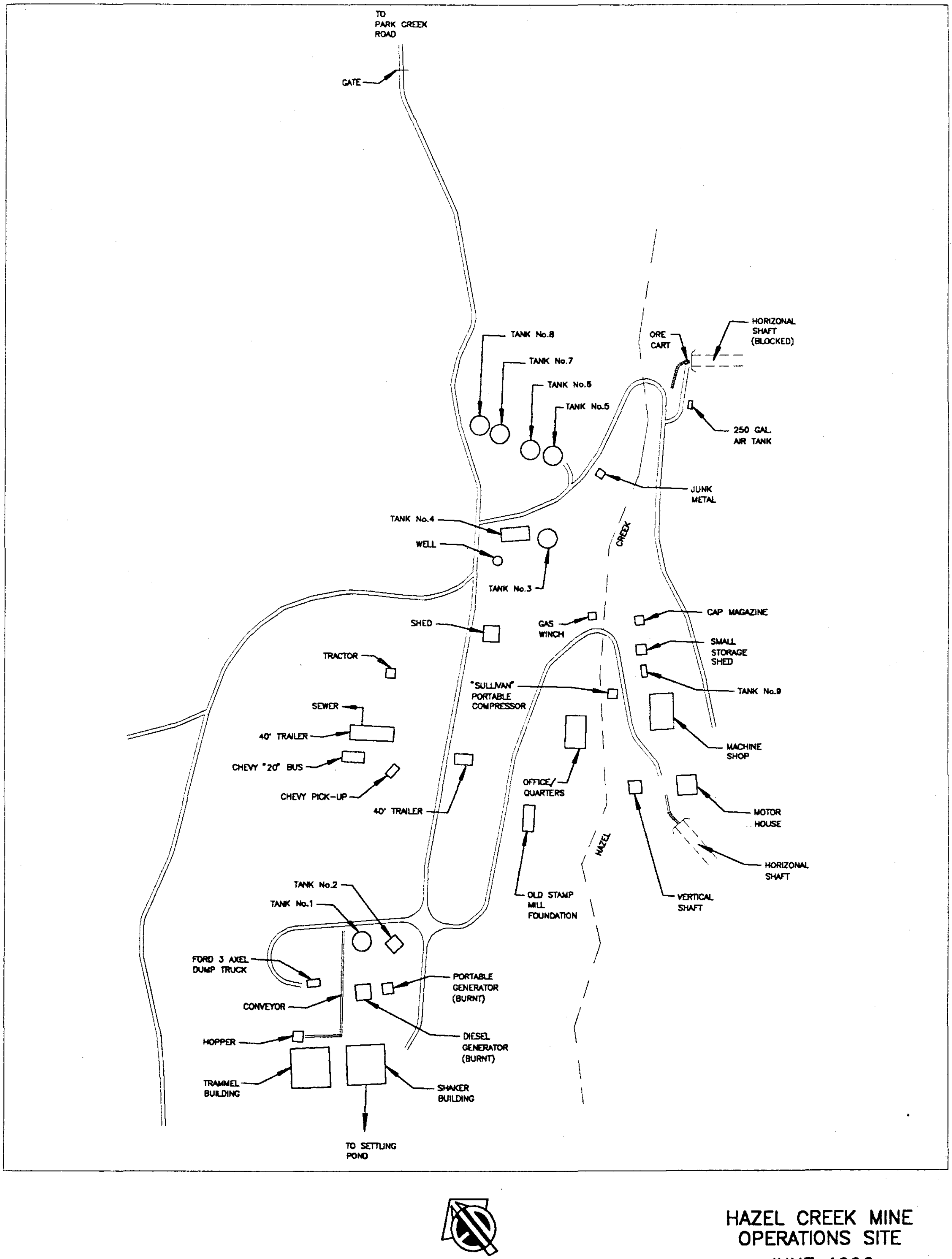
Management, and Greg Vaughn of the Regional Water Quality Control Board. The location of the mine site, relative to Jenkinson Lake is identified on Figure 3.5. A site map for the former operations of Hazel Creek Mine is provided on Figure 3.6. A copy of the tentative waste discharge requirements for mine closure is included in Appendix 8.

Damage to rivers, such as the Middle Fork Cosumnes, can also occur during suction dredge mining. Used by both recreational miners and commercial enterprises, this process implements a suction dredge which is floated on the water and a hose which sucks up water, sediment, small rocks, and gold. The primary damage to aquatic health is that of increased turbidity, as well as major damage to the bottom environment, as it is sucked clean. Occasionally, illegal activities, such as excavation into stream banks will cause additional damage, washing out large amounts of soil into the water. (California's Rivers, A Public Trust Report)



LOCATION MAP
HAZEL CREEK MINE
JUNE 1996
FIGURE 3.5

Scale: 1" = 2000'



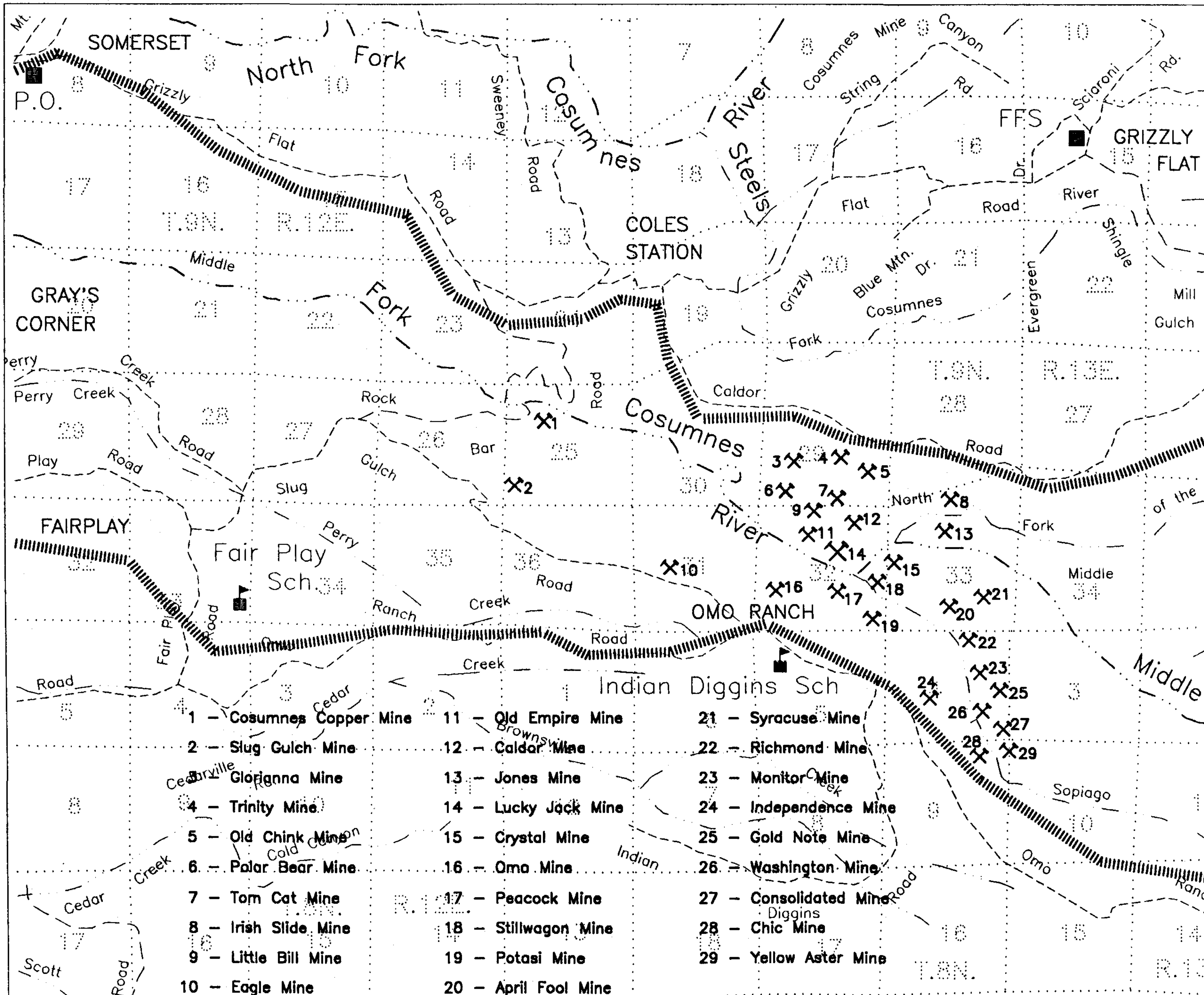
NOT TO SCALE

HAZEL CREEK MINE
OPERATIONS SITE
JUNE 1996
FIGURE 3.6

LEGEND

Drainage basin boundary
Water feature
Secondary roads
Mine location from U.S.G.S. map

NOT TO SCALE



ABANDONED MINE SITES
COSUMNES RIVER WATERSHED
JUNE 1996
FIGURE 3.7

Multiple locations of other abandoned mines in the Cosumnes River watershed that have been identified by the El Dorado National Forest Service and the USGS are provided in Figure 3.7.

H. Solid and Hazardous Waste

Although there are no designated community solid or hazardous waste disposal facilities located within the three subject watersheds, illegal dumping is a considerable problem in wilderness areas. Not only does random dumping occur along the roadways that lie near the water supplies, but specific dumping site "favorites" have been identified in several locations in all three watersheds. Currently there are no effective methods to control this illegal dumping. A concerted effort toward watershed management will necessarily include dump site clean-up and patrol.

Recreation use of waters is also associated with hazardous waste and the potential for contamination via petroleum product use in powerized boating. Small oil and fuel leakages could often go undetected, not only by the park attendants, but also by the boaters themselves. In a 1993 incident, a boat was left unattended in the lake after boating season had ended, and sunk during a heavy rain, releasing fuel to the water. This boat was removed from the water by Park officials, and the spill was remediated with the use of sorbent booms. Occasions of motor vehicles accidentally falling into Jenkinson Lake particularly at the boat docking area have also occurred at a frequency of one or two times per year.

Hazardous materials also have the potential to enter the watershed from spills that could occur on roadways. In addition to fuel spills, accidents from commercial trucking of hazardous materials have the potential to occur on the various roads which cross over or pass near the raw water supply. As populations increase in Northern California, so does vehicular traffic, in particular along the Highway 50 corridor. This increases the chances of spills from over-turned trucks, or other traffic-related accidents to occur.

CHAPTER 4

WATER QUALITY EVALUATION

This section contains a discussion of drinking water regulations and, most importantly, the results of District water quality monitoring as they relate to these regulations. The primary categories of evaluation for District Watersheds includes microbial water quality and turbidity, disinfection by-products, trace metals, and organic contaminants. In addition to water quality summary, the log-removal requirements as defined in the Regulations for each treatment facility are evaluated.

I. THE SURFACE WATER TREATMENT RULE

Microbiological water quality, typically determined by total coliform counts and turbidity are both addressed by one regulation, the Surface Water Treatment Rule (SWTR). The purpose of the SWTR is to protect the public health from waterborne disease outbreaks which are commonly transmitted by contaminated surface water. The SWTR, therefore, requires surface water suppliers to provide adequate treatment by removal and inactivation of microbiological contaminants as measured by coliform and turbidity testing. This is interpreted to mean that treatment must provide a minimum of 3-log (99.9 percent) *Giardia* cyst and 4-log (99.99 percent) virus removal/inactivation. However, the EPA Guidance Manual for Compliance with the Filtration and Disinfection requirements for Public Water Systems using surface water sources points out that, in some cases, source waters are subjected to significant influences which could increase bacteriological content, such as sewage discharge and recreational use, and that higher levels of virus and *Giardia* cyst removals may be required.

A. Microbial Water Quality

The U.S. Environmental Protection Agency (EPA) has provided the following criteria for treatment levels based on estimates of the *Giardia* cyst concentration in the source water, as listed on Table 4-1.

Table 4-1
EPA Treatment Level Criteria

Daily Aug. Cyst Giardia Concentration Per 100 mL (geometric mean)	Giardia Removal Inactivation Required	Virus Removal Inactivation Required
<1	3	4
1-10	4	5
>10-100	5	6

Recognizing that monitoring of source water for *Giardia* cysts and viruses is not generally reliable nor economically feasible for small utilities, the State of California (State) has made a series of assumptions and developed a set of criteria based on levels of total coliform concentrations in untreated water. Tables 4-2 and 4-3 summarize the treatment requirements for *Giardia* and viruses respectively, for varying levels of raw water total coliform concentrations. Frequency of raw water bacteriological monitoring for total coliform must take place two times per month at a minimum. In the event that a source water supply has been identified as having a greater *Giardia* hazard, *Giardia* monitoring of the source water may be required.

Table 4-2
Treatment Requirements for *Giardia* Cyst Reduction

Total Coliform monthly median (MPN/100 ml)	Log Reduction Treatment Requirements
<1000	3
1000 - 10,000	4
>10,000 - 100,000	5

Table 4-3
Treatment Requirements for Virus Reduction

Total coliform monthly median (MPN/100 ml)	Log Reduction Treatment
<1000	4
1000 - 10,000	5
>10,000 - 100,000	6

The treatment requirements established by the State in the tables above can be met by combining the log removal and log inactivation. Removal is achieved through filtration and inactivation is achieved through disinfection. A minimum of 0.5-log *Giardia* and 2-log Virus inactivation must be achieved through disinfection alone.

The effectiveness of a filtration technology is judged by turbidity reduction performance. Depending on which filtration technology is used, a different level of performance, defined as turbidity removal, is required. For example, treatment plants using conventional filtration must meet a treated water turbidity of 0.5 NTU in 95 percent of the samples taken. Such a facility is assumed to remove 2.5 logs of Giardia and 2 logs of viruses, as described in the Guidance Manual for compliance with Filtration and Disinfection Requirements (AWWA, 1990).

The balance of treatment needed to meet the specified log reduction must be achieved by inactivation (disinfection) as measured by CT (the product of the residual disinfectant and contact time). Tables presented in the EPA Guidance Manual specify the CT (the product of the residual disinfectant and contact time) necessary to achieve the level of inactivation desired. CT values vary based on the disinfectant used, the temperature, and the pH of the water. Copies of the tables which relate to disinfection by free chlorine (the disinfectant in use by EID) are included in Appendix 9.

The State SWTR also specifies that a water treatment plant must meet a detailed set of design, operating, and reliability criteria to ensure that high quality, dependable treatment is provided. If a utility were to disagree with the degree of treatment required, regulations allow for the opportunity to monitor microbial concentration in order to accurately document the level of risk associated with the water supply source.

B. Turbidity

Turbidity is a measure of the clarity of the water. It is caused by suspended matter in the water such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and plankton or other microscopic organisms. Turbidity is of concern in drinking water because it can reduce the efficiency of a disinfectant by shielding microorganisms. It is used as a surrogate measure of potential pathogens and for effectiveness of filtration performance.

If a water supply is treated by conventional filtration, direct filtration, or diatomaceous earth filtration, the State SWTR requires the turbidity level of the filtered water to be equal to or less than 0.5 NTU in 95 percent of the measurements taken each month and to never exceed 5.0 NTU at any time. No turbidity requirements are specified for the raw water supply unless avoidance of filtration is desired.

C. Water Quality And Sampling

To meet the requirements of the SWTR, a water supplier must comply with Maximum Contaminant Level Goals (MCLGs) for *Giardia*, viruses, *Legionella*, Heterotrophic Plate Count (HPC), or coliforms, and also meet a turbidity treatment level. Meeting the turbidity treatment level is equivalent to meeting the MCL, which is defined as the maximum permissible level of a contaminant in water, or the minimum treatment for water delivered to any user of a public water system. MCLG is defined as the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLG's are non-enforceable health goals. Table 4-4 lists the current MCLGs, MCLs, or treatment levels required for microbiological water quality constituents and turbidity.

Table 4-4
Treated Water Criteria
Microbiology and Turbidity

Constituent	MCL/MCLG	Treatment objective
Giardia	zero	3-log
Viruses	zero	removal/inactivation[a]
Legionella	zero	4-log
Total Coliform	absent	removal/inactivation[a]
Turbidity, NTU HPC Bacteria/ml	5 NTU --[b]	0.5[c] <500[d]

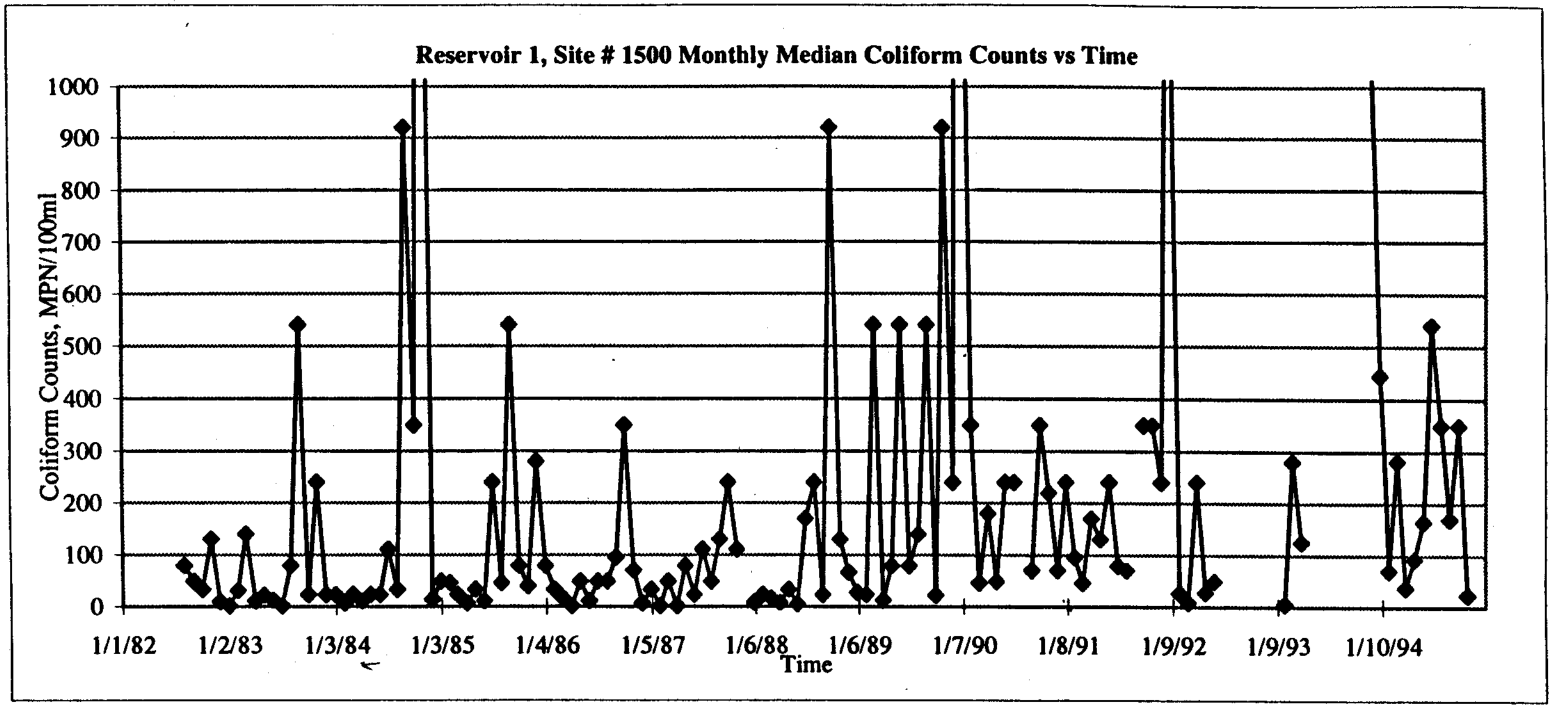
[a]Minimum treatment required for all surface water supplies.
[b]No numeric value set.
[c]Treatment levels to be achieved in 95 percent of samples.
[d] In distribution system, if no disinfection residual can be measured, substitute HPC analyses.

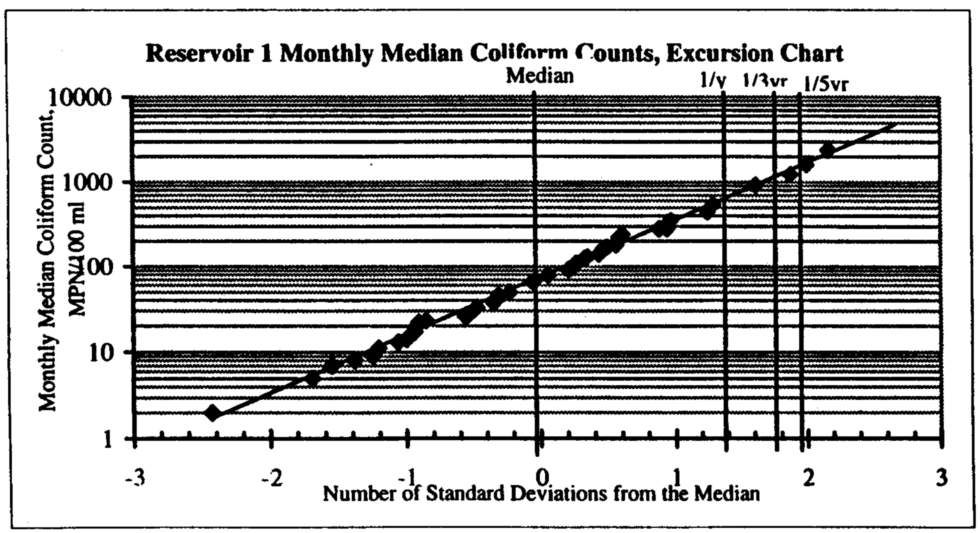
1. EL DORADO CANAL WATERSHED

The SWTR specifies that source water samples for total coliform be collected at locations just prior to the point of treatment where the water is no longer subject to surface runoff. In the case of the El Dorado Canal Watershed, this point is necessarily the intake structure in the ditch located at Reservoir One WTP.

EID began collecting total and fecal coliform data on a monthly basis at Forebay Reservoir in 1982. The location was changed to the plant intake and the frequency to two times per month in 1994. No sampling for *Giardia* or viruses has been conducted on Reservoir One source water.

Raw water coliform and turbidity data were plotted against time to identify seasonal trends. In addition, statistical analyses were performed to produce a log-normal distribution chart and to forecast a yearly high, a one-in-three-year high and one-in-five-year high total





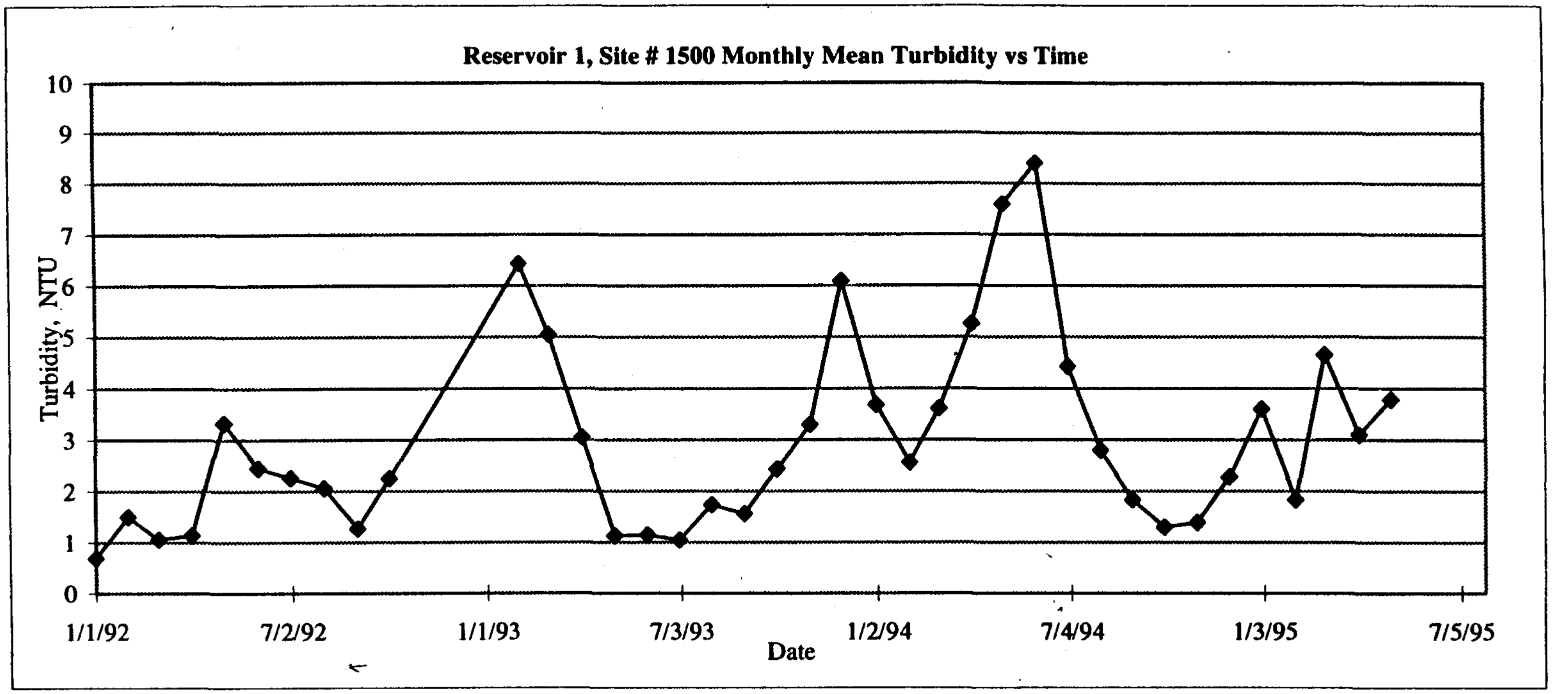
Analysis Results

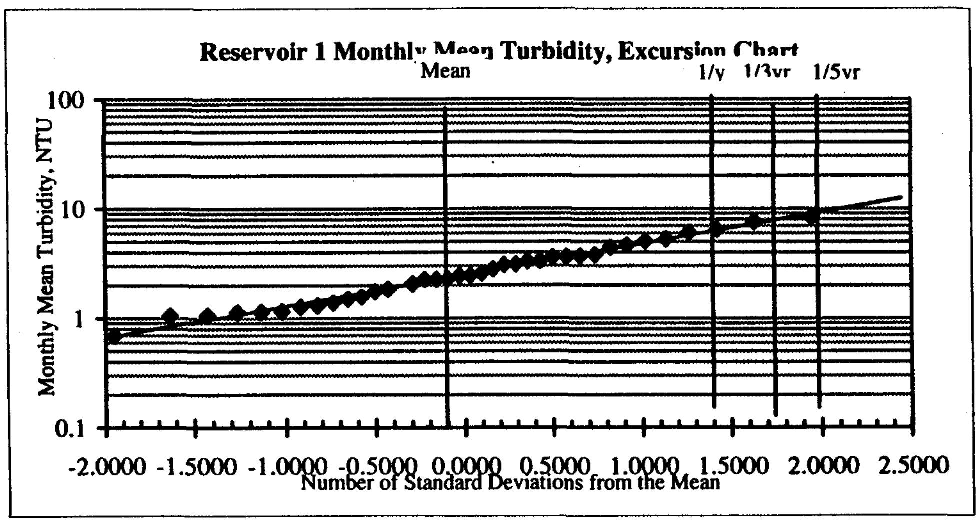
Analyte: Total Coliform
Location: Reservoir 1
Record Size: 132
Frequency: Monthly

Excursion Frequency:

Median	70
1/yr	585
1/3yr	1217
1/5yr	1588

Figure 4.1 Site 1500, Reservoir 1, Monthly Median Total Coliform Counts





Analysis Results

Analyte: Total Turbidity
Location: Reservoir 1
Record Size: 38
Frequency: Monthly

<u>Excursion Frequency:</u>

Mean	2.44
1/yr	5.90
1/3yr	7.91
1/5yr	8.80

Figure 4.2 Site 1500, Reservoir 1, Monthly Mean Turbidity Values

coliform counts and turbidity levels. Figures 4.1 and 4.2 (Brown and Caldwell, 1995) present the results of the data analyses. The Figure 4-1 Monthly Median Total Coliform Counts versus Time, indicates that coliform counts increase mostly in the fall and winter months (September to March) with more moderate fluctuations occurring throughout the rest of the year. The statistical analyses indicate that total coliform counts in Reservoir One occur at a median concentration of 70 MPN/100 mL and during any given 12-month period can expect to rise to approximately 585 MPN/100 mLs. In any given 36-month period, total coliform counts may rise to a one time high of 1217 MPN/100 mLs, and in any given 60 month period coliform counts may peak at 1588 MPN/100 mLs.

Raw water turbidity data from January of 1992 through June 1995 were reviewed and are presented on Figure 4.2 where Monthly Mean Turbidity values are plotted against time. Source supply turbidities are generally low with peaks exceeding 5 NTU associated with rain events. During storm events, turbidities can reach 20 to 30 NTU.

2. JENKINSON LAKE WATERSHED

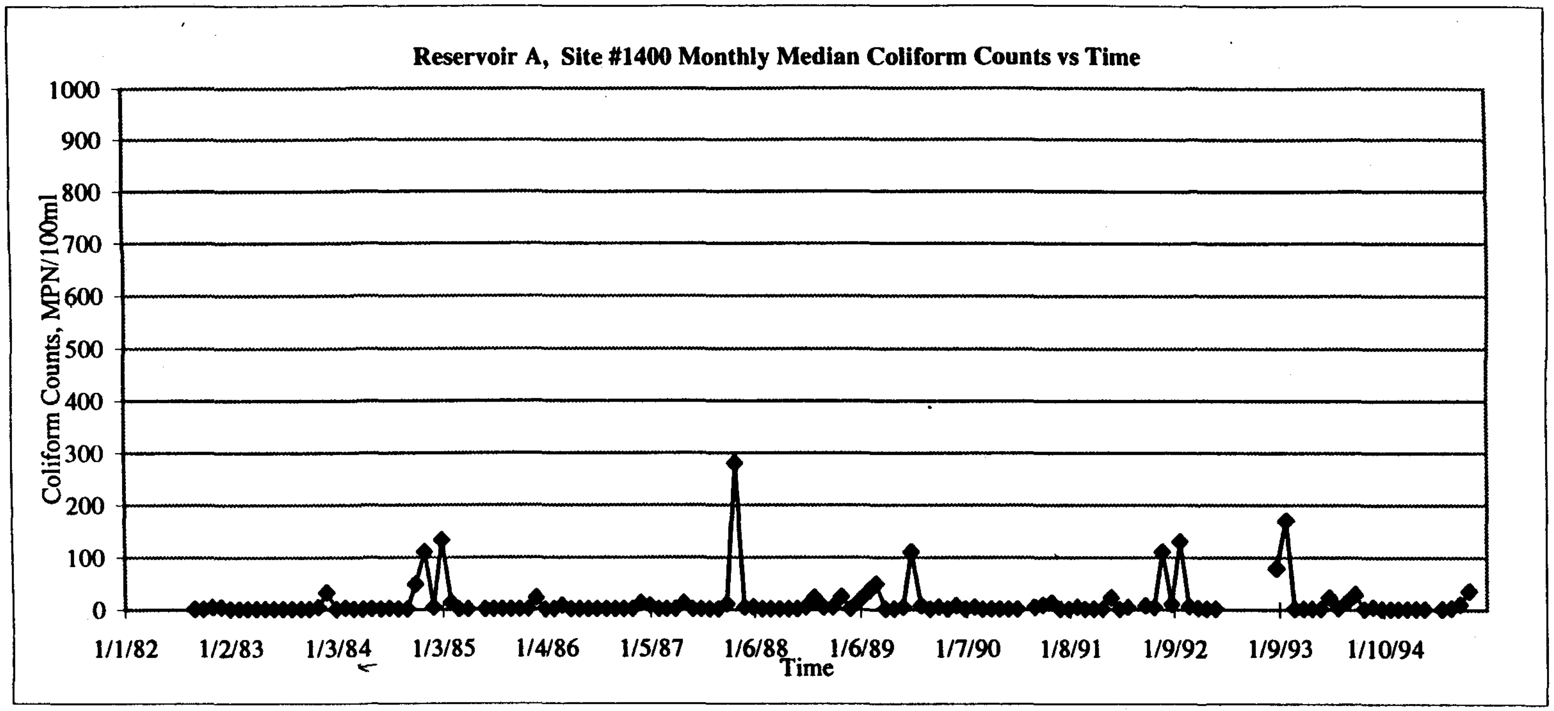
The raw water sampling location for the Reservoir A WTP is located at the end of a 48-inch diameter pipeline which brings Jenkinson Lake water about two miles to the water treatment plant. EID has been collecting Reservoir A WTP total and fecal coliform data on a monthly basis since 1982 and twice per month since 1994. No sampling for *Giardia* or viruses has been conducted on the Jenkinson Lake supply.

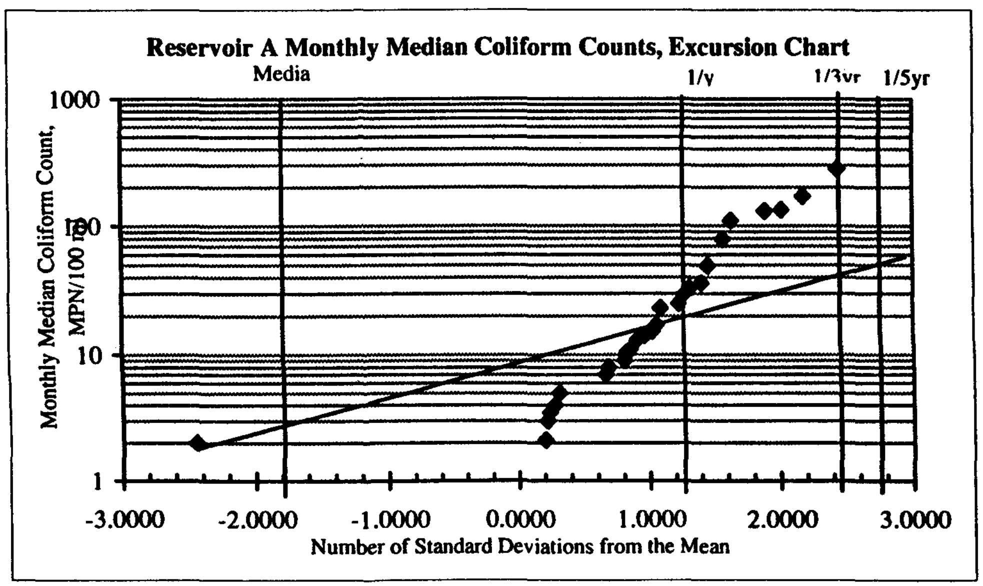
The slide gate is controlled from the level in the finished water reservoir immediately downstream of the Reservoir A WTP, with allowable high and low alarm/shutdown values selected on a daily basis by the operator in response to anticipated system demands. Plant staff reports that fluctuations in the operation of the slide gate are caused by the system configuration and variable demands downstream from the Reservoir A WTP. There is concern that this may cause unreasonable wear on the slide gate and possible early failure.

In addition, the control signal to the Sly Park Dam slide gate has experienced interruption-type failures (false signals) that cause the slide gate to go to the full-open position. When these events take place, a large sudden increase in pipeline flow occurs causing residue on the pipeline to break loose and deposit onto the filter beds. These episodes have caused almost immediate blinding of the filters, which result in plant shutdown.

Raw water coliform and turbidity data were plotted against time to identify seasonal trends. In addition, statistical analyses were performed to produce a log-normal distribution chart and to forecast a yearly high, a one-in-three-year high and one-in-five-year high total coliform counts and turbidity levels. Figures 4.3 and 4.4 (Brown and Caldwell, 1995) present the results of the data analyses. Figure 4.3, Monthly Median Total Coliform Counts versus Time plot, rises in coliform counts which occur mostly in the winter months (December through February) with moderate fluctuations and spikes occurring a few times during other months. The statistical analyses indicate that total coliform counts are extremely low and occur at a median concentration of 2 MPN/100 mL and during any given 12-month period can expect to rise to approximately 24 MPN/100 mLs. In any given 36-month period, total coliform counts may rise to a one time high of 43 MPN/100 mLs, and in any given 60-month period coliform counts may peak at 53 MPN/100 mLs.

Raw water turbidity data from January of 1992 through June 1995 were reviewed and are presented on Figure 4.4 where monthly mean turbidity values are plotted against time. Turbidities are low with only one peak exceeding 5 NTU during the period analyzed. It appears that for the majority of the time, even during periodic turbidity increases, the turbidity stays below 2.5 NTU and averages about 1.2 NTU.





Analysis Results

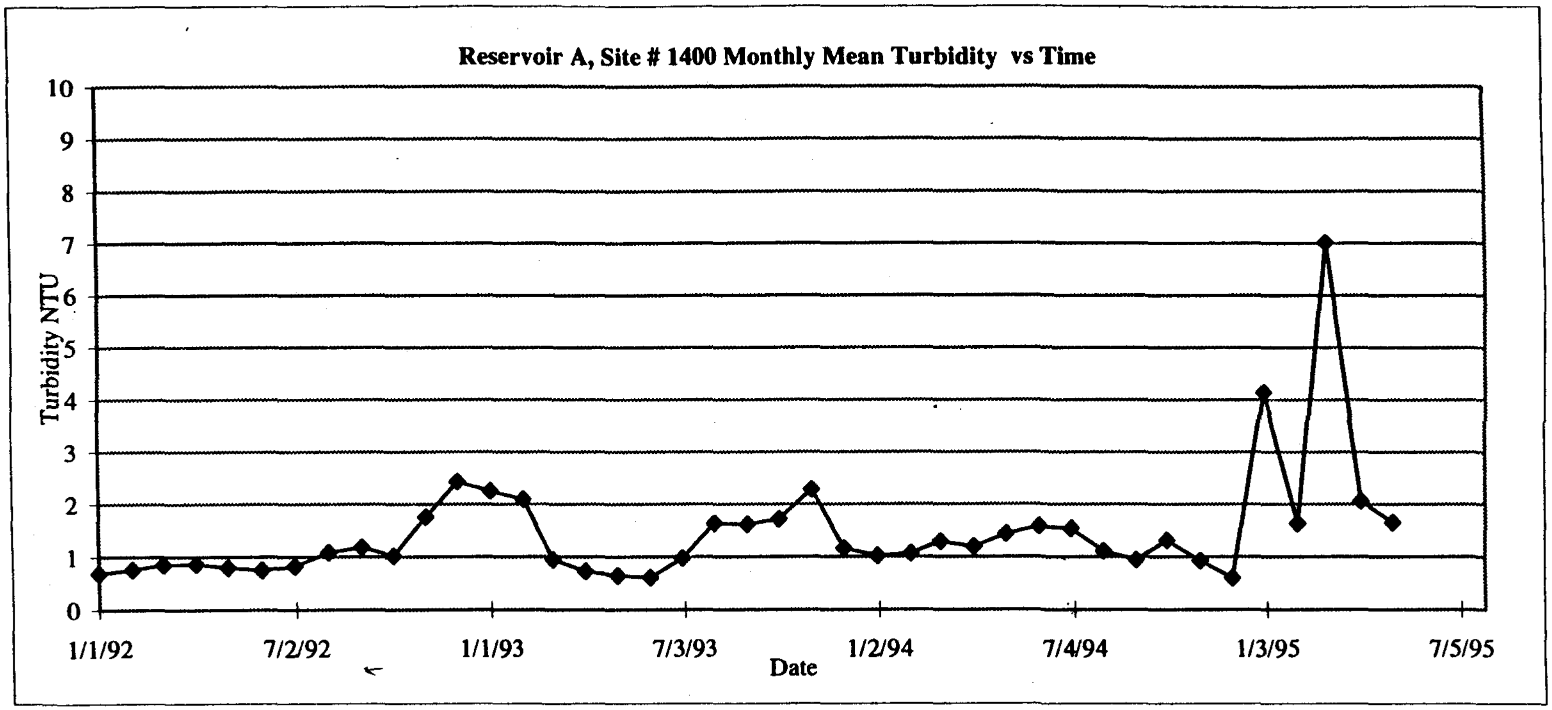
Analyte: Total Coliform

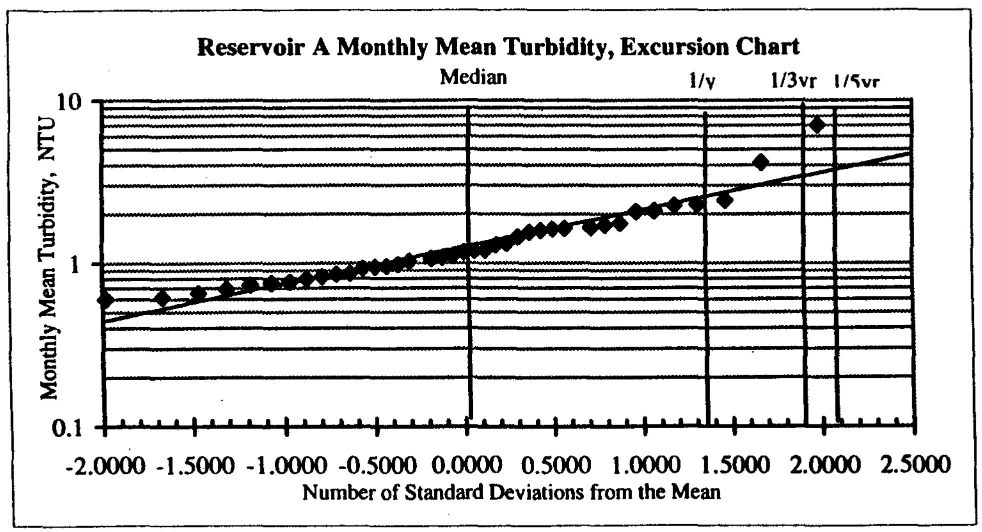
Location: Reservoir A
Record Size: 138
Frequency: Monthly

Excursion Frequency:

Median	2
1/yr	24
1/3yr	43
1/5yr	53

Figure 4.3 Site 1400, Reservoir A, Monthly Median Total Coliform Counts





Analysis Results

Analyte: Total Turbidity
Location: Reservoir A
Record Size: 41
Frequency: Monthly

<u>Excursion Frequency:</u>

Mean	1.16
1/yr	2.57
1/3yr	3.28
1/5yr	3.58

Figure 4.4 Site 1400, Reservoir A, Monthly Mean Turbidity Values

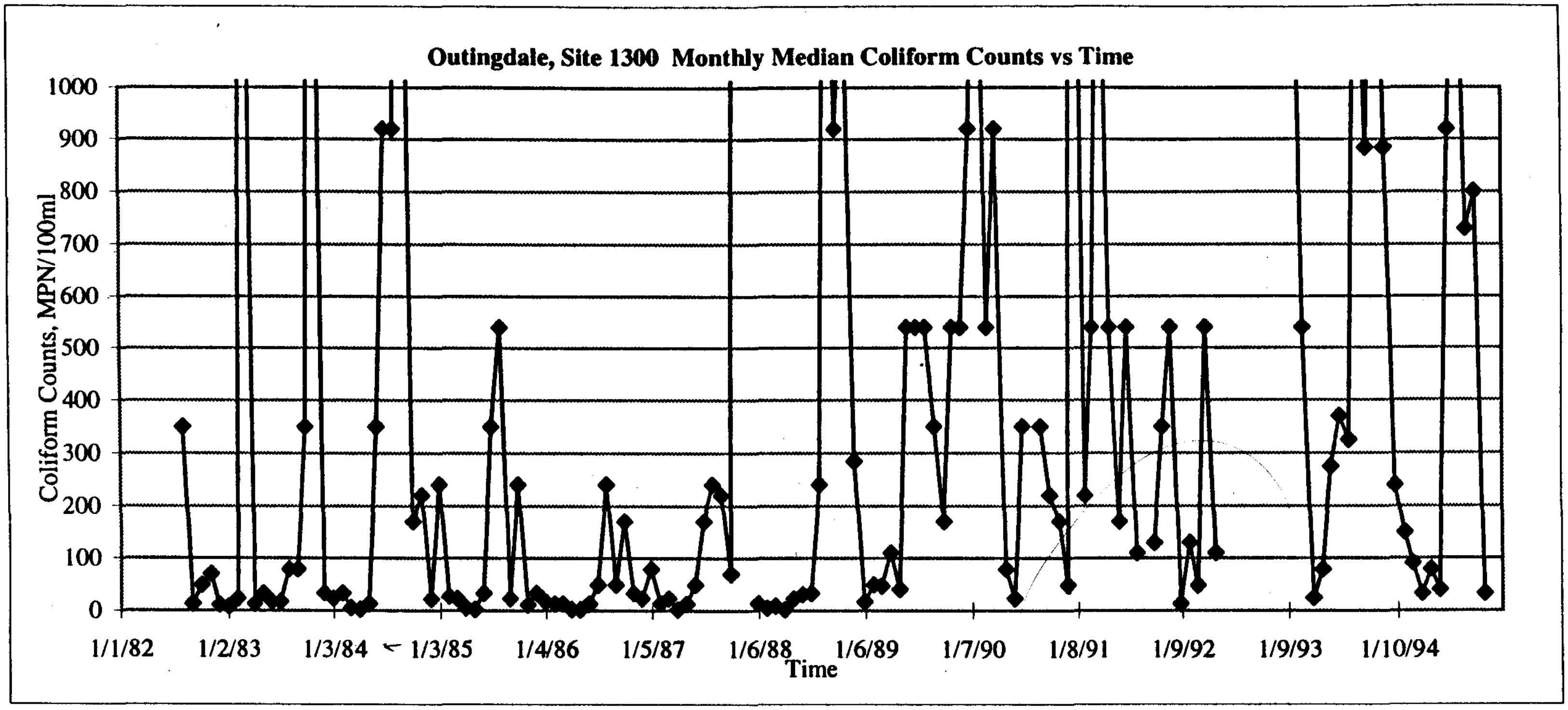
3. MIDDLE FORK COSUMNES WATERSHED

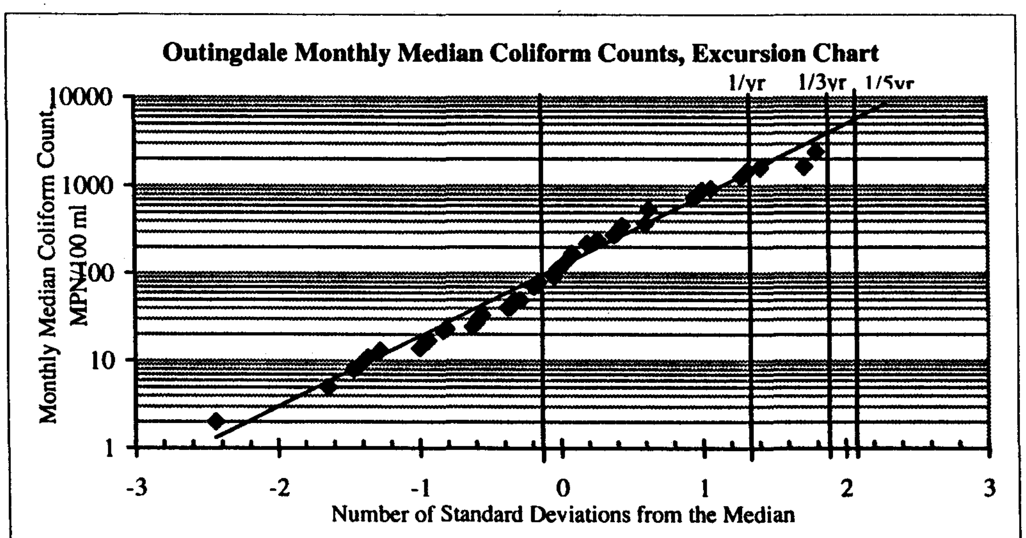
The EID Outingdale Water Treatment Plant (WTP) raw water sampling location at the water treatment facility, at the end of the supply pipeline about 1/4 mile long which brings water from the pump house at the Middle Fork Cosumnes. Water is drawn from the river by a 10-HP pump via flex hose. EID has been collecting total and fecal coliform data on a monthly basis at the Outingdale WTP since 1982 and two times per month since 1994. No sampling for *Giardia* or viruses has been conducted on the Middle Fork Cosumnes water supply.

Raw water coliform and turbidity data were plotted against time to identify seasonal trends. In addition, statistical analyses were performed to produce a log-normal distribution chart and to forecast a yearly high, a one-in-three-year high and one-in-five-year high total coliform counts and turbidity levels. Figures 4.5 and 4.6 (Brown and Caldwell, 1995) present the results of the data analyses. Figure 4.5, Monthly Median Total Coliform Counts versus Time, plots shows spikes occurring throughout the year with the highest excursions occurring during the fall and winter months (September through March). The fluctuation of total coliform counts seen in this plot is expected of a river water source where water quality can vary more quickly than a lake or reservoir source. The water quality of rivers also is more sensitive to activities within or adjacent to them.

The statistical analyses indicate that total coliform counts in the Outingdale WTP raw water occur at a median concentration of 110 MPN/100 mL and during any given 12-month period can expect to rise to approximately 1,384 MPN/100 mLs. In any given 36-month period, total coliform counts may rise to a one time high of 3,325 MPN/100 mLs, and in any given 60 month period coliform counts may peak at 4,572 MPN/100 mLs.

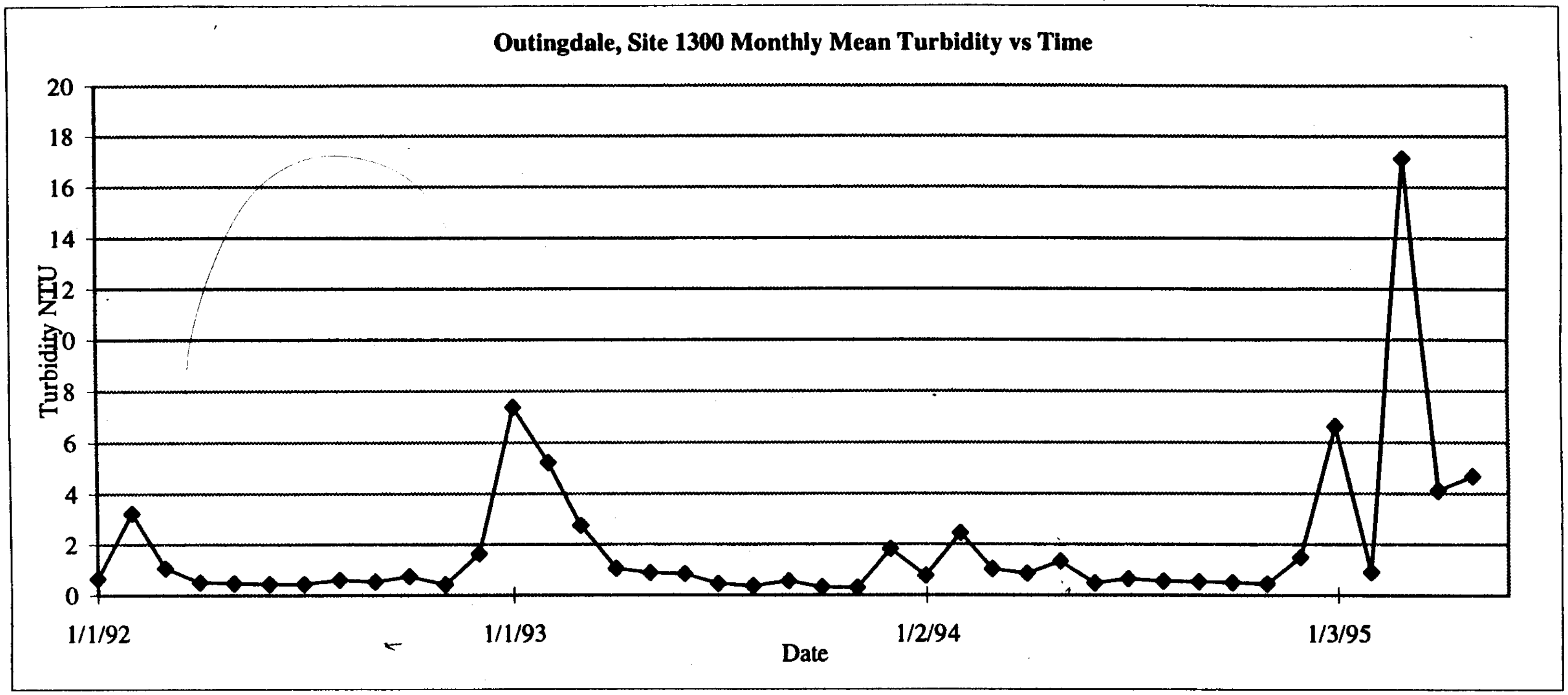
Raw water turbidity data from January of 1992 through June 1995 were reviewed and are presented on Figure 5.6 where monthly mean turbidity values are plotted against time. Turbidities are generally low with peaks exceeding 2 NTU associated with rain events. During storm events, turbidities can reach 10 to 18 NTU.

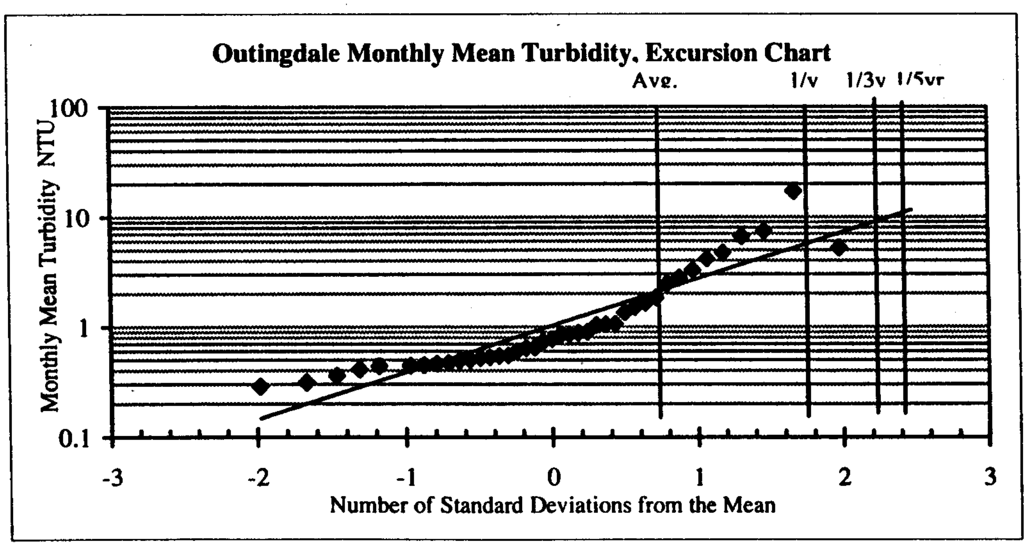




Analysis Results	
Analyte: Total Coliform	
Location: Outingdale	
Record Size: 139	
Frequency: Monthly	
Excursion Frequency:	
Median	110
1/yr	1384
1/3yr	3325
1/5yr	4572

Figure 4.5 Site 1300, Outingdale WTP, Monthly Median Total Coliform Counts





Analysis Results

Analyte: Total Turbidity
Location: Outingdale
Record Size: 41
Frequency: Monthly

Excursion Frequency:

Mean	0.77
1/yr	4.07
1/3yr	6.50
1/5yr	7.71

Figure 4.6 **Site 1300, Outingdale WTP, Monthly Mean Turbidity Values**

II. DISINFECTION BY-PRODUCTS RULE

EPA is in the process of drafting a Disinfection By-Product (DBP) rule. This section includes a review of the requirements and discussion of EID system compliance for DBPs.

Disinfection by-products are not intentionally introduced to the water supply, rather they are formed as a result of the reaction of natural organic matter with disinfectants. Generally, the longer the disinfectant stays in contact with organic matter, the more DBPs are formed. Natural organic matter (NOM) which is the source of precursors for DBP formation, has many origins including algae; organic soil and sediments; vegetation; crops; and animal waste. Factors influencing DBP formation include the concentration of natural organic matter, chlorine dose and residual, temperature, pH, and halide ion concentration.

The trihalomethane (THM) group of chlorinated organics which includes chloroform, dichlorobromomethane, chlorodibromomethane and bromoform, is the only group of disinfection by-products that are regulated at the present. The EPA MCL for THMs is 100 micrograms per liter (ppb), but is expected to drop to 60 ug/L in the near future.

Reductions in MCLs for total THM, as well as new MCLs for some individual disinfection by-products, were proposed in 1994 upon completion of the regulatory negotiations (Reg-Neg) process for Disinfectants/Disinfection By-products (D/DBPs). The objective of the Reg-Neg process was to develop a D/DBP regulation which balanced the relative risk of other disinfection by-products, and the relative risk of disease from improperly disinfected water. Under the proposed D/DBP Rule, MCLs will be developed in two stages. Stage One proposed MCLs are presented in Table 4-5.

Table 4-5
MCLS In Proposed D/DBP Rule

DBP Regulated	MCL
Stage One	
Total Trihalomethanes	80 μg/L
Haloacetic Acids (sum of 5)	60 μg/L
Bromate	10 μg/L
Chlorite	1.0 mg/L
Stage Two	
TTHMs	40 μg/L
HAA	30 μg/L

Stage One is tentatively schedule to be promulgated in late 1996 and Stage Two in 2002. Stage Two MCLs will be subject to a second round of regulatory negotiations and be based on further research.

The El Dorado Irrigation District began testing for THMs in 1981. An initial survey conducted at that time was repeated in 1985, and was submitted to the State Department of Health Services (DOHS). In 1991, the DOHS began the requirement of quarterly monitoring of the water samples which were to be collected from strategic locations throughout the distribution system. Because the amount of time that chlorine is in contact with NOMs is critical to the quanity of THMs formed, greater by-product concentrations are expected to be found at the ends of the distribution system. The intent of sample location siting, then, is to achieve information regarding the DBPs that are formed at various locations along the system.

TRIHALOMETHANE MONITORING RESULTS; 1995

TABLE 4-6

THM LOCATION	THM NO.	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1995 Avg
Reservoir A Ice House	THM0112	43	30	17	33	30.8
Fresh Pond	THM0213	66	46	30	41	45.8
Sportsman's Pump Station	THM0313	56	37	22	31	36.5
Reservoir 2	THM0410	46	38	19	33	34.0
Reservoir 2A	THM0510	49	27	22	34	33.0
Reservoir 3	THM0608	48	43	20	26	34.3
Reservoir 4	THM0708	26	41	21	26	28.5
Reservoir 5, EDM 1	THM0803	34	38	28	30	32.5
Reservoir 5, EDM 2	THM0903	24	52	20	31	31.8
Coloma Site, M3B	THM1013	33	57	13	71	43.5
2850 Cameron Park Rd.	THM1104	59	48	20	53	45.0
3548 Orinda Cir., C.P.	THM1204	27	41	18	17	25.8
EDH Water Plant	THM1302	37	54	20	57	42.0
4483 Golden Parkway	THM1402	40	65	32	72	52.3
5133 Center Oak	THM1505	73	68	44	92	69.3
5771 Pleasant Valley Rd	THM1607	50	50	24	71	48.8
7880 Barite	THM1706	81	64	32	59	59.0
Reservoir 8	THM1807	49	54	24	35	40.5
4741 Hank's Exchange Rd	THM 1911	49	53	23	41	41.5
Reservoir 7	THM2011					51.0
	Average:	46.8	47.7	23.6	44.9	41.3

Quarterly monitoring locations for the District system are identified on Figure 4.7. Results of District monitoring indicates that the average trihalomethane concentration for the entire system is 41.3 parts per billion (EID, 1995). The highest concentrations are found at THM monitoring site 1505, which is the location farthest from Reservoir A Treatment Plant, indicated as #17 on Figure 4.7. Based on this information, the District is in compliance with the current THM limit of 100 parts per billion (ug1L). If the 1995 average remains representative, routine compliance should continue when the limit is lowered to 60 ug1L. If the regulatory level were to drop to 40 ug1L, system treatment improvements and/or regulatory waivers will need to be implemented. Table 4-6 provides quarterly monitoring results for 1995.

III. ENHANCED SURFACE WATER TREATMENT RULE

The Enhanced Surface Water Treatment Rule presently being developed by EPA may in the future require a certain percent removal of total organic carbon (TOC) through enhanced coagulation. TOC is used as a surrogate for measuring the amount of natural organic matter (NOM) in a water source. Enhanced coagulation is the process of optimizing the sedimentation and filtration stages of water treatment to maximize TOC removal. By reducing the TOC concentration, disinfection by-product concentrations in the finished water should also be reduced. The percent removal is a function of the source water TOC concentration and the alkalinity of the water as specified in Table 4-7.

Table 4-7
TOC Removal Under the Enhanced SWTR

Source Water TOC mg/L	Source Water Alkalinity (mg/L)		
	0 - 60	>60 - 120	>120
0 - 4	40%	30%	20%
>4 - 8	45%	35%	25%
>8	50%	40%	30%

To avoid having to implement enhanced coagulation, certain criteria must apply both to the raw water supply, as well as to the treated water quality.

- Raw water TOC <2.0 mg/L
- Treated water TOC <2.0 mg/L
- Treated Water Alkalinity >60 mg/L
- Treated Water TTHM/HAAs <40/30 ug/L with Cl_2 disinfection.

The following table shows the limited raw water TOC data gathered for the District Watersheds:

Table 4-8
TOC Data in District Watersheds

Source Water	Sample Date	TOC (mg/L
El Dorado Canal	1/19/94	3.1
	10/24/94	1.6
Jenkinson Lake	1/19/94	3.1
	10/24/94	2.0
Middle Fork	8/3/93	3
Cosumnes	10/24/94	1.2

The TOC data listed on Table 4-8 for District Watersheds is too sparse to draw conclusions regarding the need for Enhanced Coagulation. Although these preliminary numbers imply that the District will meet TOC requirements, additional data will be necessary before the source water can be classified as having a TOC less than 4 mg/L.

IV. TRACE METALS AND ORGANICS

The EPA and California State Title 22 Drinking Water Standards MCLs for Trace Metals and Organics as compared to levels found in District watersheds are shown in Table 4-9 (Brown & Caldwell, 1995). Presented in Table 4-10 the detectable General Chemical and Metals data for Reservoir One. Review of EID metals and organics data indicates that there have been no excursions from trace metal MCLs and organics. Therefore, no assessment of contaminant loading is applicable.

Although the District has never exceeded on MCL or MCLG for these constituents on any of the samples that have been collected, all three watersheds have the potential for trace metal and organic pesticide contamination. This is based on high levels of iron and manganese in area geology as well as on abandoned mines, logging, small farming, and other land uses. In addition, stormwater contribution from roadways frequently includes contaminants such as cadmium, chromium, nickel and copper. As the population increases in El Dorado and surrounding counties, the impact of these stormwater toxics can be expected to increase.

Agricultural activity which could be a source of organic chemical contamination includes fruit and Christmas tree farming as well as timber harvest. These activities are located along all three District watersheds. However, organic chemicals have not been detected in any of the synthetic organic monitoring sessions conducted by EID, with the exception of Dalapon. This herbicide was tentatively identified in the EDCWS at a concentration below the laboratory minimum detection limit. The sources of potential contamination have been more completely discussed in Chapter 3 of this document.

Table 4-9 Trace Metal and Organic Maximum Contaminant Levels and District Exceedances

	Primary Standards[a]			
Contaminants	Federal Maximum Contaminant Level (MCL)	Federal Maximum Contaminant Level Goal (MCLG)[b]	California MCL[c]	Exceedances
Aluminum	--	--	1	None
Antimony	0.006[d]	0.006	--	None
Arsenic	0.05[e]	--	--	None
Barium	2[g]	2	--	None
Beryllium	0.004[d]	0.004	--	None
Cadmium	0.005[f]	0.005	--	None
Chromium	0.1[f]	0.1	--	None
Copper	treatment techniques[h]	1.3	--	None
Cyanide	0.2[d]	0.2	--	None
Fluoride	4[i]	4	1.4-2.4	None
Lead	treatment techniques[h]	0	--	None
Mercury	0.002[f]	0.002	--	None
Nickel	0.1[d]	0.1	--	None
Selenium	0.05[f]	0.05	--	None
Thallium	0.002[d]	0.0005	--	None
2,3,7,8-TCDD (Dioxin)	0.00000003[d]	0	--	None
2,4-D	0.07[f]	0.07	--	None
2,4,5-TP (Silvex)	0.05[f]	0.05	--	None
Acrylamid	treatment techniques[f]	0	--	None
Adipates	0.4[d]	0.4	--	None
Alachlor	0.002[f]	0	--	None
Aldicarb	0.003[g,j]	0.001	--	None
Aldicarb sulfoxide	0.004[g,j]	0.001	--	None
Aldicarb sulfone	0.004[g,j]	0.001	--	None
Atrazine	0.003[f]	0.003	0.003	None
Bentazon	--	--	0.018	None
Benzo (a) pyrene	0.0002[d]	0	--	None
Bromodichloromethane	0.1 as TTHM[k]	0	--	None
Bromoform	0.1 as TTHM[k]	0	--	None
Carbofuran	0.04[f]	0.04	0.018	None
Chlordane	0.002[f]	0	0.0001	None
Chloroform	0.1 as TTHM[k]	0	--	None
Dalapon	0.2[d]	0.2	--	None
Dibromochloromethane	0.1 as TTHM[k]	0	--	None
Dibromochloropropane (DBCP)	0.0002[f]	0	0.0002	None

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Table 4-9 Trace Metal and Organic Maximum Contaminant Levels and District Exceedances

Contaminants	Primary Standards[a] Federal Maximum Contaminant Level (MCL)	Federal Maximum Contaminant Level Goal (MCLG)[b]	California MCL[c]	Exceedances
Dinoseb	0.007[d]	0.007	--	None
Diquat	0.02[d]	0.02	--	None
Endothall	0.1[d]	0.1	--	None
Endrin	0.002[d]	0.002	--	None
Epichlorohydrin	treatment techniques[f]	0	--	None
Ethylene dibromide(EDB)	0.00005[f]	0	0.00002	None
Glyphosate	0.7[d]	0.7	0.7	None
Heptachlor epoxide	0.0002	0	0.00001	None
Heptachlor	0.0004[f]	0	0.00001	None
Hexachlorobenzene	0.001[d]	0	--	None
Hexachlorocyclopentadiene	0.05[d]	0.05	--	None
Lindane	0.0002[f]	0.0002	--	None
Methoxychlor	0.04[f]	0.04	--	None
Molinate	--	--	0.02	None
Oxamyl (Vydate)	0.2[d]	0.2	--	None
PCBs	0.0005[f]	0	--	None
Pentachlorophenol	0.001[g]	0	--	None
Phthalates	0.006[d]	0	0.004	None
Picloram	0.5[d]	0.5	--	None
Polynuclear aromatic hydrocarbons	0.0002[d]	0	--	None
Simazine	0.004[d]	0.004	0.01	None
Thiobencarb	--	--	0.07	None
Toxaphene	0.005[f]	0	--	None
1,1-Dichloroethane	--	--	0.005	None
1,1-Dichloroethylene (DCE)	0.007[i]	0.007	0.006	None
1,1,1-Trichloroethane (TCA)	0.20[i]	0.2	0.2	None
1,1,2-Trichloro, 1,2,2-Trifloroethan	--	--	1.2	None
1,1,2-Trichloroethane	0.005[d]	0.003	0.032	None
1,1,2,2-Tetrachloroethane	--	--	0.001	None
1,2-Dichloroethane	0.005[i]	0	0.0005	None
1,2-Dichloropropane	0.005[f]	0	0.005	None
1,2,4-Trichlorobenzene	0.07[d]	0.07	--	None
1,3-Dichloropropene	--	--	0.0005	None
Benzene	0.005[i]	0	0.001	None
Carbontetrachloride	0.005[i]	0	0.0005	None
cis-1,2-Dichloroethylene	0.07[f]	0.07	0.006	None
Dichloromethane (methylene chlori	0.005[d]	0	--	None

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Table 4-9 Trace Metal and Organic Maximum Contaminant Levels and District Exceedances

	Primary Standards[a]			
Contaminants	Federal Maximum Contaminant Level (MCL)	Federal Maximum Contaminant Level Goal (MCLG)[b]	California MCL[c]	Exceedances
Ethylbenzene	0.7[f]	0.7	0.68	None
Monochlorobenzene	0.1[f]	0.1	0.03	None
o-Dichlorobenzene	0.6[f]	0.6	--	None
p-Dichlorobenzene	0.075[l]	0.075	0.005	None
Styrene	0.1[f]	0.1	--	None
Tetrachloroethylene(PCE)	0.005[f]	0	0.005	None
Toluene	1[f]	1	--	None
trans-1,2-Dichloroethylene	0.1[f]	0.1	0.01	None
Trichloroethylene (TCE)	0.005[l]	0	0.005	None
Trichlorofluoromethane	--	--	0.15	None
Vinyl chloride	0.002[l]	0	0.0005	None
Xylenes (total)	10[f]	10	1.75	None

[a]All standards are presented as mg/L unless otherwise specified.

[b]Date and status of MCLG are the same as MCL, since they are required to be proposed together and promulgated together.

[c]Represents all standards set by California DHS since 1986 either in response to EPA regulations or independently. DHS had previously adopted all pre-1986 interim standards.

[d]Phase V, 23 contaminants, July 17, 1992. (57 FR 31776)

[e]Interim Standard, proposal anticipated November 1995.

[f]Phase II, initial 33 contaminants, January 20, 1991. (56 FR 3526)

[g]Phase II, subsequent 5 contaminants, July 1, 1991. (56 FR 30266)

[h]Lead and Copper Rule, June 7, 1991. (56 FR 26460). Corrections July 15, 1991. (56 FR 32112), June 29, 1992. (57 FR 28785), June 30, 1994 (59 FR 33860).

[i]A revised federal standard for fluoride was promulgated on April 2, 1986. (51 FR 11396)

[j]Effective date postponed, MCL's challenged. (57 FR 22178). Proposal of revised MCLs expected in 1995

[k]Interim Standard, a proposal for disinfectants and their by-products published in July 1994, including a reproposal for THM's.

[l]Phase I, July 8, 1987. (52 FR 25690). Correction July 1, 1988. (53 FR 25108). Technical amendments published July 1, 1994. (59 FR 34320).

Note: These footnotes apply to the schedule for promulgation of federal standards.
The State of California is given 18 months from the date an MCL is set by EPA to adopt their own standard. This may be done on an accelerated schedule or even prior to EPA.

Table 4-10

Reservoir One, General Chemistry and Metals Data

Constituent	Number of measures	Raw Water Average	Raw Water Range	Treated Water Standard
Hardness (mg/L $CaCO_3$)	8	16.3	9.9-25	--
Alkalinity (mg/L)	9	16.0	12-25	--
Nitrate (mg/L)	7	ND	ND-0.93	45
pH	9	7.0	6.3-7.8	6.5-8.5
MBAS (mg/L)	7	ND	ND-0.01	0.5
Chloride (mg/L)	8	5.46	4.5-7.8	250
TDS (mg/L)	7	37.7	26-71	500
Aluminum (ug/L)	5	256	51-420	1000
Barium (ug/L)	6	32	11-100	1000
Beryllium (ug/L)	1	1.4	1.4	4
Cadmium (ug/L)	4	0.055	ND-0.22	5
Chromium (ug/L)	3	3.3	ND-10	50
Iron (ug/L)	8	180	ND-340	300
Lead (ug/L)	5	0.6	ND-1.8	15
Manganese (ug/L)	7	4.9	ND-9.3	50
Silver (ug/L)	4	8.25	ND-32	100
Zinc (ug/L)	7	25.9	ND-170	5000

Presented in Table 4-11 are the General Chemical and Metals data for Reservoir A. Although all priority pollutants and regulated metals were tested for in the water supply, only those detected are included in this Table. Review of the District metals and organics data indicates that there have been no excursions from trace metal or organic MCLs. Therefore, no assessment of contaminant loading is applicable.

Table 4-11
Reservoir A, General Chemistry and Metals Data Summary

Constituent	Number of Measures	Raw Water Average	Raw Water Range	Treated Water Standard
Hardness (mg/L	5	12	9-13	-
Alkalinity (mg/L)	6	16	14-18	-
Nitrates (mg/L)	7	ND	ND	45
pH	4	6.7	6.4-6.6	6.5-8.5
MBAS (mg/L)	5	ND	ND-0.012	0.5
Chlorides (mg/L)	5	0.804	ND-1.7	250
TDS (mg/L)	5	30.8	21-35	500
Aluminum (ug/L)	7	67.4	ND-110	1000
Arsenic (ug/L)	5	0.2	ND-1.0	50
Barium (ug/L)	6	11.8	ND-16	1000
Iron (ug/L)	7	154	ND-270	300
Manganese (ug/L)	5	75.2	12-230	50
Silver (ug/L)	4	7.75	ND-31	100
Zinc (ug/L)	5	3.0	ND-15	5000

There are a number of active and abandoned mines located within the watershed upstream of the Outingdale WTP intake. There is a potential that the presence of these active and inactive mines could impact metals concentrations but EID's monitoring results do not indicate any elevated levels. The logging activity within the watershed poses a potential threat of organic chemical contamination. When EID's organic chemical monitoring data were analyzed from 1991 to 1995, there were no detectable pesticide or herbicide values reported.

Presented in Table 4-12 are the General Chemical and Metals data for the Outingdale facility. Although all priority pollutant and regulated metals were tested for in the water supply, only those detected are included in this Table. Review of the District metals and organics data indicates that there have been no excursions from trace metal or organic MCLs. Therefore, no assessment of contaminant loading is applicable.

Table 4-12
Outingdale Plant, General Chemistry and Metals Data Summary

Constituent	Number of Measures	Raw Water Average	Raw Water Range	Drinking Water Standard
Hardness (mg/L)	6	18.2	13-23	--
Alkalinity (mg/L)	7	22.4	11-29	--
Nitrates (mg/L)	6	ND	ND	45
pH	6	6.93	6.5-7.4	6.5-8.5
MBAS (mg/L)	7	ND	ND-0.01	0.5
Chlorides (mg/L)	7	1.6	1.0-3.9	250
TDS (mg/L)	7	36.1	23-49	500
Aluminum (ug/L)	5	156	ND-380	1000
Barium	6	13.5	ND-19	1000
Iron	7	162	ND-340	300
Lead	7	0.157	ND-1.1	15
Silver	5	9.2	ND-33	100
Zinc	6	6.5	ND-24	5000

V. SUMMARY AND TREATMENT RECOMMENDATION

The following recommendations for level of treatment are based upon the evaluation of existing water quality data from all three watersheds. Although the potential of organics and trace metal contamination does exist based on current and historical land use, water quality data does not support the need for additional treatment beyond bacteriological and virus removal. Therefore recommendations here are for log removal requirements only.

A. El Dorado Canal Watershed

The total coliform data presented on Figure 4.2 indicates that 1,000 MPN/100 mL total coliform count is exceeded approximately once every three years. Typical coliform values are in the magnitude of 70 MPN/100 mL. These values are relatively low. Considering the total coliform analysis in combination with the microbiological threats present in the watershed, the present level of treatment which achieves a 3 log removal of *Giardia*/4log viruses is sufficient. This may be changed if future monitoring of the water source shows high concentrations of microorganisms, or significant and consistent increases in raw water turbidity.

No monitoring of *Giardia* or *Cryptosporidium* is currently being performed on Reservoir One source water. Valid *Giardia* and *Cryptosporidium* data could be very useful in evaluating the microbiological water quality of a water supply. Currently no satisfactory indicator organism that can be monitored in place of either of these microorganisms exists.

B. Jenkinson Lake Watershed/Reservoir A

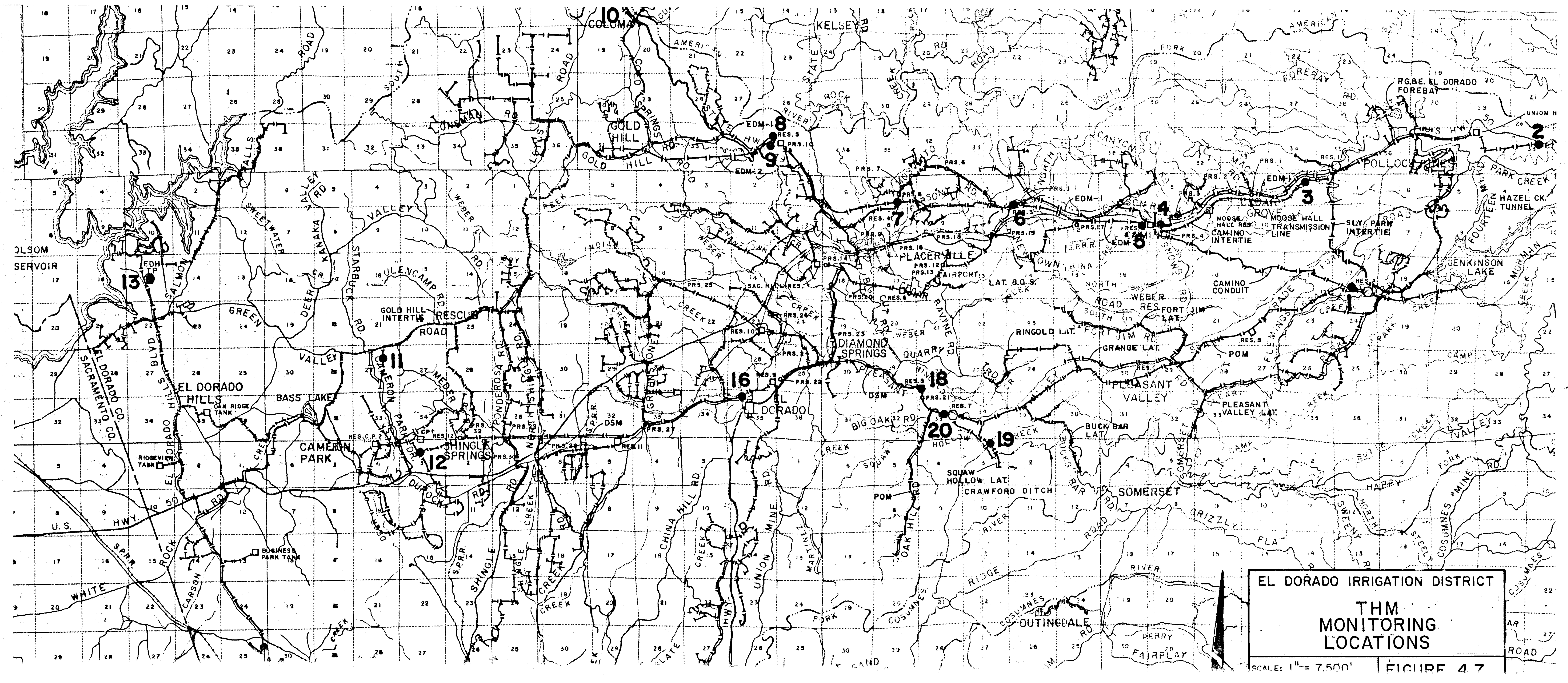
The total coliform data presented on Figure 4.1 indicates that 1,000 MPN/100 mL total coliform count has not been exceeded since 1982 and typical coliform values are very low at magnitude of 2 MPN/100 mL. Considering the total coliform analysis in combination with the microbiological threats present in the watershed, the present level of treatment which achieves a 3 log removal of *Giardia*/4 log removal of viruses is sufficient. This may be changed if future *Giardia* and *Cryptosporidium* monitoring of the water source shows high concentrations of these microorganisms.

No monitoring of *Giardia* or *Cryptosporidium* is currently being performed on Jenkinson Lake water. *Giardia* and *Cryptosporidium* data could be very useful in evaluating the microbiological water quality of a water supply. Currently there is no satisfactory indicator organism that can be monitored in place of either of these microorganisms.

C. Middle Fork Cosumnes River/Outingdale Plant

The total coliform data presented on Figure 5.5 indicates that 1,000 MPN/100 mL total coliform count is exceeded about every year and typical coliform values are the magnitude of 110 MPN/100 mL. Since the Cosumnes River experiences total coliform values greater than 1,000 MPN/100 mL usually once or more a year, a higher log reduction requirement may be appropriate. Considering the total coliform analysis in combination with the microbiological threats present in the watershed, it is recommended that the present level of treatment which achieves 3/4 log inactivation be increased by 0.5 logs to 3.5/4.5 log inactivation. An evaluation of the plant's current removal and disinfection abilities is necessary in order to fully evaluate its performance. Regardless of the outcome of such a study, the additional 0.5-log reduction can be achieved through inactivation by higher chlorine concentrations and/or increased detention time. The reduction evaluation can also be achieved by actual measured removals which would require a particle count demonstration study.

No monitoring of *Giardia* or *Cryptosporidium* is currently being performed on the Outingdale WTP raw water. *Giardia* and *Cryptosporidium* data could be very useful in evaluating the microbiological water quality of a water supply. Currently there is no satisfactory indicator organism that can be monitored in place of either of these microorganisms.


EL DORADO IRRIGATION DISTRICT
THM
MONITORING
LOCATIONS
SCALE: 1" = 7,500'
FIGURE 4.7

CHAPTER 5

WATERSHED CONTROL AND MANAGEMENT PRACTICES

The sections below, present a summary of sources that have the potential to pollute the District waters, and to introduce the concept of Water Quality Management. In addition, a discussion of management practices that can help preserve drinking water quality with recommendations for survey and monitoring is presented.

I. SUMMARY OF WATERSHED VULNERABILITY

The sections below summarize the sources and activities most likely to impact District watersheds.

A. Wastewater

There are no known direct effluent wastewater discharges, spray field or evaporation pond operations which could affect the watersheds. However, all three subject watersheds have domestic septic systems adjacent to the water and within a one-mile radius of the treatment plant intake. The key contaminants from domestic wastewater are bacteriological and viral as well as oxygen-demanding substances and nutrient loadings. Bacteriological contaminants from recreational use of waters is also a contributing factor.

B. Natural Setting

The one aspect of the natural environment in all three watersheds that has the most constant influence to water quality is that of precipitation. The chemistry of stream water is impacted tremendously by changes in volume, frequency, temperature and timing of rainfall. For example, low rainfall and periods of drought affect the water supply and cause shallow and slow-moving areas in the waterway where taste and odor algae can survive. The lowering of watershed flow and replenishment also encourages accumulation of certain non-volatile contaminants such as heavy metals and some pesticides.

On the other hand, heavy rainfall, particularly in areas unprotected by vegetation, encourages the mobilization of soil and debris which enter the waterway. This contamination from runoff is increased near steep canyon walls. Mass movement of soil caused by heavy rainfall results in landslides. Historically, landslides have caused particular detriment to the El Dorado Canal watershed which is particularly vulnerable due to the design of its conveyance structure. Freezing of water particularly in the El Dorado Canal also impacts water supply, and maintenance of the structure must include continual maneuvers to break ice formation during cold winter months.

C. Stormwater Runoff

While none of the three District watersheds covered in this report are heavily populated, the effects of urbanization nonetheless exist, most particularly due to stormwater runoff. This runoff will increase as population increases and could create significant water quality impacts. Contaminants from roads nearby residential areas and businesses can lead to watershed pollutants such as bacteriological contaminants, nitrogen, phosphorous, suspended solids, coliform bacteria, heavy metals (chiefly chromium copper, lead, nickel, zinc) and petroleum hydrocarbons. Road salting or other highway deicing chemicals can have an impact either directly by affecting water salinity, or indirectly by damaging adjacent vegetation.

D. Timber Harvest Management and Agriculture

Forest management activities have a significant impact on the quality of supply in all three area watersheds. These activities include forest road construction, logging and heavy vehicle use which increase erosion. This blocks off streams with sediment, and increases nutrient loadings. Logging also exaggerates diurnal water temperature changes due to removal of protective tree canopy. The net result of these impacts can be increased algae growth and the potential for putrification of water supply.

If not applied carefully by the timber harvest industry, pesticide use for control of insects, disease and competitive growth can also contaminate the drinking water supply. Other types of agriculture contribute similar pollutants to those observed in forest management, including erosion, pesticides and nutrient loadings from fertilizers.

E. Grazing and Non-grazing Animals

Wildlife as well as domesticated livestock in area watersheds present the potential for introduction of organisms which cause human disease. Warm-blooded mammals which frequent District watersheds such as beaver, coyote, mountain lion, and deer have been identified as being carriers of a well-known parasitic protozoan, *Giardia lamblia*. Another pathogen, *Cryptosporidium*, has been closely linked to feces of domestic livestock such as cattle. Although there are no large stockyards in El Dorado County, there are some areas, principally in National Forest lands, where cattle grazing is allowed.

F. Forest Fires

Wildfires in area watersheds can be, and have been, caused by human activities, such as sparking from engines, smoldering cigarette, and campfires. However, combustion caused by lightening strikes and other natural means also do occur. Wildfires have had a disastrous affect, to the District's water supplies, in particular to the El Dorado Canal Watershed which depends on the fragile flume conveyance structure, portions of which are constructed from wood. Flame retardant chemicals used in wildfire control, if not judiciously applied, can also cause pollution of area watersheds. Destruction of trees and shrubbery by fire can have a serious impact due to erosion and landslides during later wet weather months.

G. Mining

Water quality problems associated with mining include acid drainage bearing heavy metal contaminants. Acid drainage results from the combination of sulfur bearing compounds, oxygen and water which result in the formation of sulfuric acid. This acid can leach metals such as zinc, lead, arsenic, copper and aluminum and mobilize them such that they reach area watersheds. Debris and pollutants such as fuels and process chemicals also contribute to the hazards caused by mining. Soil erosion and hazardous material contamination such as fuels and process chemicals can also be the result of careless mining operations. Extreme damage via the suction action of dredge mining is also harmful to a healthy aquatic environment.

H. Recreation

All three District watersheds are impacted by authorized and unauthorized recreational uses. The Jenkinson Lake watershed in particular is the location of Sly Park Recreation Area which allows body contact activities as well as motorized boating. Fishing, boating and swimming will increase coliform counts perhaps ten fold from those found in reservoirs with no recreational use. Fuel spills and increased turbidities caused by recreational activities are also potential hazards to water quality.

II. WATERSHED QUALITY MANAGEMENT

The watersheds which supply the District customers with high quality drinking water, also serves other purposes. In addition to replenishment of a potable water supply, uses include recreation, irrigation, wildlife and supply for grazing animals. All of these activities can become a threat to water quality and polluted raw water will ultimately be a detriment. Therefore, the development of a balanced and controlled compromise among all users is necessary for the protection of a healthy water ecosystem. This is the concept behind an organized, multi-agency, Watershed Quality Management project.

In order to initiate such a cooperative effort, it is necessary first to identify the key watershed stakeholders. An organized development of stakeholder needs, and water quality goals will help define the necessary management projects. All Watershed control measures must be validated and supplemented with ongoing surveillance, monitoring and periodic status reports.

A. Identification of Authority

Ideally, all parties that exert control authority over watersheds which are used as drinking water supply would take part in development of watershed control measures. Some parties which have authority for watershed control within El Dorado County are identified below.

El Dorado Irrigation District
Pacific Gas & Electric Company
Georgia Pacific Industries
Sierra Pacific Lumber Company
El Dorado National Forest (USDAFS)
El Dorado County Environmental Management
California Transit Authority
Individual Fire Protection Districts
Sacramento Municipal Utility District (SMUD)
United States Bureau of Reclamation
El Dorado County Planning Department
El Dorado County Agriculture Department

All of the above identified stakeholders, and possibly others, must be invited to participate in the Watershed Management decisions, and development of quality control goals.

B. Developing Control Authority Goals

In order to achieve the cooperation of the various members of the Watershed Control Authority, it will be necessary to identify common concerns. Once the group embraces a common concern, then specific goals and projects to implement them can be developed. For example, all of the watershed control authority members listed above share a mutual concern regarding hazards of forest fires. Therefore, ideally, each could be willing to commit to the development of goals, and financial backing for specific tasks which would help prevent wildfires in the watershed.

There are many goals other than prevention of forest fires that would be of general benefit. Examples of goals which could be promoted through the Watershed Control Authority are listed below:

- Reduction of the potential for wildfires, landslides, or other natural disasters.
- Reduction of bacteriological contamination of multi-use waters by septic systems, animal grazing, or recreational use.
- Reduction of the potential for hazardous chemical release to multi-use waters caused by car highway accidents, poor disposal practices, pesticide spray programs, or domestic yard.
- Protection of water supplies from effects of urbanization, especially urban stormwater contamination.

C. Proposed Control Measures

When the goals of the Watershed Control Authority are agreed upon, it will then become feasible to propose measures that can achieve these goals. Based on these activities, and others that may be identified in the future, watershed control measures can be selected. Some examples of Watershed Control Measures that have been shown to be effective are described below:

1. BUFFER ZONES

Activities that impact area watersheds such as logging, grazing and urbanization can reduce their effect through the use of buffer zones. Buffer zones require that areas along the watercourse remain vegetated, and undisturbed. Typical buffer zones range from 50 to 200 feet in width, with rationale for width variations based on the type of terrain. Parameters such as topography and the ability of soil to support vegetation should be considered. However, often times, driving considerations include local opinions regarding the importance of watershed protection.

2. LAND ACQUISITION

Although land acquisition as a means of controlling watershed quality is an expensive alternative, it is also one of the most reliable. Land ownership limits the number of parties that must be involved in watershed management. Unfortunately, it also limits the number that might be willing to contribute financially to watershed management activities. EID is in fact, pursuing the purchase of two of the subject watersheds, the El Dorado Canal, and Jenkinson Lake Watersheds. While beneficial use alternatives have not been discussed, District ownership of these properties could make restrictive control measures easier to accomplish.

One of the alternatives that the District might well consider, especially in the El Dorado Canal, and the Jenkinson Lake Watersheds, could be restrictions on recreational use. Restrictions might include the elimination of boating and body contact sports in Jenkinson Lake Reservoir. This would not be a well-favored alternative in El Dorado County, due to the popularity of the Sly Park resort. However, the District will need to keep this as a potential alternative, should the increase in use coincide with a significant increase in water pollutants. Restrictions on the numbers of individuals that are allowed to use he facilities at one time is another alternative.

3. PUBLIC PARTICIPATION AND EDUCATION

One of the most effective measures to protect area water quality, is to alert the public to the pollution potential behind various watershed activities. Public members, if they understand and agree with the objectives of the watershed protection program, can prove to be valuable allies in implementing control measures. Education programs implemented through local schools, Community Service Districts, or other service organizations can help increase citizen's awareness of the harm that ordinary household activities can cause. Clear identification to residents of the problems that are associated with lawn-care chemicals, hazardous household wastes, or faulty septic systems could go a long way toward water quality protection now and in future years.

4. DENSITY RESTRICTIONS

This is the most common type of water quality protection used in urbanization. Through effective land use planning density restrictions can be defined for entire watersheds. Selected areas which are more critical in terms of vulnerability can be identified and increased restrictions can be placed in these areas.

5. SEPTIC SYSTEM RESTRICTIONS

Enforcement of septic systems standards is the primary responsibility of the County Department of Environmental Management. Restrictions such as lot size, and septic system construction need to be well defined and routine inspections need to be conducted. Septic system inspections should be conducted at a minimum of once every three years, with greater frequency being dependent on the system's proximity to the water supply source.

6. STORMWATER MANAGEMENT

Enforcement of storm water management is also the responsibility of the County Department of Environmental Management. While El Dorado County is not of the size where a Municipal Storm Water Permit is required, effective storm water management practices would go a long way to protect water supplies from harmful effects of road, commercial and residential runoff.

7. GRAZING RESTRICTIONS

Management of range areas which are used for livestock grazing is primarily the responsibility of the US Forest Service. The primary method of control at this time is that of limiting the number of livestock that are allowed in a given range area, with additional seasonal restrictions for specific land areas.

8. TIMBER HARVEST MANAGEMENT

Water supply protection in these areas of heavy timber harvesting can be effective through well-established best management practices (BMPs) adopted by the USEPA and developed by the U.S. Forest Service. Included in these BMPs are the buffer zones which have been discussed above. Other measures more specific to forestry include careful design and construction of haul roads, skid trails, and landings; post-disturbance erosion control; seasonal operating restrictions; and slash disposal. Seasonal logging restrictions to avoid long-term damage to soil during winter season is also advisable.

III. SURVEILLANCE AND MONITORING

Critical to effective watershed control is a comprehensive program for surveillance and monitoring of water quality. An effective monitoring program will be thorough enough and timely enough to able to identify trends in water quality parameters. Trend analysis of these parameters will help Watershed Control Authority identify specific pollutants which are increasing or decreasing so that control measures can be appropriately adjusted.

A. Watershed Surveillance

A significant part of a effective watershed management is necessarily that of surveillance. Routine and frequent inspection of the watercourse within a reasonable distance of the water plant intake is critical. Surveillance can help identify changes in the watershed that might lead to water quality problems. Additional surveillance which should include research of control authority policies for the broad watershed boundaries is also important to understand changes that are occurring and the possible future effects on the water treatment process. This broader scope of survey work will help identify critical factors such as planning for population growth, quantity of agricultural pesticide use and grazing permits, or other conditions that affect the quality of water supplies.

Surveillance will help reduce cost for watershed protection by identifying the pollutants likely to be found in the watershed, without broad spectrum analysis of multiple samples using expensive laboratory procedures.

B. Pollutants to Monitor

General groups of pollutants that can be identified with the various land uses in El Dorado County are briefly identified in Table 5-1. The pollutants listed on this table, in conjunction with information achieved from surveillance can be used to develop an effective monitoring program.

Table 5-1

POLLUTANT ANALYSIS AND LAND MATRIX

Watershed Land-Uses	Turbidity	pH	Nutrient Loading	Algae	Viruses Parasites	Bacteria	THM Precursors	Pesticides & Organics	Heavy Metals	Iron Manganese
Agriculture	X		X	X	X	X	X	X	X	X
Forest Management	X		X	X		X	X	X		
Grazing	X		X	X	X	X	X			
Mining	X	X							X	X
Recreation	X		X		X	X				
Roads	X							X	X	
Septic Systems		X	X	X	X	X	X	X		
Urbanization	X	X	X	X	X	X	X	X	X	X

C. Sampling Locations

In considering monitoring locations, the choice must be made based on the purpose of the monitoring program, as well as the physical feasibility of obtaining the samples. Consideration must also be made for the financial restrictions in selection of the number of sampling locations. *Effective Watershed Management* (AWWA 1991) identifies two general approaches to sample site selection. One is based on "Basinwide Networks, the other as Site-Specific Sampling."

The Basinwide Network approach is designed to achieve an understanding of the general water quality condition of the river or lake. It generally includes multiple sampling locations at the confluence of all subsidiary streams to a river or lake. This type of sampling program would provide the most information regarding the number and type of contaminants that have the potential of reaching the drinking water plant intake. However, it is also the most expensive given the number of District raw water supply locations.

For the purpose of an economic approach to sanitary watershed survey monitoring, a modification of Site Specific Sampling must be performed. Site Specific Sampling involves the selection of a minimal number of sampling sites beginning with those at the intake to the water treatment facilities. If sample results indicate the presence of pollutants or unusual bacteriological results, the number of sites will need to be increased in order to identify the source(s) of the problem.

C. Monitoring Frequency

Naturally, the more data that is available, the greater the information and understanding of water quality conditions. Because water quality conditions change with time, more than one sample is required to characterize a waterway. Limitations must necessarily be set with a balance of the need for information, as well as on economics.

In general, seasonal trends can be captured by implementing an initial set of quarterly sampling events. Conditions that are routine and seasonal because of changes in precipitation, temperature and land-use activities can generally be identified through routine quarterly sampling. If a specific, identifiable event such as a large scale forest fire takes place then non-routine sampling can be planned to capture the effects of that event to the watershed.

Currently, the Districts frequency for routine watershed monitoring is described in Table 5-2.

TABLE 5-2
EID WATER SUPPLY MONITORING PROGRAM

Parameter	Frequency	Location
Turbidity	Continual	Intake
pH and Temperature	2 Times/Mo.	Intake
Total Coliform	2 Times/Mo.	Intake
Fecal Coliform	2 Times/Mo.	Intake
Volatile Organics	1-4 Times/Year	Intake
Semi Volatile Organics	1-4 Times/Year	Intake
Metals	1-4 Times/Year	Intake
General Minerals	1-4 Times/Year	Intake
General Physical	1-4 Times/Year	Intake

D. Monitoring Reports

The results of watershed inspection, surveillance and water sample monitoring need to be evaluated on a daily, monthly, quarterly and annual basis. Certain parameters, such as turbidities, and raw water bacteriology need to be evaluated routinely by treatment plant operators, in order to ensure that the filtration and disinfection system at their facility is able to maintain drinking water treatment standards. Turbidities and coliform trends, as well as other contaminants that have been found to be a potential detriment to area watersheds, also need to be evaluated seasonally for the purpose of evaluating effective watershed management practices.

Thorough reporting, including pollutant trend analysis and surveillance summaries are most effective if completed once per year. The regulatory requirement for this level of reporting is once every five years (DOHS, Surface Water Treatment Rule).

Appendix 1

List of References

Appendix I
List of References

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Appendix 2

Historical Land Use
El Dorado Canal Watershed

EL DORADO CANAL WATERSHED
HISTORICAL LAND USE

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INTRODUCTION.

A report of the historical land use of a portion of the South Fork American River watershed, arbitrarily defined as the El Dorado Canal watershed, was requested as part of an examination of the watershed quality required under California law.

The El Dorado Canal watershed has been defined as extending from the headwaters of the canal to its terminus at Reservoir One in Pollock Pines. The southern drainage area extends from the headwaters of Alder Creek in Township 9 North Range 16 East, Section 6 although it extends slightly above this Section and is bounded on the east side by Alder Ridge and on the west side by Iron Mountain Ridge. The watershed is approximately 36 square miles in area [(LxW) x pi divided by 4 = area]. It includes portions of three Townships (9, 10 and 11) and five Ranges (12, 13, 14, 15, and 16) although in some cases only small portions of Sections are involved.

Historical contact in this watershed begins in 1826, although the major land use occurred after the discovery of gold at Coloma in 1848. General Land Office surveys were made between 1859 and 1875. Both private and public lands are involved in the watershed. The public lands are owned by the United States Forest Service, Eldorado National Forest, Placerville District.

Information regarding land use in this watershed has come from several sources. Some information was provided by the 1983 Historical Overview of the Eldorado National Forest by Forest Service Historian, Dana Supernowicz as well as current archaeological survey records. Additional information came from the General Land Office plat maps, a 1992 Abandoned Mine Inventory by Forest Service Geologist, Elizabeth Jones, Ph.D., and historical logging records from the Placerville District Office, Eldorado National Forest, for the past twenty years.

Where land ownership was known, archival research was conducted regarding the land use using historical deeds from the County Recorder's Office and the El Dorado County Historical Museum's archival material.

GEOLOGY.

The watershed of the El Dorado Canal consists of three types of geologic formations. Along the canal itself, the oldest rock formation encountered is that of undifferentiated Paleozoic Era rock. This has been identified as the Shoo Fly Formation of the Calaveras Complex and is composed primarily of quartzose sandstone and argillite (Loyd and Kohler, 1987:21).

The second oldest formation extends from Riverton east and throughout the watershed as it extends south of the canal. This is Mesozoic Era granite and it is the basic underlying rock of the Sierra Nevada batholith. This large batholith extends approximately 400 miles in a northwest trend. Its height extends to as much as 14,000 feet. The range has a steep eastern escarpment and a gentle western slope. The height of the range creates an orogenic lift which results in storms dropping most of their precipitation on the western side. As a consequence, the wetter western side contains a greater number of river drainages than does the dryer eastern side.

Sierran granitic rock consists of a number of related granite rocks ranging from mafic gabbro which contains no quartz crystals to true granite and the ranges of this which are more felsic. Most granitic rock consists of granodiorite or quartz monzonite; true granite is quite rare in the Sierra Nevada range. Granite is an intrusive rock. That is, it has formed under the surface of the earth and is only exposed as the surface erodes away. In the Sierra Nevada, the granitic rock has eroded to expose large groups of rock called plutons which together form the batholith. The ages of various groups of granitic rock range from 210 million years ago (m.y.a.) to 80 m.y.a. through the three Periods of the Mesozoic Era.

Mesozoic granite contains quartz, a host rock for gold.

The youngest geologic formation in the watershed is the Valley Springs formation which consists of rhyolitic tuff and sedimentary rocks. This formation is a result of Tertiary Period (Cenozoic Era) volcanic activity that ended approximately 10 m.y.a.

During this time, a long period of earthquakes and volcanic explosions rocked the Sierra Nevada range depositing rhyolite first, then andesite, over the western slope to several hundred feet deep. The Tertiary river channels were filled and blocked by volcanic ash and debris. These river channels and streams contained the auriferous gravels later sought by gold miners. Filled with volcanic material which gradually hardened into rock, the older Tertiary channels gradually became raised above the surrounding land as that eroded to lower elevations. The older stream beds were distinctly marked by strata of volcanic material interspersed with river cobbles far from modern streams.

The Tertiary American River ran from Round Top down by Morrison, Ditch Camp 7 and Bullion Bend. At Pacific House, a channel turned west-southwest toward Newtown passing close to Sly Park. From Newtown, the channel flowed toward Diamond Springs where several channels branched off. One channel turned north-northwest passing through Placerville on its way to Pilot Hill where it emptied out into a shallow sea at Roseville (Lindgren, 1911).

Tertiary channels are indicators of areas where placer gold may be hydraulic or drift mined.

HISTORICAL CONTEXT - OVERVIEW.

The earliest Indo-European contact in the watershed area was the exploration of Jedediah S. Smith in 1826 (Brooks, 1977). Christopher "Kit" Carson and Ewing Young made an 1830 trek south of the area along one of the tributaries of the Cosumnes River. In 1844, Carson returned with John Charles Fremont. Fremont and his geographer, Charles Preuss, described a lake, probably Lake Tahoe, which they saw either from Steven's Peak or Red Lake Peak. They may have descended down the Silver Fork-Upper Truckee River ridge to the Strawberry Creek-Sayles Canyon ridge and ultimately to the South Fork of the American River (Supernowicz, 1983).

The greatest impact, however, to the watershed of the El Dorado Canal (as well as to the county and the state) came following the discovery of gold at Coloma in 1848. By early 1849, following worldwide news of the new goldfields, thousands of miners and would-be miners began pouring into California by way of the Isthmus of Panama, across Nicaragua, or by way of the Overland Route.

Once this tremendous influx of people entered California, a series of dynamic events were put into play which drastically changed the social processes within the state and were ultimately responsible for making California the powerful influence it is today in the world market. How the State got this way involves the intricate patterns of social processes such as consumption, distribution, acquisition, and use of the material culture which existed in pre-1848 California and that which developed out of the gold rush era.

Prior to 1848, California consisted of Spanish coastal missions which had impacted some of the Native Americans through religious conversion. Additionally, large Mexican land grants had been awarded to Mexicans and some non-Mexicans who were involved primarily with stock raising. California at this time was not involved in a world market. Participation in the California economy in pre-1848 times was based on social and economic status. The trade emphasis was on imports from Spain and Spanish Mexico (Costello, 1992).

Early agriculture in the county, as well as the state, following the discovery of gold remained much as it had prior to 1848. It was focused on the local market; no railroads, of course, existed for transportation of produce to a larger market. Indians and Anglos, alike, grew vegetable gardens to supply local markets.

The Coloma-Gold Hill region was one of the first area to transport produce and fruit out of State around 1860 to supply the needs of miners involved in Comstock mining in Nevada. Transportation was by wagon until the construction of the Southern Pacific Railroad in 1888.

Table One shows the various kinds and amounts of crops and animals produced in the county in 1855 and 1920-50. In addition, in 1855, there were 24 steam sawmills and 16 water powered sawmills throughout the county. Seven quartz mills were operating. The Alta Telegraph had 75 miles of line throughout the county. In addition, there were fifteen toll bridges, eight lime-kilns, five tanneries, four breweries, three soda factories, two brickyards, and one flour mill. Twenty main canals had been constructed, sixteen of which operated year round. The total length of canals was 475 miles with an additional 325 miles of lateral branches (Sioli, 1883:114).

Once the easily retrievable placer gold was gone (by 1855), mining became a more costly and difficult venture. Hydraulic and drift mining techniques were utilized to blast and dig into the Tertiary gravels. Not until technology improved following the Civil War, though, was much headway made. Within five years following the end of the War, mining had begun a decline in California.

As Rodman Paul (1963) points out in a comparison of California and Nevada mining, there were 36,339 miners in California in 1870 compared to 8241 in Nevada. California's mining population had declined from a high of approximately 100,000 in 1852. Yet by 1870 Nevada's gold and silver production greatly exceeded California's. The population in California in 1860 was approximately 380,000. This suggests that by 1870 when the total population had increased to 560,000 the majority were involved in occupations related to providing goods and services in a highly competitive market.

By 1870, as Table One shows, agricultural diversity had multiplied. Although no data could be found for fruit production, this was a thriving industry within the county. Fruit was being hauled by wagon to various parts of the county and state as well as to the Nevada Comstock from the several fruit producing regions of the county.

Data for grape growing and wine production was limited and varied in form. In 1855, there were 3000 grape vines reported planted in the county. In 1870, the report listed only the gallons of wine produced and in 1920 the acres planted were listed. In an attempt to translate this varied information to correlative data, contact was made with several local vintners. In general the information was very similar. The most definitive information for the historic period came from Greg Boeger of Boeger Winery.

Historic spacing of vines consisted of an 8 foot by 8 foot area. This allowed approximately 680 vines to be planted per acre. The 3000 vines planted in 1855, therefore, represented about 4 and a half acres which would have produced approximately 600 to 1000 gallons of wine, depending on the variety planted (Boeger, 1994).

The figure was probably closer to 1000 gallons as the variety was primarily Mission grapes. The number of gallons produced in the county doubled within four years with the Zentgraf Winery in Salmon Falls Township and by 1860 some 800 acres of vines were planted in about 770,000 vines (Sullivan, 1980).

By 1870, Sullivan reports, the county contained one and a half million vines and produced over 200,000 gallons of wine and 7000 gallons of brandy (1980:B-2).

Cattle ranching had increased by 320 percent, dairying had increased by 440 percent, but the greatest increase came in sheep ranching which increased 2777 percent.

Bancroft gives the reason for the incredible increase in sheep ranching as a direct result of a severe drought in 1862-63. The loss of cattle feed required cattlemen to slaughter starving herds by the hundred thousand. Cattle were then replaced by sheep which were seen as hardier stock better able to survive California's variable climate (Bancroft, 1890).

By 1870, agriculture, wine production and sheep ranching were the largest economic producers in El Dorado County.

Both sheep and cattle were grazed in the lower elevations during the winter months and the higher elevations during the summer months. The impact of grazing, particularly of sheep, upon the ranges was enormous. As Supernowicz indicates the herdsmen set fires during the 1860's and '70's to remove brush and timber, opening up new ranges. They wrongly believed their actions would improve forage the following year. Fires might burn all season long until winter. Everything from manzanita to sugar pine trees twenty years or older would burn (1983:88).

Newspaper accounts and records of sheepherding activities show clearly that "the most destructive fires in the mountains of California were caused by sheepmen during the thirty years prior to the Forest Reserves Act of 1890 (West, 1932 in Supernowicz, 1983:89). In addition to fires, overgrazing of sheep contributed to the severe soil erosion.

Dairying was a predominant, though not exclusive, occupation of the Italian-Swiss emigrants to the county. As Rood (1992) points out, many Italian-Swiss emigrated to California (and El Dorado County) in order to obtain agricultural land as well as their fortune in gold. California's climate was similar to their homeland and reports of earlier emigrants back to Switzerland were very favorable and encouraging. The general pattern was that of a young dairyman emigrant who would become a partner with a landowner, later would buy out the landowner, then a benefactor aiding a second wave of emigrants to come to California. The contribution of the Italian-Swiss to the county was an economically productive milk and cheese industry, though dairying was not limited to just the Italian-Swiss as the dairies of the Sweeneys and Veerkamps of Gold Hill show.

By 1870 there were 59 mining ditches in the county covering 966 miles in length. Thirty seven quartz mills were in operation and 25 sawmills (Sioli, 1883:114).

The mining ditches were supplying water for agriculture, ranching, logging, and hydraulic mining by 1870. The economic diversification which had developed out of the decline of placer mining was well supplied with water by the former mining ditches.

By 1950, the emphasis was on stock raising in the county, particularly cattle ranching.

Viticulture had experienced several decades of natural and economic crises which ultimately destroyed the industry until the last twenty years or so. Between 1884 and 1900, Pierce's disease (a rickettsia-like pathogen) and the phylloxera louse heavily damaged the grape industry throughout California (United State Government, 1953).

Introduced on 1850 cuttings either from the east coast or Europe, the phylloxera louse went unnoticed and/or disregarded until large areas of vineyards were destroyed by 1878. Although the industry recovered, additional attacks by disease and pests combined with later economic recessions, Prohibition and even its later repeal, and the Depression of 1929 to destroy the grape industry in El Dorado County. Prohibition actually had less of an impact on the industry than did its repeal. During Prohibition, grapes continued to be shipped east to immigrant families for personal use and the market stayed active. The repeal of Prohibition, however, created a glut on the market which resulted in lower prices, ultimately driving large numbers of grape growers out of the industry (Boeger, 1994).

Today the grape and wine industry has revived, though the vineyards are planted at higher elevations than they were historically. Soils at the higher elevations are deeper and retain seasonal rainfall better, requiring less irrigation (Bethell, 1994).

A pear blight in the 1950's wiped out that form of agriculture in the County for a number of years, though pears are making a comeback at this time.

Sheep ranching declined between 1870 and 1950 and cattle ranching increased. The beginning of the end of the large cattle ranches appears to have been triggered by rising land taxes and lower beef prices following this period of time and the beginning of land development. Ranchers saw an opportunity to sell out from an increasingly difficult financial situation. In the lower elevations, some of the land sales were triggered by the construction of Folsom Reservoir and the purchase of surrounding lands by the Bureau of Reclamation in the El Dorado Hills area.

El Dorado Canal.

J. Ross Browne described the early construction of ditches in California as "magnificently successful". Early ditches were short in length and the water was sold at high prices. The early success led merchants to encourage the construction of more and longer ditches to hoping to increase the population, gold production, and trade. A problem developed, however, with construction of more massive systems. Good hydraulic engineers were hard to find and ditches were often constructed by carpenters who had a penchant for constructing wooden flumes, even where none were needed. Flumes were expensive, lost value rapidly, and required rebuilding within ten years. "The big ditches, almost without exception, proved unprofitable" (Browne, 1868).

In 1868 24 canals averaged 35 miles in length, though only one came close to this average size and the range of ditch size extended from 1.5 miles to 450 miles in length. Fourteen of the 24 canals ranged between eight and twenty one miles in length, a more representative depiction of the general length of canals in the county. The average length of these fourteen canals was about 13 miles. The El Dorado Canal could be considered an average sized canal and more typical of the majority of canals within the county.

El Dorado County water entrepreneur, John Kirk, came to El Dorado County as an accomplished engineer. In 1859, he made a report on the possible route for a government road from Honey Lake to City of Rocks, Nevada. His chief engineer was Francis Bishop who also worked on the government road in Nevada.

Kirk was originally from Bucks County, Pennsylvania. When he was twenty, he worked on the State Canal in New York and later built railroad bridges in Ohio and Indiana. He came to California in 1850 where he obtained employment in Sacramento as a contractor repairing levee breaks, built a bridge and city streets, and constructed the city's water system (Billeci, 1993).

In 1853, John Kirk and his family moved to Placerville where he became involved in the development of the South Fork Canal with Bishop. Kirk was one of the first men to foresee the value of water-rights in the upper reaches of the watershed of the South Fork of the American River (San Jose Pioneer, 1878:2).

TABLE ONE

	1855	1870	1920
Wheat	11,700 bushels	3,897 bushels	0
Barley	9,520 bushels	8,330 bushels	0
Oats	9,675 bushels	250 bushels	0
Hay	2,187.5 tons	6,227 tons	500 tons*
Wine	3000 vines	200,000 gallons	880 acres
Rye/Corn	No data	1,139 bushels	0
Peas/Beans	No data	1,251 bushels	No data
Potatoes	No data	5,728 bushels	No data
Wool	No data	39,910 pounds	No data
Butter	No data	224,885 pounds	No data
Cheese	No data	23,892 pounds	No data
Honey	No data	1,660 pounds	No data
Fruit trees			
Apples	1,608	No data	120,000
Peach	1,159	"	211,250
Others	166	"	
Grapes	3,000	1,500,000	370,000**
Swine	4,620	4,150	1,000*
Cattle	1,281	5,385	7,500***
Dairy cows	769	4,132	
Sheep	654	18,137	4,000*

* Figures are for 1948, the earliest year of agricultural records maintained by the Department of Agriculture in El Dorado County.

** Figure is approximate.

*** No figure was available for dairy cows. Since dairying was a local occupation at this time, the figure for cows may be included in the total for cattle.

Kirk was the engineer responsible for the construction of the El Dorado Canal. The purpose of construction of this canal and the South Fork Canal was to provide water for hydraulic miners. A series of dams and reservoirs were planned to ensure year-round water. Kirk spent his own money for four years on the El Dorado Canal project until he ran out of money.

In 1860, the United States became embroiled in a civil war that soon severely drained money and manpower for such projects envisioned by Kirk. Two years after the war ended, Kirk and Bishop collaborated to continue the survey and construction of the water conveyance system.

Water rights obtained by the pair included irrigation purposes this second time. However, neither man had the capital to complete the massive construction effort. By 1871 less than a mile of the canal had been completed. Kirk and Bishop sold their water rights and property for $60,000 to the El Dorado Water and Deep Gravel Mining Company. Bishop was one of the six investors of this company. The company had large amounts of capital. Their primary aim was to enlarge the El Dorado Canal system and use it to provide water for their hydraulic mine, the Excelsior Mine, in Placerville (Billeci, 1993).

Over 1000 Chinese laborers were hired out of San Francisco to excavate, construct flumes and hand-placed rock walls. Some 100 Euro-Americans also worked with them, mostly Italians (Billeci, 1993).

Teams of forty to eighty men worked on the ditch and lived in several camps set up along the canal. Billeci states that the largest Chinese camp was at Fresh Pond where more than 200 Chinese lived (1993:63).

A thousand foot tunnel was drilled between Echo Lake and the American River watershed. The canal was completed in July, 1876.

The El Dorado Canal was the first canal constructed in El Dorado County in 1856 at a cost of $650,000.00 ($25,000 a mile). It was constructed at a grade of 4 feet per mile, was 10 feet wide at the top, six feet wide at the bottom and was four feet deep. The flumes were eight feet wide and six feet deep. The ditch functioned as a year round canal with short supplies of water during very cold winters and dry summers. It was capable of delivering 2,800,000 gallons with a loss of 35 to 40 percent from leakage and evaporation (Williams, Jr., 1885).

The canal was one of the largest and most costly in California. It was an elaborate system of tunnels, flumes and dams that delivered water for 22 miles from its headwaters at Medley Lakes (today's

Aloha Lake) to Sportsmen's Hall (today to Reservoir 1 in Pollock Pines).

By 1881, hydraulic mining ventures were looking at severe legislative restrictions which had been coming for some twenty years. The twenty year legal battle had begun when hydraulic mining debris began choking downstream rivers and channels, flooding towns and creating hazardous navigational problems. By the time of the 1883 Sawyer Act and the 1894 Caminetti Decision, legal restraints made hydraulic mining an extremely costly venture and many mines began closing down.

Agriculture began to supersede mining for water usage and the purpose of the canal shifted to supply the tremendous increase in diversified crops within the county.

Agriculture, however, could not support the cost of the expensive water and the equally expensive water conveyance system.

In 1892, the mining company sold its holdings to the Placerville Gold Quartz Company, operating as the El Dorado Company, which held onto it until 1907, gradually increasing its length to 45 miles of main ditch with 100 miles of diversion branches (Billeci, 1993). During this period of time, there was some consideration given to using the canal as a source of water for the development of hydroelectric power.

Poor water sales continued to cause financial problems for the El Dorado Company and in 1907 the canal was sold to C.N. Beal of the Sierra Water Supply Company. Beal had plans to develop reservoirs and water conveyance systems for the purpose of hydroelectric development, but the Depression of 1907 forced him into bankruptcy. The canal reverted to ownership of the El Dorado Company who then found a buyer in the Western States Gas and Electric Company which had already purchased the American River Electric Company and constructed a flume and powerhouse on the South Fork of the American River (Starns, 1994).

Western States took control of the El Dorado Canal in 1916 and immediately began to make necessary major repairs to the system. Western States diverted water to the newly constructed American River Powerhouse and promptly found themselves in litigation with local farmers for water rights. The case was heard by the State Railroad Commission, then the forum for water rights issues. The Commission's decision was "first come, first served". Whoever developed first, would have first rights to the water. The Commission recognized that the farmers would probably develop additional agricultural lands before Western States could develop high elevation reservoirs, dams, and canals and what was developed would have the right to receive water. After Western States had constructed their additional water conveyance system and another powerhouse (the El Dorado Powerhouse), that company would have the rights to the required water to operate its facilities (California, State of, 1918)

Western States rebuilt the canal increasing its capacity from 40 cfs to 156 cfs, added siphons, trestles, spillways, flared walls, gunite lining, constructed a reservoir (Forebay Reservoir), and a 26,800 horsepower powerhouse.

In 1927, Pacific Gas and Electric obtained the rights to the El Dorado Canal. They have continued operation of the canal to this date.

The Ranchers. No attempt was made to examine all of the pioneer residents of the study watershed. A look at four prominent ranchers in the area serves to show the primary land use of the region.

Alexander Morrison came from Aberdeen, Scotland to Illinois in 1845. He later emigrated to California in the early 1850's. Nothing is known of his residence before he came to El Dorado County. He is not listed in the 1866 Great Register. Morrison married his wife, Jessie, and the couple had two children, Andrew and Isabel (who later married John Bell of Tucson, Arizona). Land patents show that Andrew first purchased 160 acres in the northwest quarter of Section 21 in 1885, although Supernowicz (1994) feels he was in the area possibly twenty years earlier. The land became known as "Morrison's Place". In 1891, he purchased from the government a large tract of land between Mill Creek and Plum Creek Ridge (Map One).

These tracts of land were additional to his large ranch in the Clarksville area. Alexander Morrison died at the age of 76 on August 15, 1893. He had suffered from spinal trouble for some time (Mountain Democrat, August 19, 1893). His estate was valued at $4,385 for real property and $7485 for personal property. The property included 7 horses and 100 head of stock cattle. According to Supernowicz, Morrison may have run some sheep in the area, but he was primarily a cattleman (1994).

Morrison's son, Andrew, patented additional lands to add to the above tracts in the Alder Creek region. In 1890, Andrew patented all of Section 16. This was followed by an additional 160 acres in 1903, 40 acres in 1904, and another 160 acres in 1906. That same year Andrew's wife, Tillie, also patented 160 acres if land making the total land patented by the Morrison family about 1446 acres (Map One).

Andrew Morrison died on September 9, 1904 as a result of an accident on the Freeman ranch near Clarksville. The wagon in which he was riding turned over after his horse ran away. Morrison was

Abe married Annie J. Goyan in 1892. Their children were Grace and William Abraham.

Abe's brother, Frank, was born on November 12, 1870 "on the old Darlington ranch three miles out Cedar Ravine on the Texas Hill Road" (Mountain Democrat, July 7, 1955:3). Frank lived on the ranch all his life and had been occupied in stock raising until close to the age of 80. He died at the age of 84 in 1955.

Upon the deaths of Frank and his sister, Sarah, the Darlington ranch went to Grace Marshall and her brother William. The ranch was later purchased by the El Dorado Irrigation District as a part of the proposed Texas Hill reservoir (Duffy, 1994).

The Darlingtons associated with Darlington Flat and the Darlington homestead in the study watershed area, then, were Frank Darlington, and later, Frank's nephew, William Abraham. William Darlington died on December 26, 1976 at the age of 74 (Deeds, Book 25:755).

Mining. Although mining in this particular watershed appears to have been quite a bit less intensive than in other parts of the county, at least one hydraulic mine was identified in Section 32 of Township 11 North Range 14 East (Jones, 1992).

Clark (1970) describes the mining in the Pacific Mining District as occurring primarily in the vicinity of Pacific House. This is the location of a Tertiary river channel. Hydraulic and drift mines were first worked in the 1850's and 1860's with some later work at the Pacific Channel drift mine in the early 1920's.

Hydraulic mining gradually developed in technology following the decline of the loose and easily retrieved placer gold in the rivers and streams after 1855. Prior to the Civil War the technology was limited and water pressures were low. Canvas hoses easily blew apart if the pressure was too high. The necessary pressures required to blast into the auriferous (Tertiary) gravels of the ancient river channels developed only after the Civil War when Hoskins' Little Giant cannon was converted from cannon powder to water power and rubber hoses and, later, iron penstocks, replaced the canvas hoses. Water pressures increased enormously and hundreds of thousands of gallons of water could be directed against hillsides, moving tons of gravel, dirt, and anything else on the hillside that was in the way of the gold.

Ultimately, a twenty year legislative battle began in 1860 brought by downstream farmers and ship owners who felt the repercussions of tons of mining debris which entered rivers, blocking navigational routes and creating hazards and floods. The town of Marysville was devastated by debris caused floods which also destroyed farming along the main valley rivers. As a result, the 1883 Sawyer Act and the 1894 Caminetti Decision required permits and debris dams and the cost of hydraulic mining increased to the point that this form of mining was virtually abandoned around the turn of the century, although it was continued to some degree (with and without permits) into the early part of the twentieth century.

Roads, Railroads, and Electric Lines. Forest Service Archaeological records show the historical construction of several roads in connection with early homesteads. These include Van Winkle's and Morrison's roads constructed between 1859 and 1875.

County Road 88 was constructed from Sly Park to Fersh Pond in 1859. This 60 foot wide road was intended to intersect with the great Emigrant wagon road at or near Fresh Pond. The road has never been improved except for occasional grading (Trumbly, 1980).

Sioli (1883) mentions the Ogilby Road and, of course, the early Placerville to Carson City Road (now Highway 50) was constructed in the mid-1850's. First known as the Pioneer Trail, the road was later known as Johnson's cut-off, then the Placerville to Carson Valley road. Constructed in 1853, this road saw traffic in the thousands on a daily basis when miners left California for the Comstock lode around 1860. The road was paved as the Lincoln Highway in 1918.

In 1856, the old Emigrant Trail was later known as Pony Express Trail Number 25. It continues to be known as Pony Express Trail and extends through Pollock Pines. In 1965 that portion of State Highway known today as Pony Express Trail was relinquished to the county when the freeway was completed from the 8 Mile Road interchange to the Sly Park Road interchange (Trumbly, 1980).

In the Plum Creek watershed, located within the study watershed, Forest Service records show there exist 12.85 miles of private roads and 12.95 miles of Forest Service roads.

The Mill Creek watershed, in the study watershed, contains 3.65 miles of public roads and 7.95 miles of private roads.

In connection with the development of logging in the watershed, the California Door Company (Caldor) constructed a railroad into the area around the turn of the century to its logging camp in Section 15 Township 10 North Range 14 East. Probably in connection with the logging, telephone lines were extended into the watershed around 1914 and 1916 to Pollock Pines and the Plum Creek Sawmill Complex.

The ability of California industry to enter the world market was greatly enhanced by the construction of the Southern Pacific Railroad in 1888. The eastern extension of the Camino, Placerville, and Lake Tahoe Railroad, a standard gauge industrial railroad, allowed products to enter and leave California at several points through the width of the State and through El Dorado County.

Logging. A large number of sawmills are reported for the watershed study area. These include Blair's sawmill, Beach's mill, Snow's mill, the Plum Creek sawmill complex, the Girard mill site, Fresh Pond mill, Mill Creek sawmill, and the Ashland sawmill.

In addition, logging was undertaken by the Hudson Lumber Company, the Placerville Lumber Company, the Trotochan Lumber Company, the Sanders Brothers as well as the independent loggers such as Morrison, Quinn, Bryant and the local company of Caldor.

Early logging methods from the 1850's to the 1890's utilized wagons and ox teams for moving fallen timber. Skid roads were constructed to skid logs to the small mills which operated in areas for about an average of ten years before being dismantled and moved to a new area. Oxen, mules, and horses were later replaced with the Dolbeer Steam donkey, a small, upright steam engine used to power a single drum winch. It was used for unloading logs at the mill at first and later was used to pull logs to landings and to load logs onto log cars.

With the construction of the narrow gauge railroad into the forest, larger amounts of logs could be transported to mills at lower elevations. Improved technology in saws aided in the cutting of greater amounts of logs, also.

Large logging endeavors were not just the sole domain of the larger companies, however. Jim Quinn sold his timber rights to William Wheeler in 1906 with right of ways for the construction of wagon roads, railroads, and tramways, as well as the right to construct mills, factories, buildings, ditches and pipelines, cut log storage, and the right to construct electric lines in Section 36 Township 10 North Range 15 East. It was agreed in the contract that the logging would be completed in fifty years and would not interfere with the grazing and agricultural use of the area by Quinn.

Logging records obtained from the Placerville District of the Eldorado National Forest show current logging (over the past twenty years) has been undertaken in the Alder, Plum Creek, and Mill Creek regions. Forest Service records show that very little was done until 1986 when salvage logging required the removal of trees over 1,928 acres in the Alder Creek region. The logging was done in average increments of 28 acres over a six year period of time.

Within the Plum Creek watershed, Forest Service records show salvage logging occurred between 1980 and 1992. Some 161 acres were logged over this five year period of time by tractor method.

There is no record of wild fires for the Plum Creek watershed.

The Mill Creek watershed Forest Service records for a five year term show 411 acres logged in 1974 in average increments of 103 acres harvested by the Tractor method. The following year 538 acres were harvested in 90 acre increments by the Tractor and Helicopter method. In 1983 106 acres were hand grubbed and in 1990 Georgia-Pacific made one harvest of 660 acres by the cable method. In 1993 264 acres were harvested in 33 acre average increments by Tractor and BioMass methods.

The 1992 Cleveland fire impacted a portion of the study watershed, also, although the acreage was not obtained for this report.

Much of the logging, however, has been done by the private company of Georgia-Pacific since 1987-88. Prior to that, American Forest Products logged much of the area (Pricer, 1994).

Sawmills. Lumber production within El Dorado County began with the construction of Sutter's sawmill at Coloma, although the gold rush era impacted its construction and subsequent operations for a few years at first. As gold mining declined and economic diversity developed within the county, lumber production was one of the primary industries. Timber was abundant and the demand for lumber was great, not just for housing but for expanding development in mining, agriculture, ditch construction, commercial structures, and fuel.

By the 1860's timber stands which had covered the western slope down to Shingle Springs had been depleted.

The earlier flimsy whip saws which had been the predominant cutting tool in the 1850's were replaced by gang saws. These consisted of "long narrow blades that used an up-and-down reciprocating motion to cut the logs. Although the gang saw engine wasted energy overcoming inertia on each stroke and return, the saw did slice every log identically, regardless of flaws" (Supernowicz, 1983:118).

Gradually, saws were constructed more and more efficiently and by the 1870's larger logs could be cut. The 1880's saw the development of the band saw which allowed all sizes of trees to be cut, although smaller mills could not afford the newer, more expensive saws.

After the construction of the railroad from Sacramento to Placerville in 1888, California entered the world market for timber sales.

Sawmill operations fluxuated with the boom and bust periods of the economy as did the amount of timber harvested. However, in the mid-1940's the Society of American Foresters met to discuss problems resulting in lower timber production in spite of a larger number of mills operating within the county. The primary problem expressed was that of inexperienced, irresponsible employees who were almost worthless. The employees were those men who had not been eligible for the draft during World War II and, most likely, had experienced several devastating years previous to that during the Great Depression.

Following World War II, and the return home of soldiers, the quality of employee improved and by 1950 the lumber industry had begun to experience a boom in the national economy (Supernowicz, 1983).

Summation. The watershed of the El Dorado Canal is situated at elevations ranging from 3460 feet at Pollock Pines to over 6600 feet at the headwaters of Alder Creek. This area is heavily timbered and receives precipitation in the form of rainfall and snowfall. The general topography is that of fairly steep to very steep hills intersected by canyons. Mid to high elevation meadows offered cooler, watered locations for grazing sheep and cattle during the hot, dry summers and early pioneers took advantage of this opportunity throughout the county.

Many El Dorado County pioneers were involved in multiple economic pursuits which often were seasonal and provided a year round income.

The Morrisons and Darlingtons were essentially cattle ranchers who grazed cattle at the higher elevations during the summer. The Quinn brothers were primarily sheep herders who sold their timber rights for logging. Joseph Bryant was involved in mining ventures in Diamond Springs with two of his brothers, Warren and Alex. Herman Bryant also appears to have been a brother and the "Bryant Brothers" may have been a lumber company composed of at least Herman and Joseph. The Bryant Brothers traded timber for land close to the Diamond Sawmill on Camp Creek and purchased land in Diamond Springs adjacent to the Diamond Mill Lumber Company (Deeds, Books E:338, F:239, F:552, G:285 and 286).

In 1908, Joseph's son, Charles Freeman Bryant, sold a right of way to the J & J Blair Land and Lumber Company for a wagon road to be constructed over a portion of Section 31 in Township 11 North Range 14 East. The purpose of the road was to haul logs and lumber and material to and from the Blair Sawmill which was to be constructed in Section 3 of Township 10 North Range 14 East.

These multiple economic pursuits of cattle and sheep grazing, logging, and sawmilling were the predominant forms of land use for the study watershed. It appears that mining was not extensively pursued in the area for several reasons. The upper elevations were difficult to access in comparison with easier lower elevations that were highly productive. By the time of the mid 1870's when land patents began to be obtained for the upper elevations of the study watershed hydraulic mining was beginning to decline. The first people to begin to purchase large tracts of land in the upper elevations, also, were basically ranchers who needed the cooler, higher elevations for the grazing of stock during the hot summer months.

Logging and cattle grazing provided a dual use of the land and gave a double return on the land, a multiple use that was no doubt considered financially judicious.

With the continuing decline of the cattle industry in the county, the remaining use of the study watershed has been that of timber harvesting conducted by private companies such as American Forest Products and Georgia-Pacific, in addition to the multiple uses of the forest provided by the United States Forest Service.

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Appendix 3

Historical Land Use
Jenkinson Lake Watershed

DRAFT

HISTORICAL LANDUSE OF THE SLY PARK WATERSHED

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For

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June, 1994

DRAFT

INTRODUCTION.

A report of the historical land use of the watershed surrounding Jenkinson Lake at Sly Park was requested as part of an examination of the watershed quality required under California law.

The Sly Park watershed has been defined as extending from the Cold Canyon tributary of Sly Park Creek to the dams at Jenkinson Lake, a manmade reservoir. It includes both forks of Sly Park Creek and a second creek, Hazel Creek. In addition, there are numerous seasonal drainages into the reservoir and numerous seasonal tributaries to the named Creeks.

The watershed is approximately 16.5 square miles in area [(LxW) x pi divided by 4 = area]. The average width was found to be about 2.1 miles. It includes portions of Township 10 North Ranges 13 and 14 East.

Historic contact in this watershed begins in 1826. A significant contact came in 1848 which resulted in tremendous landuse the following year, initiating major changes for the region. Today, the land is owned both privately and publically. The public lands are owned by the United States Forest Service, Eldorado National Forest, Placerville District and the Bureau of Reclamation. Many of the private lands are owned by the Georgia-Pacific Lumber Company.

Information regarding land use in this watershed has come from several sources. Some information was provided by the 1983 Historical Overview of the Eldorado National Forest by Forest Service Historian, Dana Supernowicz as well as current archaeological survey records. Additional information came from the General Land Office plat maps, a 1992 Abandoned Mine Inventory by Forest Service Geologist, Elizabeth Jones, Ph.D., and historical logging records from the Placerville District Office, Eldorado National Forest. Other records include historic deeds provided by the El Dorado County Recorder's Office, historic documents at the El Dorado County Historical Museum, and Paolo Sioli's "Historical Souvenir of El Dorado County, California", 1883.

GEOLOGY.

The Sly Park watershed contains three types of geologic formations. The north side of Jenkinson Lake and, essentially, the north side of the watershed is composed of Valley Springs Formation. Commonly known as rhyolite, a primary mineral in the rock has been petrologically identified as sanidine (Welch, 1992).

The east and south sides of the watershed contain large areas of Mehrten's Formation, commonly known as andesitic mudstone.

These two formations are the result of Cenozoic Era volcanic eruptions which deposited ash and mudflows over the western slope of the Sierra Nevada range to depths of several hundreds of feet.

Sanidine is a high-temperature mineral of the alkali feldspar group. The Al-Si distribution is totally random and occurs in clear, glassy crystals embedded in unaltered acid volcanic rocks. Sanidine occurs as phenocrysts in rhyolite, the volcanic equivalent of a granite.

Andesite is the volcanic equivalent of quartz diorite. It is composed primarily of oligoclase or andesine feldspar (Klein & Hurlbut, Jr., 1985). Sly Park andesite has not been examined for mineralogical composition, but does appear to contain feldspar and hornblende. Some of the andesite contains Tertiary river cobbles and appears as a conglomerate.

The south side of the watershed also contains large areas of undifferentiated Paleozoic (?) rocks. These have been identified as the Shoo Fly Formation of the Calaveras Complex (Wheeldon, 1986). This formation of metavolcanic and metasedimentary rock is composed primarily of quartzose sandstone and argillite (Loyd and Kohler, 1987:21). A few small outcrops of quartz can be found intermixed with the Shoo Fly Formation. Mica in some of the quartz from Sly Park has been examined by X-ray diffraction (Post, 1991).

The Shoo Fly formation indicates an ancient fault zone and such zones contain a variety of economic minerals and ores, including gold.

The existence of Tertiary volcanic material with river cobbles in the Sly Park area suggests it contains a remnant of a Tertiary river channel. Lindgren (1911) has described the route of the Tertiary American River as running close to Sly Park. It actually appears to have run through the Park, based on geologic evidence as seen in road cuts. These ancient river channels and streams contained the auriferous gravels later sought by gold miners.

HISTORICAL CONTEXT - OVERVIEW.

The earliest known Euro-American contact in the watershed probably occurred during the southwest exploration of Jedediah S. Smith in 1827. Smith and his group of 15 American trappers attempted to cross the Sierra Nevada by following the ridge of the South Fork of the American River but were turned back by heavy snow drifts. In order to avoid a second contact with Native Americans in the Pollock Pines-Camino-Placerville area (their first contact had been very unpleasant for the local Maidu and they feared retribution), the explorers apparently turned south at Pollock Pines and headed toward the general direction of Pleasant Valley toward the North Fork of the Cosumnes River. The exact route is not known, of course; it is likely they passed through the watershed at its westernmost boundary, though there is no description of this trip in his journal (Brooks, 1977:162).

The contact which resulted in major environmental and economic changes within the watershed occurred in 1848 as a result of social forces in the United States which had begun many years earlier.

In the first early years of the gold rush era, 1848 to about 1855, California was experiencing a massive transitional stage that was both exciting for the new Californians and tumultuous, particularly economically.

During the Mexican period, California's economy was based on imports from Spain and Spanish Mexico. The primary items imported "related to social customs, health practices, religion, music, and art", thus binding Alta California to Spanish Mexico culturally (Costello, 1992). In turn, the Spanish missions exported hemp and animal fats; these latter were used for cooking, candle making, soap, and other products (Ogden, 1925; Tays, 1941 in Costello, 1992). While some hides and sheepskins were exported in the early part of the 19th century, they were not a major export until the early 1820's (Costello, 1992).

In general, until the gold rush era, California was slowly moving into the capitalist world economy, but was operating on the edge of it as an extension of Spain. With the onslaught of tens of thousands of people in 1849, California was faced with what Bancroft (1890) has called a "magnificant disorder". The excitement of gold fever resulted in economic chaos as over-trading, land speculation, and extravagance created growing debts in California. In addition, labor for agriculture or for constructing roads, buildings, bridges, or the industries which would aid in such endeavors or constructions (farms, sawmills, foundries, etc.) were lacking for several years as everyone turned to mining to improve their lot back home. Few planned to stay in California and so no thought was given to improving conditions.

Roads, in particular, were in terrible condition. Muddy quagmires in the rainy wintertime, they turned to morasses of deep, choking dust in the hot, dry summers. At times they were virtually impassable and as Minke (1960) has pointed out if it had not been for the Chinese who transported goods in these conditions many businesses and small mining camps and towns would have perished.

In 1846, the Polk administration began a war with Mexico for the territories which later became the states of Arizona, New Mexico, and California. This was a war which ultimately was not very popular with Americans, however it did spur some initial overland migrations to California, primarily over the Truckee-Donner route.

At the same time, the Church of Latter Day Saints (LDS) had moved to the Iowa Territory as an advancement to a western move to "escape persecution for their distinctive religious doctrines and social practices (Owens, 1989:37-38).

The story of their trek west has been effectively told (Stegner, 1964). In an attempt to ameliorate the persecution, earn wages for themselves (needed to offset the hardships of their migration), and perhaps ensure a more friendly attitude from the federal government, Brigham Young offered a Battalion of 500 volunteers to go west with the United States army under the command of General Stephen Watts Kearny (Owens, 1989).

Over two thousand miles, the Battalion marched from Council Bluffs, Iowa on the Santa Fe Trail to New Mexico, then to Arizona, and, finally, to San Diego in early 1847. By the time of their arrival, however, the war with Mexico was virtually over and most of the Battalion was mustered out in San Diego. Many of the men went on to Sutter's Fort as Brigham Young was encouraging them not to return to their families just yet. The hardships the LDS emigrants were experiencing included a shortage of food and there simply was not enough food to feed the ex-Battalion members if they returned (Owens, 1989).

Some 200 former Battalion members ended up at Sutter's fort, working for John Sutter who sent them on to Coloma early in January, 1848 to help James Marshall build the sawmill planned on the South Fork of the American River.

The discovery of gold at Coloma put an end to work on the sawmill for some time as everyone began panning for the loose placer gold. By June, however, most of the LDS had decided to return to their families who, by now, were settled at Salt Lake City, Utah.

A new route was sought from the Truckee-Donner route due to the reputation that route had obtained following the devastating experience of the Donner Party in 1846. Those forming the expedition to return to their families chose to attempt to forge a route over the Carson Pass. Accordingly, they began to gather in June in Pleasant Valley until everyone in their party could join them.

A group of 45 men and one woman, the wife of one of the Battalion members, left Pleasant Valley in July. Three of the party went on ahead to scout for a good route over the Carson Pass. The rest proceeded up a route marked in part today by Starke's Grade Road. That evening they camped in a little valley which was "discovered" by Corporal James Calvin Sly and which they named "Sly's Park" in his honor.

The remainder of the trip home and the tragedy of discovering the bodies of the three scouts who went on ahead is told by Owens (1989) and is not really a part of the history of Sly Park or its' watershed. James Calvin Sly never did settle in the area; he did return at least twice leading groups of miners and settlers into California over the Mormon-Carson Emigrant Trail. Ultimately he settled in Canada and was killed in the Black Hawk Wars (Sly, 1993).

Polk's unpopular war with Mexico for the three territories became popular after the discovery of gold. While Sutter wanted to keep the discovery of gold a secret in order to accomplish his personal goals, news of the discovery was forwarded to the President via California's military governor, Colonel Richard B. Mason. Polk saw a way to popularize the war: by showing the world what a tremendous asset California was to the United States. This was not the first time gold had been discovered in California, but it was the first time it was a political benefit and Polk saw to it that news of the discovery travelled around the world.

In 1848 China had been torn by the Tai Ping Rebellion and a famine. The lure of gold drew thousands of Chinese to California. By 1851 several thousand Chinese had arrived, most from Canton Province and most from farming and fishing backgrounds.

They came to California to a world very different from the home they had left in order to participate in mining, an activity with which most were unfamiliar. As a result, the Chinese mining techniques were borrowed directly from those used by the Euro-Americans, although Chinese innovations were made to these techniques. One important innovation was that of using traditional Chinese irrigation devices for water conveyance (LaLande, 1985:31).

The Chinese were excellent, also, at moving supplies through areas when weather was inclement and businesses continued as a result of the Chinese who worked for wages no one else would work for.

The Chinese most often were directed to abandoned "worthless" claims. Thus, a system developed whereby miners sold their worked claims to Chinese and then moved on to preempt new claims which the Chinese were not allowed to touch. The Chinese often were able to remove large amounts of gold from the "worthless" claims. They hauled water in buckets to mining areas. Using water hydraulics developed in farming in China, they extracted ore from quartz and delivered it to mills for very low fees. As a consequence, almost abandoned districts could be revived and a quality of stability was provided which went unrecognized at the time.

One important factor in Chinese mining was that while some mined individually, most worked as members of a company. Large companies of 50 to 500 Chinese were efficient and organized and capable of productive labor. The 1860 census for El Dorado County showed a population of over 450 Chinese in Diamond Springs Township. This included Chinese who were registered singly and in groups. The groupings could be arbitrarily shown as:

Groups of 20+	10-19	5-9	1-4
4	13	17	10

This suggests that the majority of Chinese worked in small to medium sized groups of less than 20 individuals in this township.

As the loose placer gold became scarce, the Chinese organizations began to attract negative attention and Euro-American miners began focusing on eliminating the competition.

Miners began to compete more and more for less and less gold (at least easily retrieved gold), and the Euro-Americans began to seek social methods for ensuring they had the best opportunities to obtain the remaining gold. One solution was to impose a "Foreign Miners Tax" of $20.00 a month (later reduced to $4.00 a month). At first it was placed on Mexicans who were seen as an immediate threat for reasons of political power undoubtedly related to the recent war of 1846. Additionally, in the southern mines, Mexicans outnumbered Euro-American miners and had mined some $20 million. It was felt this would increase the numbers of Mexicans and South Americans entering the gold fields unless something was done (Holliday, 1981). Obviously a California just wrested from Mexican rule would not be seeking to encourage Mexicans to enter California and become wealthy.

Australians, too, were recipients of the tax as many of them were recently from penal colonies in Australia and were rough even for a frontier environment.However, the focus of the tax ultimately became the Chinese who were harrassed also by floggings, beatings, robbery, expulsion, and murder. The Chinese, not being Christian and thus not bound by the Christian oath, could not testify in Court until 1869 when it was ruled that the 14th Amendment gave them this right.

The Foreign Miners Tax actually constituted a substantial income to many communities, which could not have existed without the revenue (Minke, 1960). Yet the harrassment took its toll and many Chinese ultimately returned to China.

By 1849 gold miners and would-be miners began pouring into California from the United States and around the world. They came by ship and by overland trails and their numbers were so great that the sequential wagon trains resembled one gigantic wagon train.

One primary route into California was over the Mormon-Carson Emigrant Trail and through Sly Park for several years until the development of Johnson's Cut-off which later became Highway 50. The numbers of emigrants through Sly Park were in the thousands; approximately 6,000 people passed through Sly Park in 1849 and possibly as many as 10,000 the following year (Owens, 1989). So great, in fact, were the numbers that the ruts of wagon wheels in granite can still be seen in areas along Camp Creek. The emigrants usually were out of feed for their stock and preceeding pioneers had utilized what feed existed on the western slope. Later emigrants were forced to cut down oaks in order to feed their stock oak leaves. Many of the oaks over the route were destroyed as a result (Mahach, 1992).

By the time the emigrants made their way down the trail into Sly Park they were suffering from the numerous hardships most experienced: the difficulties encountered in just getting over the Sierra Nevada range caused them to have to jettison most of their supplies, including food. Scurvy and cholera were prevalent, claiming at least 700 lives in 1850. When they arrived in Sly Park many felt they had arrived at "one of the most romantic spots in the world". In 1849, they could cut hay for their stock for free. By 1850, however, an establishment had been built on the north side of Sly Park called "The Mountain House" and the owner, or someone else, had mowed all the hay and was selling it for $500.00/ton or $4.00/pound (Owens, 1989).

The area today which encompasses the recreation area of Sly Park was historically described as two separate areas. "Sly Park Ranch" consisted of 320 acres (two quarter sections) in what is now the front part of the park, and was composed of portions of Sections 8, 16, and 17. In the 1874 General Land Office plat map, it appeaers to have encompassed pretty much the same area. "Hazel Valley Ranch" consisted of 160 acres northeast (or in the back of the park) of Sly Park Ranch and was composed of what today are portions of Sections 9 and 10. On the 1874 GLO plat map, the area then consisted of portions of the southeast quarter of Section 4 and the southwest quarter of Section 3. More modern surveys have resulted in the changed sections.

Sly Park Ranch.

It is not known who the owner of the Mountain House was, but two of the earliest preemption claims were filed in 1853 by Hiram O. Bryant (or Briant) and William Stonebraker, both of Diamond Springs (Preemptions, Book C:213). At that time, Sly Park was a part of the Diamond Springs Township. Both preemption claims stated that the land was being preempted for agricultural and grazing purposes which lends some support to the hypothesis that Bryant and Stonebraker ran the Mountain House and sold hay to emigrants passing through Sly Park.

Two other early preemption claims for the Sly Park area were filed by I. Ricks (later described as Joshua Hicks), George Rice (also spelled "Bice") in 1854. Daniel Hilton preempted 160 acres 4 7/8 miles east from Sly Park in the same year (Preemption Claims, Book C:371, 388). Rice's claim was filed on July 11, 1854; his land was described as being 3 7/8 miles east of the Sly Park Ranch on the north side of the emigrant road from Sly Park to Iron Hill. Ricks' claim was filed October 9, 1854 and was located 2 7/8 miles east of Sly Park Ranch (Book C:388). This would place Rice's claim close to the 1874 location of Cutler's sawmill in Section 12 (Township 10 North Range 13 East); Ricks' claim would have been one mile west of Rice's claim and Hilton's would have been one mile east of Bice's. Later deeds describe the claims of the three men as being 4.5 miles east of Sly Park apparently using the farthest boundary description. The preemptions were for "agricultural, grazing, and mill purposes", however Rices' claim suggests he was primarily interested in the timber.

Stonebraker (and probably Bryant, although the sawmill referred to as "Bryants sawmill" seems to be associated more with Joseph and Herman Bryant who came to the area later) built two sawmills along Sly Park Creek, one in Section 12 and one in Section 16 Township 10 North Range 13 East.

Stonebraker also built a road, or "cutoff" across the small, narrow valley in the back of the park. This cutoff connected with the Mormon Emigrant Trail and is today marked by the boat launch at Stonebraker campground.

In 1854, the Court of Sessions in Placerville ordered that the road leading from Down's Ranch to Sly Park should constitute Road District Number 24 (Trumbly, 1980). It is apparent from this action that a road connected Sly Park with other parts of the county at this early date.

William and Fanny Mariah Stonebraker were 27 years old in 1853. Both had been born in Ohio about 1826. William Stonebraker was a farmer. The Stonebrakers had resided in Missouri before coming to California (1852 Census:page 5).

Stonebraker and Bryant operated their sawmills until 1853 at which time they sold their preemption claim to James H. Moraty (also spelled Moratty) for $6,000. The price suggests that the land was very valuable and that the Stonebraker's and Bryant had made a very good living off of it (the price also reflects the increased land values as a result of land speculation during the gold rush era).

Three years later Bryant, Moratty, and the Stonebraker's sold to Thomas J. Payne the two quarter sections originally pre-empted by Rice and Hilton. They realized $3,000 from this sale. In 1857, Bryant (spelled "Briant" in the Deed) sold to William Stonebraker his 320 acres which had been the preemption claims of Daniel Hilton and George Rice. He realized $500.00 from this transaction (Deeds, Book C:295).

No information on the Stonebrakers or Hiram O. Bryant exists after this time and it is assumed they returned to their families in the midwest.

In 1852, real estate values began to fall from the extravagantly high levels they had reached as a result of the land speculation. Bank failures began, triggered by the failure of Adams and Company, one of the most trusted California banks. Two hundred banks failed following bank runs (Bancroft, 1890:173). In 1855, another depression was experienced in California as gold declined and mined gold moved east for the purchase of goods leaving California with no money.

Thomas J. Payne made a profit off of his purchase of the Bryant and Stonebraker land. The following year, in 1857, he sold 160 acres known as Sly Park Ranch for $4400.00 to Luther C. Cutler, John Fuller, and T.M. Kelley. The three men were also involved in logging, however shortly after the purchase, Kelley quit-claimed his share to Cutler.

Payne, however, did not pay taxes on the 320 acres preempted by Rice and Hilton in Sections 13 and 18 of Township 10 North Range 14 East and it was turned over to the Sheriff for sale in 1856.

Hard times, coupled with limited easy gold and news of new strikes in other areas, particularly the Comstock in Nevada in the 1860's, caused miners to begin to make serious decisions about returning home, staying in California and settling down, or moving on to other gold fields in other states and territories. The record in the Deeds reflects this in several ways. Early land and mine transactions were frequent between emigrants. Records of transactions are sometimes missing. By 1862, however, the Homestead Act was in force; records are much more reliable and the population has become much more settled. Interest still existed in mining, but other occupational endeavors are in full force: logging, sawmilling, merchandising, cattle raising, and farming.

In 1857, Luther C. Cutler and John Fuller operated the sawmills built by William Stonebraker (and probably Bryant). Cutler's mill which was located close to the border of Sections 7 and 12 of Township 10 North Ranges 13 and 14 East was called the Pioneer sawmill. A boarding house for employees was located with it (Probate File #58). Fuller also constructed a mill, known as the Sly Park mill (also, "Cutler's mill"), which was located close to the present location of the second dam on Sly Park Creek in Section 17. The Pioneer sawmill, and most likely, the Sly Park mill, was water powered. Water was supplied to the Pioneer sawmill by means of a flume taking water from Sly Park Creek (GLO plat map).

John Henry Fuller was registered to vote in 1876, giving his age as 21. He was a farmer, born in California, who lived in the Diamond Springs Township. The following year he married Anna M. Combs, age 19, of Placerville Township.

Aaron D. Treadway preempted 160 acres about 5 miles east of Sly Park in 1857 for grazing, agricultural, and mill purposes

(Preemptions, Book D:50).

On July 14, 1859 the County Board of Supervisors ordered that the road leading from Diamond Springs by way of Bartrams' Mill, Pleasant Valley, and Atlantic Mill to Keeley's Barn (Kelley's ?), at the upper end of Sly Park be declared a public highway. This applies to that portion of Sly Park Road from Pleasant Valley to a point within what is now the lake (Trumbly, 1980). The road dropped into Sly Park at a point very near where the current first boat launch is located.

The same day the Board also ordered that the road running from Pollock Pines to the intersection with the road described above be declared a public highway. This essentially ended the era of the Empire Toll Roads, Numbers One and Two.

In 1859 the 480 acres preempted by Ricks, Rice, and Hilton was sold by Frank Hereford (of Sacramento City) to William S. Messinger and O. R. Amsden for $4000 (Deeds, Book E:269). There is no record showing how Hereford obtained the land which two years earlier had been sold by Hiram Bryant to William Stonebraker. Two weeks later, Hereford sold an undivided one fourth of the same property to Ellen Horton of Sacramento City as her separate property (Deeds, E:310).

Cutler's Pioneer sawmill had two saws and produced 9,000 board feet of wood per day. Both Sugar Pine and "Hard" Pine were cut (Probate File #58). Logging to and from this mill (as with other mills in the area) was done with oxen who pulled logging "trucks", or wagons. Only pine butt logs of clear material of a diameter capable of being handled on the ox trucks were used in the mill. Lumber was sawn in the spring, when water was available for power. The wood was piled and dried during the summer months, then the majority of wood was hauled by ox team to Sacramento County. The sawn timber was also sold around Michigan Bar, Live Oak, and Bridge House for ranch buildings. Flume lumber was also sold for the purpose of building flumes which would carry water to hydraulic mines. There were about forty such mines operating in the county (Supernowicz, 1986).

Luther Chamberlain Cutler was born around 1818 or 1819 in Maine. It is not known exactly when he came to California or whether he mined at first when he arrived. What is apparent is that during the economic hard times of the mid-1850's, Cutler took advantage of opportunities available to him in farming and logging.

Very little is known about Luther Cutler's personal life. The 1870 census shows he was married to a Martha E. from Vermont. He was 51 years old at the time and she was 44 years old. The Cutler's had no children, but did adopt a young boy named Henry Alonzo Stark (also known as "Starks") who had been orphaned when his parents were killed, reportedly by mountain lions. In 1870, Henry was 13 years old. He had been born in Minnesota.

Cutler ran stock on the range known as the Hazel Valley Ranch, which he had purchased from Sam Kyburz in 1875. The Hazel Valley Ranch consisted of 160 acres in the east half of the northeast quarter of Section 9 and the west half of the northwest quarter of Section 10, Township 10 North Range 13 East, north of Sly Park Creek (GLO plat map, 1874).

As with many stockmen in the 1870's, Cutler owned a ranch in the lower elevations one mile north from Michigan Bar on the Cosumnes River. This was the Jacob (or Jackson) Framson Ranch. It appears that Cutler's stock was primarily cattle and milk cows as well as oxen used in logging. This interpretation is drawn from some of Cutler's personal property described in the probate record. Cutler also owed a bill to W. R. Knights and Company which dealt in hides, sheep skins, tallow, furs, goat and deer skins.

By the 1870's Cutler had formed a business partnership with a young sawyer named Alexander Joel Card, originally from New York. In 1870, Card was 36 years old and was married to a woman named Mary, age 32, who was from Ohio. The Card's had five year old twins Alexander and Andrew, and daughters Florinda (age 4) and Visalia (age 1). All these children had been born in California. A third female child lived with them whose name was Louisa Thuch (?). Louisa was six years older than the twins and had been born in Oregon. She may have been adopted or, possibly, was Mary's child by a previous marriage.

While the Diamond Springs Township included a very large area from Diamond Springs to Sly Park, it is interesting to note that in 1870 the Township contained over 157 Chinese, most of whom were miners. This was a decrease from over 450 Chinese who were counted in the 1860 census.

Henry Fagen (also, Fagan) began purchasing land in the area; some of his estate includes a small portion of the western tip of the Sly Park watershed in Section 18. He also owned a mine located opposite the Hazel Valley House. This may have been the Hazel Valley Quartz Mine. Fagen may be the "Dutch Henry" whose ranch is located in the north half of the northeast quarter of Section 18 (GLO plat). This appears to have been James Waites' 1853 preemption which was located one mile west of Sly Park. Very little is known about this early settler. He and Fred Heitman purchased the Empire Toll Road #1 station from Dan Harmon in 1863. The Empire Toll Road #1 was the section of today's Sly Park Road which ran from Pleasant Valley to Sly Park. (Empire Toll Road #2 ran from Sly Park to Park Creek Road [Peabody, 1988]).

Fagen later purchased large tracts of land in and around the watershed study area, including the Old Atlantic Mill which contained 320 acres and the southeast quarter of Section 17 which includes the area of today's Group Campground number five. Fagen formed a company in 1863-64, but later apparently operated alone as a rancher. He died in 1875.

A number of Swiss-Italians were in the area including Frank and Alexander Guidici, Zachary Leoni, Augustine Chironi (later, Sciaroni), Italians Louis and John Faretto, Nicoli Avanceno (Avansino), Louis Bacigiluppe, and John and Dominico Raffetto. From Switzerland were John and Mary Papa and their two children John and Constantine, ages 13 and 12 years. James and Ann Mismore (also spelled Missamore) were from Ohio. James made a living as a logger. The Mismore's had five children, including Lafayette who, as an adult, would become a prominant landowner in the Gold Hill area. Morris Eastwood was 38 years old; a miner from Ohio, he settled in the Hazel Valley area.

The economic depression of 1873 which swept the United States does not seem to have seriously impacted the economy of Sly Park, athough the evidence for this assumption is very limited and is based on negative evidence. There is no indication that the economic activities of logging and farming changed for the landowners in the area except to improve financial conditions for most.

One other indication of an economic boom in the Sly Park area is seen in the development of the school. Children in the area received schooling as early as 1872 and possibly earlier. It was in 1872, however, that the public school system took over the Sly Park School. Water was supplied to the school by means of a ditch on the north side of the meadow which carried water from Sly Park Creek and conveyed it to other ditches; ultimately the water reached Diamond Springs. The school was located "beyond the hotel not quite to the Cutler Ranch house (Sly Park House), on a knoll" (Miller, 1990). Carlo and Margarette Farati, later known as Charles and Margarette Farette, deeded land to the school district for the school. This land was located in the "southwest corner of Section 9". The description in the deed places it off the west end of today's Sierra Point (Deeds, Book 37:402). About 30 children attended the school which was open during the summer months only as it was too difficult to get to school in the winter. The school was later moved to Fresh Pond, east of Pollock Pines, then later abandoned around 1910 when it merged with the Pollock Pines schools. By the time it died out, the schoolhouse was not worth moving; virtually no one lived at Sly Park anymore (Miller, 1990).

Although a severe drought in 1862-64 had reduced cattle raising and placed an emphasis on sheep and agriculture (with irrigation), Cutler appears to have remained a cattle rancher, moving his cattle from his Michigan Bar ranch in the summer to the Hazel Valley ranch. In 1876-77, another drought resulted in the loss of 20 million dollars in crops and cattle (Bancroft, 1890). Again, there is no indication that Cutler was seriously financially affected.

During the decades of 1870 and 1880 approximately 20,000 head of cattle and 10,000 head of sheep were driven through Sly Park every year on their way to the higher elevation feeding grounds in the mountains. Teamsters, cattlemen and tourists stayed at the two-storied Hazel Valley House and three large barns housed their mules and horses (Stark, 1954).

The new Timber Act of 1878 made available for purchase surveyed public lands within California, Oregon, Nevada and Washington Territory. Excluded were lands within military, Indian, or other reservations of the United States. The land had to meet certain stipulations. It had to be valuable chiefly for timber or stone, but be unfit for cultivation, it had to be uninhabited, contain no mining or other improvements, except for ditches or canals, and the purchaser had to be a United States citizen or be filing for citizenship and indicate he was not purchasing the land for speculation, but for his own use (Mountain Democrat, June 29, 1878). This opened up lands east of Sly Park of purchase of 160 acre tracts of land at the very low price of $2.50 an acre.

The location of Sly Park to these newly opened public lands provided one more opportunity for economic development in the area during times when other areas within the country were experiencing hard times or economic depressions.

In 1856 the Sacramento Valley railroad had been completed as far as Folsom. Three years later, residents of Placerville were pushing for an extension of the railroad into that town in order to preserve it. Francis A. Bishop (later involved with the construction of the El Dorado Canal) was placed in charge of the railroad survey as Chief-engineer. In 1863 he declared the road bed was ready and the railroad was completed from Folsom to Latrobe in 1864.

The railroad was extended to Shingle Springs in June of 1865 following the appointment in 1863 of a Commission to survey a route to Placerville. The Commission was composed of John Kirk, Lacy and Arvidson. Kirk was later involved with the construction of the El Dorado Canal along with Bishop.

The extension of the railroad to Shingle Springs was of benefit to the lumber industry in Sly Park as park logs and lumber were transported to the shingle mill at that town. This was one industrial development which aided the development of Sly Park by widening the market to out-of-county resources.

In 1871, the Placerville and Sacramento Valley railroad was purchased and transferred to the Central Pacific railroad, but poor management resulted in costly litigations. As a result the line was not completed to Placerville from Shingle Springs until 1888.

The Crawford and High Camp Ditches.

Another explanation for the low financial impact on the area during national depressions or economic hard times undoubtedly had to do with the increased development of the Sly Park watershed area beginning in the 1870's. In addition to the increasing extensions of the railroad into the county, that development was enhanced tremendously by J. J. Crawford's ownership and construction of what became known as the Crawford Ditch system. A water conveyance system in the county was required due to the nature of California's climate which, historical records show, tended, at least in the 19th century, to consist of alternating years of drought and overabundance of water. However, summers in the west are particularly dry and water for mining needed to be brought to the mines.

The Crawford Ditch system developed out of one of the three main canal systems in the county, the Park Canal and Mining Company. The other two main systems were the California Water Company and the El Dorado Water and Deep Gravel Mining Company.

In 1851, the firm of Bradley, Berdan and Company began constructing a vast ditch system designed to provide water for manufacturing, mining, mechanical and chemical purposes. The company began with water rights claims on Ringgold Creek, east of Diamond Springs, Sly Park and Camp Creeks, the North Fork of the Cosumnes River, Weber Creek, and the South Fork of the American River (Sioli, 1883:104-105). Competing with miners for water, the company was naturally immediately involved in litigation over water rights.

At the same time, Jones, Furman and Company began constructing a small ditch from Squaw Creek to Diamond Springs. This ditch was extended up to Clear Creek in 1852 and on to Camp Creek in 1853 when it was also enlarged along the entire length (Sioli:106). Jones, Furman and Company went bankrupt and the property was sold to W. P. Scott. Scott named the ditch the "Eureka Ditch" and extended it up to the confluence of the Steely Fork and North Fork of the Cosumnes River.

In 1875 the Eureka Canal Company was purchased by J. M. Crawford of Philadelphia and was renamed the Park Canal and Mining Company (Limited). J. M. Crawford was the chairman and his brother John Jones (J.J.) Crawford was the general manager. J. J. Crawford was 29 years old at the time and a Metallurgist by occupation. He was later the State Minerologist for California.

John Jones Crawford and Samuel Hale were the owners of the very rich gold mine on Tennessee Hill in the Fort Jim area. The claim was one mile long and one quarter mile wide. Their hydraulic mining was conducted by means of ditches and flumes connected with the Park Canal which was capable of carrying 1200 inches of water to the claim, with 175 feet fall (Sioli, 1883:88). Peabody (1986) adds that the mine was equipped with a steam-powered, five-stamp mill and hoisting works, boarding and lodging houses.

Crawford was also involved in the Davenport mine about 5 miles southwest of Sly Park and was mining in the Ladies Valley area.

The Eureka Canal Company, under the management of the Crawfords and the signature of D. O. Mills, applied for water rights in 1873 and changed the location of their upper dam on Park Creek. Darian Ogden (D.O.) Mills was a prominent banker in California, having developed the Bank of California, as well as in the Comstock Lode of Nevada.

The Eureka Canal Company planned reservoirs in the Sly Park and Hazel Valley ranch areas. The reservoirs were to receive waters from both Park and Hazel creeks. A ditch capable of carrying 6000 inches of water (measured under a 4 inch pressure) was planned to run in a southwesterly, then northeasterly direction along the dividing ridge between Park and Clear creeks to Gay's old station (now the historic Gay House). From this point it would run across Clear Creek "to a junction point of a ditch coming from Camp Creek on the divide between South Webber Creek and Clear Creek..." (Water Rights, Book A:69). Ultimately the water would be conveyed by ditches to Newtown, Ladies Valley, Diamond Springs, Mud Springs (El Dorado), to Sacramento County. The ditch was planned to be 8 feet on the bottom, 12 feet on the top, and 4 feet deep. The purpose of the water along the whole line was to be for mining, milling, etc.

In 1877, the company constructed a ditch capable of carrying 1,800 inches of water from Camp Creek under the New Baltic mill across Diamond and Stonebreaker (probably named for William Stonebraker) Creeks, dropping into Sly Park Creek in Hazel Valley (Sioli: 106). The extent of the water conveyance system at this time (1877) was almost 300 miles.

The ditch segment which carried water from Camp Creek, across Diamond and Stonebreaker Creeks, to Sly Park Creek at Hazel Valley was the High Camp Ditch. This ditch was the most important improvement to the water conveyance system (Palmer, 1993).

Construction on the High Camp Ditch began in 1877. "A Chinese company was responsible for the excavation and construction of the earthen elements of the ditch while the blasting and wall building was left to an American firm" (Palmer, 1983). The work was completed within six months and as the ditch was capable of carrying 1800 miner's inches of water in comparison to the 1200 inches the old Eureka Ditch could carry, it increased the amount of gold which could be produced from area mines, aided in the development of lower elevation farming, and enhanced logging in the region. For some 25 years, the High Camp Ditch was a significant factor in the development of the Sly Park watershed as far as mining and logging were concerned.

Mining.

Most of the important mines which contributed to the economy of Sly Park were located out of the watershed. There was an economic interrelationship, however, between Sly Park water and timber and intra-county mining which made logging and mining important ventures for the stability and development of the study watershed. Historic and modern mining has occurred in the Sly Park watershed.

Peabody (1986) describes newspaper articles in the Mountain Democrat in various issues of the late 1800's which comment on mining activities in certain mines near or in Sly Park. An attempt was made to locate these mines to determine whether or not they were in the watershed. These mines included the Baltic, Big Bonanza, Blue Gouge Sister Quartz Mine, Farewell Mine, Gold Spike Mine, Hazel Creek Mine, Hazel Valley Mine, Mr. Moore's claim, the Theodore Rupley Claim, Tom Shea's mine, Snow and Woods' claim (also known as Phelps and Wood's claim), and the Weybright and Newell mine.

The Baltic mine was located in the southeast quarter of the southeast quarter of Section 23, Township 10 North Range 13 East. Only a small portion of this mine might be considered to be within the study watershed. The Baltic mine was a lode gold mine developed by a 240 foot tunnel with north/south drifts. A ten-stamp mill was erected in 1896 and heavy improvements were made in 1898. The mine was active until 1907. The potential for Mercury contamination and Acid mine drainage exists at this location (Wheeldon and Associates, 1991).

"Big Bonanza" was the name of two different mines. One was located in Henry's Diggings on the Middle Fork of the Cosumnes River and the other was located in Township 12 North Range 10 North. Both were well out of the study watershed and no record could be found for a mine with this name within the watershed.

The Blue Gouge Sister Quartz Mine was located by Louisa Sciaroni in 1901. It was located close to the modern day (historic mine) Blue Gouge Mine out of the study watershed.

The Farewell Claim was located in 1897 by Luigi Campini. It was a 20 acre claim located in Section 31 of Township 10 North Range 14 East, well out of the study watershed.

No information could be found for the Gold Spike Mine. The Golden Spike Gold Mine was located in 1900 by Joseph Heisser, but no Township, Range, or Section was given for its location.

The Hazel Creek Mine was first mined in 1948 and is located on Hazel Creek approximately one mile northeast of the Sly Park reservoir. It is located within the study watershed in the southeast quarter of the southeast quarter of Section 3, Township

10 North Range 13 East. This mine was a 30 acre lode gold mine. An adit was driven and a mill was erected in 1948. Thirty to forty tons of ore were mined and milled daily. The ore consists of considerable amounts of galena (lead) and pyrite, with native gold in quartz. The mill was located on the north bank of Hazel Creek, and employed flotation, amalgamation and a retort system. The potential exists for Mercury contamination and Acid mine drainage contamination into Hazel Creek (Wheeldon and Associates, 1991).

The Hazel Valley Quartz Mine was located in 1879 by Anton Wangler. It was located on Sly Park Creek. There is a large depression in the side of the south slope above the creek today which may be the remnants of this mine which measured 1500 feet long by 600 feet wide (300 feet on each side of a ledge).

"Mr. Moore's claim in the Sly Park vicinity" may refer to the Hewitt Gravel Mine and Quartz Claim owned by E.A. Rix, P.H. Reardon, T. Moore, P.G. Johnson, and T.A. Murray. This claim was located May 11, 1896 and was situated in the Mt. Pleasant Mining District adjacent to the Rocky Bar Gravel Mine. The Rocky Bar Gravel Mine was located in Section 4, Township 9 North Range 12 East. If this is the mine "in the Sly Park vicinity", it is out of the study watershed. No other mine belonging to a "Mr. Moore" was found for the watershed during the research.

Theodore Rupley, his father, John Wesley Rupley, and his brothers William and Joseph, were mining in the county from Smith Flat to Silver Creek from at least the late 1870's to the turn of the century. It is possible they were mining earlier as they arrived in California in 1853, though no archival record documenting early transactions could be found, and the Rupley children were quite young at this time. John Wesley Rupley was mining a stone quarry in the south half of the northeast quarter of Section 10 Township 10 North Range 11 East and operating the Wiley Toll Road (later the Lake Tahoe wagon road) in the same area in the mid-1880's to 1891. A strip of land 80 feet wide in this portion of land was sold in 1904 to Bartlett Doe of San Francisco for a possible railroad right of way. It seems likely he raised his family while working in the quarry and operating the toll road, after which time his boys became involved in mining and logging.

The Rupley's had sons Theodore, William, Joseph, and Jacob, and a daughter Columbia (married Holliday).

Theodore Rupley was born August 31, 1840 in Ohio. He was described as a miner on his death certificate following his death August 13, 1917. He was mining in the Fort Jim area around 1872 and was involved in several mining ventures with his brothers and father. Rupley was married to a woman named Catherine and was living at Smith Flat.

William Rupley was born January 22, 1855 in El Dorado County. Although he was involved in numerous mining ventures, he was described as a farmer in the Smith Flat area when he died at the age of 54 in 1910. His father was John Wesley Rupley of Pennsylvania; no information could be obtained about his mother.

Joseph Rupley was born at the Rupley "Home Ranch" between Smiths Flat and Camino in 1858. He was known as a stage and stockman having operated horse dcrawn stages between Placerville and Carson City and Lake Tahoe. Later he established the first motor stageline between Placerville and Lake Tahoe. He was also involved in some mining with his brothers Theodore and William.

The Theodore Rupley Claim was located in the southwest quarter of the northwest quarter of Section 10, Township 10 North Range 13 East. This was an 80 acre placer claim of placer gold located on Sly Park Creek. Because of the nature of placer mining, the potential exists for Mercury contamination to Sly Park Creek (Wheeldon and Associates, 1991).

The Tom Shea mine described as being in the Sly Park vicinity could not be found in the Mining Locations. The closest mine Tom Shea apparently had to Sly Park was the Robert Emmett Gravel Mining Claim in Section 11, Township 10 North Range 12 East.

Peabody listed the Snow and Woods claim (also known as the Phelps and Wood claim) as being in Section 16 Township 10 North Range 13 East which would place it within the watershed. This claim, however, is more appropriately located in Township 10 North Range 12 East and was out of the watershed.

No information could be found for a mine owned by Weybright and Newell.

Wheeldon and Associates (1991) describe an unknown mine in the southeast quarter of the southeast quarter of the northwest quarter of Section 23, Township 10 North Range 13 East based on a shaft symbol noted on the USGS topographic map. No other information could be found for this mine and the potential for contamination to the watershed is unknown.

Five mines can be placed within the Sly Park watershed. These are the Hazel Creek mine, the Hazel Valley mine, the Baltic mine, the Theodore Rupley claim, and one unknown mine. None of these mines is currently active.

Luther Cutler died on January 17, 1882 in Alameda County, though he was apparently not living in that county. There was no obituary in the Mountain Democrat except for a small statement of his death and a notice of the funeral. His wife apparently preceeded him in death as he was survived only by Henry Stark, two brothers and a sister. John Blair and A.P. Catlin were the executors of his enormous estate. D. W. Chichester appraised a part of the estate and Charles Clemons appraised another portion.

A number of claims on Luther Cutler's estate, following his death in 1882, gave valuable information about the workings of his land holdings and operations. A Chinese laborer, Ah Gee, filed a claim for $20.00 for one month's work on the ranch. Several different mill keepers worked at the Pioneer sawmill and had claims for their wages. Henry Stark received $307.50 for labor in taking care of buildings and the ranch at $2.50 a day for 123 days. He also inherited the Michigan Bar and Sly Park ranches; although he did not inherit the right to sell the land, it was stipulated that if Stark had children and died before they did, his children would inherit the ranches and had the right to sell them.

Cutler's brothers, Sanford and Thomas, and his sister, Hannah G. Ford, apparently were not living in the area. Sanford, it is known, was living in Indiana in 1884.

At the sale of Cutler's personal property numerous persons living in the Sly Park, Diamond Springs, Pleasant Valley, Middle Fork Cosumnes River, and Placerville areas attended. As examples of what was sold, the following descriptions are given:

Stark	**Eastwood**	**Sing-Sing**	**Card**	**Davenport**
1 mare	Lot Snath	1 Anvil	Scythe & Snath	Saddle
4 shirts	Saw	2 hammers	2 whiskey barrels	1 old force pump
overalls	Lot traps	7 pair tongs	1 barrel Lot Hay Rakes	Scythe & snath
5 pairs drawers	2 overalls	Lot traps Vice Picks		Spring
12 cow bells	30 lbs tobacco	Saw		Lot traps
Shot gun	2 jugs	Basket		Hammer
1 broom	Tobacco			Wrench
Bedstead & bedding	2 axe handles			Lot traps
6 boxes cigars	Shovel			Ox whip
Iron brand: S.P.				Axe
1 coat				1 book
1 pair pants				Lot Hay Forks
Violin				

This is not a complete list of what each of these men bought. It should be noted, perhaps, for clarification that some items were sold by "lot". This simply describes that a number of items from one to "x" number were sold in a bunch. A "snath" is the handle of a scythe. "Sing-Sing" apparently was another Chinese in the Sly

Park area.

Stark, who inherited the ranches, was more interested in equipment for running the ranches, as well as interested in obtaining Cutler's clothing. Sing-Sing may have been a blacksmith, judging from the items he purchased. Davenport was hydraulic mining five miles south of the park and Card was Cutler's logging business partner. Eastwood was homesteading land in Hazel Valley. He filed a claim against Cutler's estate for payment for the purchase Cutler had made of 156 pounds of pork at 12.5 cents per pound.

Probate records also showed that Cutler had stock and equipment at the Michigan Bar ranch which included 10 oxen stags, 31 oxen steers, 2 bulls, 54 cows with calves, 71 two year olds, 66 one year olds, 3 horses, 3 wagons, one logging truck, and 21 ox yokes.

Henry Stark married Mary Melinda Carmichael the same year that Luther Cutler died. Mary Melinda Carmichael was a native of El Dorado County and a charter member of Marguerite Parlor. She was born at Reservoir Hill, near Placerville, on June 12, 1857, one of three children. Her mother was Ann Elizabeth Carmichael. No information could be found on her father. Mary Melinda's siblings were a sister, Cynthia Nevada (married Frank Childs), born at Negro Hill (Folsom), and a brother, Robert I. Carmichael.

The Starks moved to Sly Park to live at the Sly Park House. This house was known variously as the "Cutler Hotel, Sly Park Hotel, Park Hotel, and Park Resort (Peabody, 1986:238). It was located a few hundred yards away from the Sly Park School which was located in Section 9, off the west end of today's Sierra Point within the park (Deeds, Book 37:402). This would put its location in either Section 17, if it was located close to Sly Park Creek, or the southeast quarter of Section 8.

The Starks had three children: Park Cutler, born June 29, 1889; Henry Elmer, born March 15, 1891; and Hazel Alma Starks born April 25, 1895.

At some point the Starks left the Sly Park House and moved to the Hazel Valley House. This house was a two-story house they ran as a hotel. It contained a dining room, bar, and small post office. They also had a dairy and raised cattle. In later years, they added a small store. Community affairs usually took place at the Hazel Valley House. The GLO plat map of 1874 shows the Hazel Valley House to be located on Pine Creek in the northwest quarter of the southwest quarter of the southeast quarter of the northeast quarter of Section 9, Township 10 North Range 13 East. Pine Creek apparently was an early name for Hazel Creek as the location on a modern USGS topographic map places the House on Hazel Creek about 500 to 600 feet northeast of the confluence of Sly Park and Hazel Creeks.

By 1895, the Hazel Valley House was boarding workmen from the nearby Blue Gouge Mine (out of the watershed study area) through the winter.

In 1883, Sioli described Joseph Bryant as owning "two mills, the Diamond mill close to the Main Trunk canal and the Stonebreaker mill, on the old emigrant road at Lake Springs-the latter has not been running for years" (1883:113). Joseph Bryant also owned a lumberyard in Diamond Springs, but sent "most of his lumber down below" (this is possibly a reference to the shingle mill at Shingle Springs). Much of the lumber cut was for the production of shakes and it was primarily Sugar Pine which was cut for this purpose. Joseph Bryant was born in New York in 1822, the second of six children. One of his brothers was Herman LeRoy Bryant, with whom he was involved in the lumber business. Two other brothers were Warren and Alexander. The Bryant brothers came to California in 1864. Herman Bryant had a ranch at Latrobe and, with his in-laws, the Nightengales (Nightingale) (relatives of Florence Nightingale) summered cattle at Sly Park around the turn of the century. No relationship could be found between Hiram O. Bryant and Joseph and Herman, although that cannot be ruled out. Herman and Joseph's father was Freeman Bryant of Massachusetts.

Also in 1883, Seth G. Beach began operating a box factory in Placerville established on property owned by Frank Morey in 1882. Beach was associated with C. D. Chichester, but the firm only carried Beach's name.

In order to create a market for boxes, Beach initially sold peach and pear trees to local farmers, hoping to increase the fruit industry and develop a need for boxes for shipping fruit. By 1888, the factory had expanded and was moved to a location on Sacramento Street (where the current Bank of America and Fire House are located) and a retail lumber business was added. All the lumber used in the box factory and a majority of that sold at the retail outlet was purchased from several of the smaller local sawmills (Mountain Democrat, August 27, 1939:7).

In 1890, John Fuller and William E. Newell deeded the Sly Park sawmill to John's wife, Annie, and to Constatine Papa. The sale consisted of the building and all machinery and all apurtenances excepting the steam engine and boiler. It included mill saws, 19 head of work oxen, three logging trucks, ox yokes, chains, and about 10,000 feet of clear lumber which was currently at the mill.

Papa apparently changed his mind or did not fulfill some obligation enabling him to become the owner for the next year Fuller and his wife sold the mill and land to Henry Sylvester Morey. The land was described as that portion of the southeast quarter of Section 17 lying on the north side of Sly Park Creek. Morey was a machinist who later owned and operated the Placerville Foundry on Main Street in Placerville. The 1867 Great Register indicated he was born in Maine around 1839, however it also stated he had been naturalized in 1867 in the 6th District Court in Sacramento County. He may have come to Maine from England or Europe and then moved on to California.

Morey was also later instrumental, working with Agustus Mierson (from Prussia) and James Blair (from Scotland), in purchasing land in the lower elevations for the development of the Sacramento and Placerville Railroad (Starns, 1992).

In 1891 Alexander Card, age 55, and a resident of the Diamond Springs Township, married Annie Fleming, a native of California, aged 15 years. Annie's mother, Ellen Fleming gave consent for her daughter to marry.

The Mountain Democrat reported on May 16, 1891 that the Bryant's, Davenport's and the Sly Park mills "will soon be in full blast, and teams are already at work hauling out some of last year's cut" (page 1).

Morey sold the Sly Park sawmill and the land to John and James Blair in 1892. This sawmill was described in the deed as being in the southeast quarter of Section 17, Township 10 North Range 13 East. It was known as the Fuller and Newell sawmill.

The Blairs were from Scotland and had begun emigrating to California in 1848 when John Blair came to America. He was joined in 1850 by two brothers, Matthew and James. John came out to California in 1852; his brothers waited in Ohio to see if he would be successful or not, however, "it was understood that whatever business John engaged in would be in the name of J&J Blair" (Yohalem, 1977:194).

The Blair Brothers were involved in the lumber business as well as mining and land speculation. James Blair's son, J.B. Blair, operated a sawmill in Sly Park which may have been the Sly Park sawmill (Fuller and Newell mill). This mill was said to have been located below today's second dam. If the mill was located on Sly Park Creek (and it most likely was) and in the southeast quarter of Section 17 it would have been located just below the second dam at Jenkinson Lake.

Examining the record of operation of the Blair lumber mills, they seem to have operated in essentially the same kind of manner as that described in 1882 by the California State Mineralogist. That is, the typical mill was

> located in some convenient valley, to which a small stream of water is conveyed by ditch or flume, for the use of the engine. The mill is covered by a roof of rough boards, while the sides are open. The building is generally constructed after the engine and saws are set, the boards being cut by the mill, and the house built

> over the machinery. The mill is generally, if not always, driven by a common steam engine of sufficient power.

The primary timber cut was Sugar Pine for building and logs were hauled on wooden "trucks" pulled by oxen over skid roads. Other kinds of timber were cut to provide material for boxes for the growing fruit industry in the county.

Log trucks had large wooden wheels with steel rims. When hills were too steep for oxen or horses, the log trucks were abandoned and the logs were slid down chutes. Often logs were "dry decked" because there was not an adequate supply of water for a log pond. The first mills used powered carriages operated by wooden rack and pinion gears. By the 1880's, cable and pulley drive carriages were used (Yohalem, 1977).

Cola (1994) described an arrangement used by Hooper just outside the watershed study area, but worth reporting. Hooper had constructed a narrow gauge railroad to haul logs (shown on the 1874 GLO plat) over very steep terrain. In order to provide a brake system, two sets of tracks were constructed. As a load of logs were carried down one set of tracks, a car filled with water would rise on the other set of tracks, its weight helping to slow the log car and keep it from running away down the tracks.

When James Blair died in 1902, his estate was valued at $20,000 and consisted of vast land holdings, mines, and lumber operations. His estate was divided between his wife, Amanda, and their six children.

John Blair died in 1907 leaving has his legatees and devises Robert Blair, Jeanette Turney, Newell Blair, Frederick Blair Birdsall, William Blair Knights, John Newell Blair and Mabel Birdsall. His heirs were Mabel Birdsall, John Newell Blair (his daughter and son) and William Blair Knights, a grandson.

Caleb Gardener Carpenter died on December 17, 1891. His heirs included his five children. One son, Walter D. Carpenter, inherited land in Sly Park in the east half of the southeast quarter of Section 5, Township 10 North Range 13 East.

Caleb was from New York; he had been born in 1817. As a young man he had worked on a farm, in a sawmill, and in a carding mill, all endeavors in which his father was engaged. Carpenter came to California in 1851 by ship and settled in Diamond Springs marrying Sarah H. Payne, from England, that same year.

For four or five years he was involved in mining, but about 1856 or '57 he began a brewery in Diamond Springs. Later he became a fruit grower in that town and developed one of the finest orchards in the county, growing apples, pears, peaches, plums, apricots, almonds, walnuts, quinces, nectarines, chestnuts, mulberries, oranges, lemons, figs and pomegranates, persimmons, and grapes (he had about 125,000 grapevines) (Sioli, 1883). Carpenter made vinegar, wine, and brandy in addition to raising stock (cattle) (Deeds, Book 43:057).

In 1895 Walter D. Carpenter added to his Sly Park lands by patenting the north half of the northwest quarter of Section 9. Combined with the east half of the northeast quarter of Section 8, this gave him 160 contiguous acres of land (Patents, Book G:139). After Walter D. Carpenter died in August of 1895, the land became the property of his wife, Jennie Carpenter when his three children, Lawrence P., Walter C., and Albert J., all of Sonoma County, deeded the land to their mother.

Carpenter's estate consisted of the east half of the northeast quarter of Section 8 and the north half of the northwest quarter of Section 9, Lots 3 and 4 of the northwest quarter of Section 4, Lot 1 of the northeast quarter and the east half of the southeast quarter of Section 5 in Township 10 North Range 13 East. This land was bisected by a small creek called Carpenter's Creek; today it is the creek which flows beside the Miwok Trail at Sly Park. The homestead is marked on an 1893 map (reprinted in 1931) as "Carpenter".

Before Henry Stark died on February 1, 1898, he was mining at the Knapp and Faretta placer gold mine (out of the watershed study area). After his death the ranches and Hazel Valley House were inherited by Mary Stark. She continued to run the ranch with the help of her children, especially her older son, Park.

In 1898 three students were promoted to the next grade at Sly Park School: Ella and Ida Farretta and Cleve Robinson.

Mary Melinda Stark's mother, Ann Elizabeth Carmichael, died around 1905. Her three heirs were her children, Cynthia Nevada Childs, Mary Melinda Stark, and Robert I. Carmichael, all residents of El Dorado County. They each inherited one third each of the northwest quarter of the northeast quarter of Section 9 and the southwest quarter of the southeast quarter and the north half of the southeast quarter of Section 4 in Township 10 North Range 13 East. This 160 acres had been patented by Annie E. Carmichael in 1896.

The three heirs deeded all the timber and trees on this 160 acres to Albert J. Rupley in 1923 for $1500. The deed only included timber and trees at least 15 inches in diameter three feet from the ground and the logging had to be completed 18 years after March 11, 1923 (by March 11, 1941). It included Rupley's right to build all necessary sawmills, buildings, roads, chutes, ditches, etc. for logging purposes.

Around the turn of the century, the government land east and north of Sly Park became available to the public and patents were applied for; in all, some 41 patents are described in Book K, alone. Familiar names, along with unfamiliar names, are found throughout the two Ranges (13 and 14) included in the watershed study. These include Ira Burke, Nieta Allen, Carlo Farati, Zadie DeVoe, Henry Gremenger, John B. Rupley, Clarence S. Bryant, James Walk, Joseph Bryant, Annette Weyman, William L. Nightengale, and William Vandenburg (see Map ____).

Alexander Card sold his west half of the northwest quarter of Section 16 to R. A. Lang in 1909 and Lang sold the property to Park Stark in 1911. At that time the property also consisted of a dam, dam site, water-right, and ditch. The water was taken from Park Creek about one third of a mile above the property and was conveyed to a point about 150 feet from Duncan's house in Hazel Valley.

In 1892 Albert H. Duncan had purchased 160 acres in the west half of the southeast quarter and the east half of the southwest quarter of Section 9. This homestead had been patented by Morris S. Eastwood on May 1, 1884.

Duncan located water rights to 50 inches of water from Sly Park Creek and built a ditch in 1895. He diverted water by means of a small dam which was situated about 100 feet from the dam of Mary Stark. Her dam was commonly known as the Old Cuttler (or Cutler) dam. The water was diverted into a ditch by means of a short 10 x 12 inch box or flume. The ditch averaged about two feet in depth and about one foot wide on the bottom and was said to be able to carry 50 miner's inches of water measured under four inches of pressure.

In 1911, Duncan claimed another fifty inches of water diverted by a dam and similar flume across the creek about 200 yards above the dam of Mary Stark. This water was used for irrigation, household, and domestic purposes.

Duncan sold his 160 acres in Section 9 to Allen Bishop and Harvey P. Goodman in 1911, plus an additional 160 acres of land in Section 10. Bishop, a single man, sold his share of the 320 acres of land to Goodman the following year, along with all ditches, water rights, and personal property. That Bishop owned a house is evidenced by a 1911 map of the park showing "Bishop's house" in Hazel Valley. It is believed that the chimneys in Chimney campground are all that are left of Bishop's house.

The Seth G. Beach box factory began shipping box shook (parts) out of the county in 1914.

The Earl Fruit Company of Placerville had purchased large tracts of land in the watershed study area (and surrounding the watershed) for the purpose of mining and logging. Much of this land was sold to the USFS, Eldorado National Forest, in 1928, adding to the National Forest by Proclamation #1852 and the Raker Act. The assumption that the Fruit Company was engaged in mining and logging is based on a 1919 deed of land from C.E. Pollock, et.al., to the Fruit Company in which the Company purchased pine, spruce, fir, and cedar 14 inches and larger as well as all sawmills and related buildings and all machinery from the Pollock's who were involved in logging. The Earl Fruit Company appears to have been producing its own boxes.

In the 1919 transaction to the USA, the Fruit Company sold large amounts of land but retained the right to mine or remove gold and silver deposits under certain Forest regulations. The Forest also agreed to reimburse the Fruit Company for all marketable timber and other timber products (Deeds, Book 175:414). The following year, the Fruit Company deeded all right and title to minerals and mineral rights described in Book 175:414 to the Forest (Book 183:284).

Duncan's portion of Hazel Valley was sold three more times before being purchased in 1915 by G. B. Vicini of Amador County. Vicini and his heirs retained the property until 1929, building and operating resort houses. In 1929, the land was sold to EID for $25,000.

Another section of Hazel Valley consisted of 160 acres of land homesteaded by Carlo and Margarette Farati (later, Charles and Margaret, or Margarette, Farette). Margarette Farati was born in California on May 3, 1858. Her father was from France. Charles Farati was born in Genoa, Italy. When he registered in 1882 he was 36 years old and described his occupation as a miner in the Diamond Springs Township. He was naturalized in El Dorado County in 1867.

The Farati land was the west half of the southwest quarter and the south half of the northwest quarter of Section 9, Township 10 North Range 13 East. Farati applied for the Homestead Certificate on October 21, 1889 at the request of Silas G. Babb. Two years earlier, the Farati's had deeded a portion of this land to the Sly Park School District, as mentioned above.

Farati sold his homestead to Silas G. Babb in 1913 and Babb sold it the same year to Park Stark who added it to his adjacent landholdings.

Charles Farati died on January 6, 1916 at the age of 68 years. He was survived by his 55 year old wife and ten children. By this time, the Farati's were living at Coon Hollow. Farati had been employed for over 30 years by the Blair Lumber Company (Mountain Democrat, January 8, 1916).

Park, Elmer, and Hazel Stark sold their land to EID around 1929. EID had plans for the construction of a reservoir, but never was able to finance this construction. Ultimately, the land was sold to the Bureau of Reclamation which planned to construct the reservoir as part of the Central Valley Project. Construction of the dam and reservoir began in 1950 and was completed in 1955.

F. L. Burns redeemed land in Sections 4, 10, and 19 in Township 10 North Range 13 East. Only the lands in Sections 4 and 10 are within the watershed study area. Burns later joined with L. C. Sisemore in a small logging venture. In 1920, Burns and Sisemore purchased vast tracts of land within the watershed study area from Nathan and Rosa Kohn in Township 10 North Range 14 East including all the trees and timber "together with the privilege of erecting a sawmill or mills", building roads such as wagon, rail, or skid roads (Deeds, Book 93:326). William L. and Myra Nightingale (also, Nightengale) deeded land within the watershed study area to Burns and Sisemore in 1920. This included portions of Sections 17, 18 and 20 in Range 14.

Around 1931, George and Fred Phippen, brothers, began to implement a timber harvesting project in the Sly Park area. The Phippens had signed an agreement with A.J. Rupley to purchase all of Rupley's merchantable timber on 2581.61 acres around Sly Park (though not within the Park itself). Rupley was to hold a lien upon the sawmill which the Phippens were to build.

Two years later, however, Fred Phippen died. Before he died, he deeded his interest in the Sly Park sawmill to his wife, Cecelia, and to his son, Harold. George and his sister-in-law, Cecelia, became partners in the Phippen sawmill which was built around 1933. It was located immediately east of Bishop's house, across Hazel Creek, close to the confluence of Sly Park Creek. The ruins of this sawmill can be seen today when the reservoir waters are low enough.

The sawmill was typical of the kind of economic endeavors which developed in the county around 1860, although this particular sawmill was constructed in the Twentieth Century. The early small sawmill companies were generally seasonal, particularly such mid-elevation timber industries which had to cope with bad weather in the winter. The companies tended to be self-sufficient, making all their own repairs in the blacksmith shop on site, housing all employees on the job site. A description of this sawmill shows that in addition to the mill and boiler house, it consisted of a blacksmith shop, an office and living house (combined), a cook house containing a wood range and water tank, garage and woodhouse, and five to six small cabins.

By 1939, approximately 1600 workers were employed in the lumber business in El Dorado County and received $1,800,000 annually for the production of grade lumber and the manufacture of box shook. The approximatee annual cut of lumber in the county was one hundred million board feet, mostly sugar pine, Ponderosa pine, fir, and incense cedar (Mountain Democrat, August 27, 1939:7).

This same year the Placerville Lumber Company planned to cut about 200,000,000 feet of timber in the Alder Creek camp area. Of that, five million was to be sold to Caldor in Diamond Springs, five million to the Sacramento Box and Lumber Company, and ten million to the Seth G. Beach Box and Lumber Company. The Placerville Lumber Company employed 140 men that year.

In 1943, Seth G. Beach and Harvey West entered into an agreement which involved the sawmill at Sly Park. Beach owned the S.G. Beach Box and Lumber Company of Placerville. West and M. L. Cramer owned the Placerville Lumber Company (PLC). The PLC wanted to purchase Phippen's sawmill, but did not want to invest its finances in the mill at that time. The PLC had also entered into an agreement with the United States Forest Service (USFS) for the purchase of 14 million feet of timber. Beach's Box Company wanted to obtain the box lumber manufactured from the timber cut at Phippen's mill. The PLC suggested that the Box Company purchase Phippen's Mill, including some adjacent property north and east of the mill. The Box Company would then give the PLC an option to re-purchase the sawmill and property within the following yeawr.

The Box Company agreed to purchase the sawmill for $40,000, plus the cost of purchasing and installing electrical equipment and the cost of constructing a power line connected with the power line owned by PG&E which extended to the Middle End Mine in Grizzly Flat. The Box Company was to operate the sawmill during the 1943 season and would continue to operate it thereafter, if the mill was not purchased by the PLC.

In April, 1940, the Mountain Democrat reported the Phippens' mill was beginning operations and had employed some 30 men (April 11).

The Phippens sold their sawmill to the Box Company on April 9, 1943. Around the same time, the PLC entered into a twenty year agreement with the Rupley family for timber harvesting in the Sly Park area close to the sawmill.

Ultimately, the Bureau of Reclamation began construction of the reservoir. A 1954 Land Purchase Contract was formulated between the United States of America, Fay Rupley Gunby, and the PLC for timber harvesting in the Sly Park area. It appears that the PLC used the Box Company's sawmill during this time to harvest timber and clear the reservoir area.

Land use continued to be for logging purposes as well as livestock grazing at these higher elevations.

Hazel Valley. Hazel Valley was first settled around 1861 when Henry Fagen sold 160 acres to John Seaman (Deeds, G:397). No record could be found showing how Fagen obtained the land. Seaman sold the land to Richard Kent (Deeds, H:138) and Kent sold it to Sam Kyburz in 1875 (Deeds, S:129).

Samuel Kyburz had come to California from Switzerland with John Sutter around 1811, according to his obituary in the Mountain Democrat. He was Sutter's advisor and business manager. Kyburz made the preliminary survey for the Coloma mill site at Sutter's request.

In the early 1850's Kyburz was a merchant in Sacramento and San Francisco. Following that, he came to Clarksville in El Dorado County where he farmed and raised stock for the rest of his life. He was a Justice of the Peace for several years. Kyburz and his wife had three sons, Samuel E., Albert, and Daniel, and one daughter, Mrs. Charles Kent of Oakland. He was buried in Folsom (January 22, 1898:4).

The same year that Kyburz purchased the 160 acres in Hazel Valley from Richard Kent, he sold it to Luther C. Cutler and it became a part of Cutler's estate (Deeds, S:251). Cutler's estate, of course, was inherited by Stark, and was ultimately sold to EID in 1929. It became a part of Jenkinson Lake when that reservoir was constructed as a part of the 1955 Central Valley Project.

Tuman Mill Site. In 1883, Herman and Charlotte Bryant had a daughter whom they named Alida Leona. Alida Leona Bryant grew up to marry Virgil Avansino in 1912, one of two sons born to Nicola and Julia Avansino of Pleasant Valley. Alida and Virgil Avansino had a daughter, Alida J. Avansino, who married George D. Tuman.

In 1936, Alida Tuman deeded a parcel of land to her husband on which the remains of the Tuman Mill are located in Section 16 of Township 10 North Range 14 East.

Very little information could be obtained about the Tumans or the mill. It appears to have been a small mill, possibly even smaller than the Phippens' mill.

Edward E. Tuman leased the F. H. Brown planing mill in Pollock Pines in 1939, possibly a connection with the Tuman Mill for processing timber.

By 1940, the Mountain Democrat reported that no information had been received as to whether or not the mill would operate that year. By 1945, George, now apparently living in Siskyou County, quitclaimed the land back to Alida who was living in El Dorado County.

Alida Tuman later remarried and, in December of 1948 as Alida Hogan, deeded the Tuman Mill property to her uncle, Stanley S. Bryant (Herman's son). Stanley deeded the property to his two daughters, Verna Minton and Amy Burnett, in 1959. Verna preceeded

Amy in death and in 1992, just before her own death, Amy quitclaimed the land to her husband, David W. Burnett, Jr., and son, Dennis W. Burnett (Deeds, Book 3708:716).

Summation. The historical land use of the Sly Park watershed shows early use and settlement, primarily as a result of the gold rush era and because the Sly Park area lay on the Mormon-Carson Emigrant Trail. It does not appear to have been an area of intensive mining, although some mining certainly did occur within the watershed. The principal early use of the area, however, was for the timber resources which were required in drift and hydraulic mining outside of the watershed, as well as for shingles in building construction. A secondary use of the timber, but increasingly vital, was for fences and buildings in ranches within the county.

As a consequence, numerous small sawmills were developed early in the area and probably provided much of the county's milled lumber from 1853 until 1910 when the Sly Park area experienced a depression. The revival of logging in the '30's helped to offset some of the depressed economy locally, although there is no doubt that the Great Depression affected a large number of people in El Dorado County.

A second major use of the Sly Park watershed has been that of high elevation grazing lands. This use has carried with it the unique tradition of mountain transhumance: that is, moving cattle and sheep from lower elevations during the summer months to higher elevations. However, an additional feature was that entire families would move to the higher elevations during the summer months with the stock.

The Sly Park watershed population was highly diverse in ethnic representation initially, just as much of the rest of California was due to the influx of miners from around the world. By 1860, however, an obvious change is seen in the population. The decreasing loose placer gold, so easily retrieved, combined with economic depressions and hard times in California and the discovery of new gold fields in Alaska, Canada, Colorado, Utah, and Nevada resulted in a substantial decrease in California's population. Those who did stay, stayed with an intent to settle and economic diversification developed around this time, primarily in the form of increased logging, ranching, and farming.

The European families who obtained land at the higher elevations included those of Italian, Italian-Swiss, and German background. These families all shared the knowledge of mountain transhumance brought to California from their native lands. In fact, one primary reason these families tended to come to California was to obtain land. Many could not purchase land in their native lands and the availability of relatively inexpensive land in California was as much a draw as was the hope of becoming rich in the gold fields.

The Italian-Swiss brought their cultural traditions of "agro-pastoralism" created out of an alpine ecology. Mountain transhumance was developed as a subsistence strategy to short growing seasons, poor soil, steep slopes, and long winters. Communities were independent of each other, yet cooperative with each other. "Family partnerships [and marriages] were also used as a means to protect family interests" (Rood, 1992:57).

Honigmann (in Goodenough, ed., 1964) describes two overlapping categories of population in central European villages: those who worked the land and those who do not work the land. Those who work the land are called Bauern, or peasants. They practice dairy farming, sell timber, house tourists, and derive additional income from family members who employed in business or industry, or, occasionally, from a tavern the landowner operates.

"This subsistence strategy, which is the only effective means of exploitation of the limited environment, has led to a very conservative culture where new methods are not viewed as beneficial" (Rood, 1992:53).

"It ideally suited commercial stock raising, because calves and heifers intended for autumn sale could be raised cheaply through the summer...leaving valley hay for the more productive milch cows" (Honigmann, 1964:278). The higher elevations were also more conducive for making and storing butter, cheese, and other milk products over the summer which were then sold for profit.

While such products were sold in Diamond Springs, Placerville, Smith Flat, and other areas, they were also sold to miners and to the boarding houses associated with the local sawmills.

Mountain transhumance was so suited to the climate and terrain of El Dorado County it was quickly adopted by non-European settlers such as the Bryants and Cutler who had no background in this culture.

California (and El Dorado County) had a tremendous need for the products which logging, ranching, and farming provided. Additionally, farming provided individuals with a certain amount of economic stability so that depressions did not seem to affect families in the area as much as in the rest of the United States.

In particular, during both the national depressions of 1873 and 1893 (caused by government funding of the massive railroad systems) the Sly Park area experienced small economic booms. In 1873, this was enhanced by the construction of the High Camp Ditch, a segment of the massive Crawford Ditch system, to provide water to Sly Park and lower elevations for mining, milling, and agriculture. In 1893, there was a revival of mining in areas adjacent to the watershed which had a positive economic impact on those living in the Sly Park watershed. Logging increased in the watershed in order to meet the increased demands from mining. The Blair Brothers were able to operate their sawmill at Sly Park from 1890 to 1908, an 18 year length of time almost double their mill operations in other parts of the county.

In 1925 the Pollock Lumber Company was cutting logs in Township 10 North Range 13 East Sections 10, 11, 12, and 16 and in Range 14 East in Sections 17 and 18. Additional logging was apparently being done by smaller companies such as the Rupley's, Bryants's, Burns and Sisemore, and Gremenger (Wildman, 1925).

Although a number of different people were involved in land purchases within the watershed, the years of approximately 1860 to 1929 represent land ownership within Sly Park by essentially one family: Cutler-Stark. Cutler and Stark were involved in the industries of logging and ranching, although both were also merchants by way of owning the local store and hotel. In adjacent tracts, land was continuously owned by members of the Bryant/Nightingale, Blair, and Rupley families.

Higher elevation pastures and logging areas were owned around the turn of the century by families such as the Bryants, Nightingales, Gremengers, and Rupleys who also owned lower elevation stock ranches. These families were basically involved in two industries: timber and ranching. Large stock ranchers operated under the system of transhumance, that is, moving stock from lower elevations during the summer to the higher elevation meadows and back again in the winter. This relieved pressure on lower elevation pastureland which otherwise would have required large amounts of irrigation during the dry summer months and was easier on the stock which did not have to endure the intense summer heat of the lower elevations. It was obviously a move enjoyed by most families, too, who moved their homes to the higher elevations for the duration of the summer; some saw it as a vacation.

The Central Valley Project and the re-purchase of the lands east of Sly Park by the United States Forest Service brought most of the area back under the dominion of the United States of America. While some of the land north of Jenkinson Lake is privately owned and has been converted into subdivisions, the major portion of the watershed consists of Sly Park, the reservoir and campground owned by the Bureau of Reclamation and managed by EID, and Eldorado National Forest (ENF) land. Private lands within the ENF are owned by Georgia-Pacific Logging Company which is currently logging tracts of land.

Today the USFS records of cultural resources in this study watershed reflect the uses described in this report: there are remnants of houses for Vandenburg, Bryant, Nightengale, Rupley, Stark and Zumwalt. Stonebraker's, Blair's, and Beach's sawmill sites are noted, as well as remnants of 1874 ditch systems. Early road systems are represented by Louis Lepitit's grade, roads to Cutler's sawmill, and roads to various homesteads, such as Gremenger's. Telephone lines were introduced into the area in the early part of the century, around 1915.

In all, this particular watershed is an example of historic development in the area from logging and mining to transhumance ranching and farming. The population declined to a large degree in 1910 when mining declined and logging moved to Fresh Pond. The Stark brothers continued to ranch in Sly Park and others were logging in the higher elevations, but Sly Park as a stable community was ended.

By the time the Phippens' mill was cutting timber in Sly Park during the depression, there were only 14 mills operating in the county and the two largest, the California Door Company (Caldor) and the Michigan-California Lumber Company, were producing most of the lumber (Supernowicz, 1983). In spite of falling timber prices between 1930 and 1940, the Phippens' mill continued to operate. This may have been due to the shift to the Beach Box Company and the emphasis on box production for the developing fruit industry within the county. In addition, following World War II, there was an increased distribution of lumber on the world market and a change in the use of timber as housing construction increased. In addition, as Supernowicz points out, there was increased use of lumber for farms, railroad construction, mining, manufacturing and shipping, fuelwood, pulpwood, poles, pilings, fence posts, veneer logs and bolts, and wood for hardwood distillation (1983:125).

Today logging is done within the watershed study area on private lands owned by Georgia-Pacific Lumber Company or by the Forest Service.

The tremendous resources of the area in minerals and timber, as well as land on which cattle and sheep could be grazed, the early development of Sly Park as a route into and out of the county as well as to higher grazing pasture lands, and the development of a large water conveyance system in Sly Park resulted in the development of early, stable economic factors which sustained the area's population until around 1910. At that time the Public Lands were being sold to ranchers and loggers who continued to utilize the watershed's resources in a similar manner. Sly Park, itself, changed from a community where loggers and miners resided and became more of a ranch for Park and Elmer Stark who formed their own company, the Stark Brothers. The school had moved to Fresh Pond with the movement of logging to that area.

In addition, mining appears to have declined in the surrounding area and this seems to have leveled a final blow to the Sly Park community. Hydraulic mining, in particular, had been dealt a severe blow in 1884 with the Sawyer Decision, and again in 1893 with the Caminetti Act, both of which placed severe and costly environmental requisites on hydraulic miners. Drift mining replaced hydraulic mining to some degree, but even drift mining gradually was replaced with dredge mining in the lower elevations, particularly at Folsom.

The Eldorado National Forest was created in 1910 and came under the general Forest Service policy of multiple-use management. "Years of overstocking had reduced much of the vegetation to stubble, causing increases in the rate of erosion" (Supernowicz, 1983:150). Forest Service investigations showed that sheepherders had created the greatest damage to the ecology and the Forest Service began to develop policies regarding grazing on public lands. Use fees were developed to help pay for the care and protection of the natural resources in the forest.

While families continued to graze cattle in the summer months, much of the privately owned land was logged by numerous small logging companies, particularly during the Great Depression. This seasonal work for men was supplemented by the seasonal work for women in the county who were able to obtain work in the fruit packing sheds.

Some time between 1910 and 1944 the Park and Plum alotment was formed within the Eldorado National Forest. The private land was owned by several members of the Bryant family. The public land, ENF land, was combined with the Bryant land in order to make a larger land unit for grazing cattle.

In 1944, seven different grazing permitees ran cattle in the Park and Plum alotment. These permitees included Bryant, Carbine, Pilliken, and Neilsen. Bryant grazed 100-110 head of cattle until his death in 1957. Carbine had about 22 head of cattle he grazed at the higher elevations until his death around 1961. The Pilliken's had begun grazing use in 1940 around Camp Creek, but ultimately gave it up as uneconomical. Today, only Howard Neilsen still grazes cattle in the Park and Plum alotment (Brink, 1994).

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Appendix 4

Historical Land Use

Middle Fork Cosumnes River

HISTORICAL LAND USE IN THE WATERSHED OF THE MIDDLE FORK COSUMNES RIVER

By

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For

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INTRODUCTION.

A report of the historical land use of the watershed of the Middle Fork of the Cosumnes River was requested as part of an examination of the watershed quality required under California law.

The watershed of the Middle Fork of the Cosumnes River encompasses an area that is approximately 39 square miles in area (L [27 miles] x W [4.5 miles average] divided by pi (3.1417) = area square). It includes portions of Townships 7, 8, and 9 North and Ranges 11 through 15 East, Mount Diablo Meridian.

Historical land use in this watershed extends back to 1849 and the large influx of tens of thousands of gold miners who came to California following the discovery of Gold at Coloma in 1848. The area, however, was surveyed much later (1874) by the General Land Office than the 1866 surveys for the remainder of the county. This may have been due to the low population and relatively limited interest in the area in comparison to the greater population and interest in other areas of the county.

The early 1874 surveys done by the General Land Office were apparently not very accurate, either, as later surveys place Sections within the Townships and Ranges in very different places. This made researching the area by using the maps somewhat difficult, though not impossible. Current sections within Township and Ranges do not match, even closely in some instances, sections for the 1874 maps.

The watershed includes both public and private lands. The public lands are owned by the United States Forest Service, Eldorado National Service. Much of the information about the land use in this watershed has come from the 1983 Historical Overview of the Eldorado National Forest by Forest Service Historian, Dana Supernowicz. Additional valuable information has been supplied by a 1992 report written by Forest Service Historian, Rebecca Palmer, on Henry's Diggings, a mining camp dating to at least 1852 and which encompassed Sections 28, 29, 32, and 33 of Township 9 North and Range 13 East (MDM). In addition, archaeological research conducted by Dr. Susan Lindstrom in 1982 at Oiyer Springs and PiPi Valley includes an important historical overview of part of this watershed.

Additional information came from historic documents at the County Recorder's Office: deeds, pre-emption records, patents, etc. as well as from the County Historical Museum: Great Register data and Probate records, for example.

GEOLOGY.

The watershed of the Middle Fork of the Consumnes River lies on the gently sloping western face of the Sierra Nevada Range. This range is a large granite batholith extending for almost four hundred miles in a northwest trend. Its height extends to as much as 14,000 feet in some places and the range makes a formidable barrier to storms. The orogenic lift creates a wet western slope and a dry eastern slope which, although steep in comparison to the gentler western slope, has fewer drainages as a result.

During the early Tertiary period (prior to 65 million years ago [y.a.]), the existing mountain range of the time was worn down by erosion exposing gold-bearing quartz veins lying deep within the granite. Its general height was about 3000 feet. By 65 million y.a., a tropical climate resulted in enormous amounts of rainfall; numerous broad rivers and channels flowed down the very gentle slopes depositing vast amounts of water in the shallow subtropical sea which existed in today's Sacramento Valley.

Broad river valleys were cut deep by the river channels and the gold-bearing quartz veins were subjected to enormous pressures of large amounts of water. This natural hydraulicking released the gold and re-deposited it into the river channels.

About 30 million years ago, the Sierra Nevada range was rocked by a long period of earthquakes and volcanic explosions, first of rhyolitic deposits and then of andesitic deposits. The result was that the Sierra Nevada range rose as a direct consequence of earthquakes which lifted the mountains and ash deposits which covererd the slopes to hundreds of feet.

The ash deposits filled the Tertiary rivers and channels, filling and blocking them effectively. Over time, new rivers and channels were cut around this solidified volcanic material, making valleys and rivers several hundred to several thousand feet below the now higher Tertiary channels. Such auriferous channels became marked by water rounded river cobbles high above any current rivers and often in areas where no rivers were known to exist. New Tertiary channels cut through old ones, again freeing more gold in the loose placer form.

In the area of the watershed of the Middle Fork of the Cosumnes River, no Tertiary river existed for the Cosumnes River. However, the Tertiary Mokelumne River ran through the area.

The Middle Fork of the Cosumnes River runs east-west primarily through an area of Mesozoic granite with the exception of one area in Township 9 North Range 13 East which consists of undifferentiated Paleozoic rocks. Some of the Paleozoic rock has been identified as the Shoo Fly Formation of the Calaveras Complex.

The Shoo Fly Formation is composed mainly of quartzose sandstone and argillite (Loyd and Kohler, 1987:21).

East of this area of Paleozoic rock the river is bordered on the north and south by ridges of Mehrten and Valley Springs Formations of the Tertiary period (Wagner, 1981).

The Eastern fault zone is the primary fault zone through this area. Known also as the East Gold Belt (Clark, 1970), the predominant rocks in this area consist of granitic rocks, serpentine, slate, phylite, greenstone, amphibolite, various schists, quartzite, some hornfels and limestone, many of which are host rocks for gold. The gold belt runs in a generally south to north direction through Indian Diggings and Grizzly Flat. While Grizzly Flat is out of the Middle Fork Cosumnes River watershed, it was a part of the general mining area historically.

The area is underlain, also, by the Tertiary Mokelumne River which extends from Grizzly Flat to Indian Diggings and beyond.

Clark (1970) describes the Indian Diggings Gold District as consisting of the "Indian Diggings, Henry Diggings, Omo Ranch and Brownsville areas. Indian Diggings is best known as a placer-mining district, but there are a number of lode deposits."

The Fairplay District lay to the west of the Indian Diggings District. This district included the Slug Gulch and Cedarville (also spelled "Cederville") areas. Primarily a placer gold district, it also had some copper mines. Geologically, this district contains parts of an isolated Tertiary gravel channel extending southwest from Slug Gulch toward Fairplay. The geology also consists of limestone, slate and schist, granodiorite and younger, intervolcanic gravels (Clark, 1970).

HISTORICAL CONTEXT - OVERVIEW.

The historical period for El Dorado County essentially begins with the discovery of gold at Coloma in 1848. This event was followed by the influx of tens of thousands of gold miners whose primary intent was to make their fortune and return home. Consequently, their interests were not in taking care of the land as much as in removing as much of it as necessary in order to retrieve the gold locked within the bedrock and the ancient auriferous gravels hidden under tons of solidified volcanic material.

The first gold the miners retrieved was the loose placer gold in streams and rivers; while some made their fortunes this relatively easy way, many others found themselves working for years and only making a daily living. Before 1855, most of the placer gold was gone and miners were beginning to turn to other, more difficult, methods to obtain gold.

The impact of the gold rush and the subsequent decline in easy placer gold had a number of significant effects in the county and the State. The most obvious first impact was the tremendous increase in population from all over the world into an area that had previously had a relatively low population of Native Americans, Spanish, and Mexicans involved in cattle ranching.

The economy was not prepared to deal with the great needs of such a large and diverse population, particularly with respect to fresh foods, and many of the problems experienced early on by miners had to do with poor nutrition.

During these early years, the best description of California is that it was one of constant change. Land prices soared as a result of speculation, food prices sky rocketed, and the population continually increased. Towns came and went as word of gold strikes sent miners off from one place to another. Sanitation was nonexistent, rats, fleas, and mosquitos were plagues on the population. Roads were quagmires of mud in the winter and avenues of choking dust in the hot, dry summers.

The year of 1855 was one which saw a small pox epidemic invade California. In addition, an economic depression occurred when the bottom dropped out of the real estate market following land speculation and political corruption (Winther, 1936:106-107). Little mining had been done the previous year as a result of a drought; a chain reaction developed as miners required credit from merchants who, then, also required credit from the jobbers. The jobbers, "in turn had to request credit from Eastern shippers" (1936:109). California money flowed East and overseas to England and France; gold production decreased, local banks were drained of gold supplies and the economic situation in California became desperate. Banks began to fail as bank runs began. Companies went bankrupt and out of business; the Sacramento Union described a "deep feeling" prevailing as a result of the privations of the banking privilege" (1936:114).

An early problem which faced miners was how to extract gold from the host rock, once placer golds were gone and the miners turned to methods of mining lode gold. One of the earliest methods used was that of the arrastra developed by the Spanish. The arrastra consisted of a circle of flat rocks with a retaining wall. A horizontal beam was attached to a pivot beam in the center of the circle. Humans, mules, or waterwheel power would apply power to one end of the horizontal end. At the other end large boulders would be dragged over broken up ore and mercury, pulverizing the ore. The mercury would amalgamate with the gold. Heating the mercury turned it to vapors and the gold would be freed from the amalgamate.

A major drawback to this system was an early death from mercury poisoning. A lesser drawback, but one which led to another invention, was that it was a time consuming process.

Consequently, stamp mills were invented. This was a simple construction of two or more vertical iron pestles driven by a camshaft that raised and plunged the pestles into mortars (or "batteries"). Gold ore was placed in the batteries, mercury added, and the mixture pulverized by the stamping action of the pestles. After crushing, the ore was either cleaned out by hand or flushed out over a riffle bed where the gold could be retrieved by heating the mercury to vapors (Watkins, 1971). Again, a hazardous occupation.

Cyanide was used in some processing systems to virtually leach the ore out of its host rock. Methods for dissolving gold out of ore using cyanide of potassium were developed early in the 19th century, but were not practical until the middle of that century "when Elkington patented his process for electroplating articles with gold and silver from cyanide solutions" (Mining Directory Catalog, 1937:51). The cyanide process required dissolving gold in a weak solution of sodium or potassium cyanide and precipitating out the metals with zinc.

Mills using cyanide were either a "sand" plant or a "slime" plant or a combination of these two forms. Certain soapy and soft ores were treated by the slime process while free milling ores could be handled by a combination of the two methods (1937:51).

Smelting, using oil or powdered or lump coal, was done more effeciently using a large furnace, rather than a small one. A furnace of less than 100 tons daily capacity was felt to be inefficiently small. Sulphuric acid was a by-product of some smelters, expecially in districts near phosphate deposits. Other smelters produced oxide of arsenic and still others produced antimony (1937:54).

In addition to gold, however, other ores have been mined in the watershed of the Middle Fork of the Cosumnes River. Copper, limestone, garnet, epidote, calcite, quartz, magnetite, and pyrite have also been mined. Other ore minerals mined are chalcopyrite, bornite, chrysocolla, malachite, molybdenite, and powellite, and some silver (Loyd and Kohler, 1987).

By 1860 several events occurred which caused a decline in the population of California miners. New strikes were reported for Colorado and the Nevada Comstock and miners left California for the new gold fields. The Civil War began in the south and east and undoubtedly a number of miners from those affected regions left to take care of their homes and families. An 1863 drought sent many miners out of state to other mining regions in Idaho, British

Columbia, Colorado, and Nevada. New procedures for mining gold required money and the formation of companies or corporations, rather than being an individual effort as with placer gold. Mining costs were soaring, also, as a result of the costly legal battles the miners were involved in with downstream farmers and ship owners. These latter people were experiencing the devastation from hydraulic mining debris that choked rivers and resulted in navagational hazzards and flooding of towns and farms.

Hydraulic mining developed into the environmentally destructive force it became following the Civil War when Hoskin's Little Giant cannon was converted to water power. Other improvements included replacing canvas hoses with rubber hoses, and even later replacing those by riveted iron penstocks. The water force was strong enough to kill and sometimes did (LaLande, 1985:34).

The amount of water used by hydraulicking systems was enormous. May (1970) describes the North Bloomfield Gravel Company, Nevada County, using over 15 thousand million gallons of water in 1879; the Spring Valley Mine at Cherokee used 36 million gallons over 24 hours while 25 million gallons in 24 hours was not uncommon. Vast systems of dams, reservoirs and ditches, water-races, and flumes were constructed to meet the needs of hydraulic mining.

The legal battles between farmers and miners continued until the Sawyer Decision of 1883 and the Caminetti Act of 1894 which placed severe restrictions on hydraulic mining making it such a costly venture that that form of mining began to decline, though the process was still used into the early 20th Century.

Those former miners who did stay in California began to turn to other forms of making a living and began to take an interest in developing the new State. Many brought with them valuable skills for developing businesses, farms, ranches, and other industries.

HISTORICAL LAND USE IN THE MIDDLE FORK COSUMNES RIVER WATERSHED.

The earliest land use in the Middle Fork Cosumnes River watershed is directly related to the gold rush era and mining. During the early 1850's, a number of towns developed out of mining camps in the Middle Fork watershed. These included Indian Diggins, Henry's Diggins, Omo Ranch, Brownsville, Fairplay, and Somerset. Currently, 35 mines are shown as existant within the watershed.

Mining and Ditches.

First placer mined, the Middle Fork watershed region was hydraulic mined as early as 1852 (Walter and Palmer, 1992). In addition, drift mines which tapped into Tertiary gravels were placer mined. Quartz mining began in 1867 and continued to around the turn of the century.

Many of the placer mines were quite large. The Trinity Placer mine, for example, in Township 9 North Range 13 East encompassed 270 acres in Sections 28 and 29. The Michigan and Eagle mines were 96 and 122 acres respectively. The Relief Placer mine along On It creek was hydraulicked down to limestone bedrock. The Irish Slide Placer mine was also a drift mine and was worked until at least 1956. The Cosumnes Copper mine was worked as late as 1950 and produced gold, galena, pyrite, sphalerite, chalcopyrite, stibnite, arsenopyrite, ankerite, and sericite. It contains a main adit of 380 feet and several thousand feet of drifts.

Water was brought to a number of stamp mills for milling the ore by means of a number of ditches including the extensive Douglas Ditch in Township 8 North Range 14 East, the Shanghai Ditch, Cole's Ditch, the West Ditch, and approximately 50 other unnamed ditches or ditch segments within the watershed. The Shanghai Ditch was 16 miles long (Browne, 1868:202).

The Cedar and Indianville canal carried water from the Middle Fork Cosumnes River to Indian Diggins, Cederville, and Brownsville. Its cost was $100,000 (Sioli, 1883:104). Two other ditches, the Indianville and Cederville ditches, were built in the summer of 1852. Both had their headwaters on the South Fork of the Cosumnes River and supplied water to a water powerred sawmill at Brownsville.

In 1855, two more ditches were built which provided water from the Middle Fork from a point four miles above PiPi Valley. The cost was $200,000 each. These ditches supplied the miners at Brownsville, Indian Diggins, Cedarville, Fairplay and Spanish Creek. From here, water was taken cross-country to Plymouth, Arkansas Diggins, Michigan and Cook's Bars (1883:196-197). By 1857, all water ditches passed into the hands of J. M. Douglass.

Joseph McCurn Douglass was listed in the 1866 Great Register as being 46 years of age that year. He described himself as a banker from Kentucky who resided in Placerville. As early as 1853, Douglass was licensed to sell goods in Placerville. Douglass was elected as a delegate to the convention of 1857 organized to insure the swift completion of a wagon road from Sacramento to Carson Valley. One of 125 delegates, Douglass was appointed treasurer to the Board of Wagon Road Directors (Sioli, 1883:122).

Douglass was also appointed Treasurer to the Directors of the proposed Placerville and Sacramento Valley Railroad Company (1883:132) and was included in a lawsuit with numerous others when the Railroad Company sued in 1866. Judgment was for the Railroad Company and Douglass was ordered to pay over $973.00. Judgment was satisfied the following year in the amount of $708.41.

Douglass ran for State Senator in 1856 and lost to G. J. Carpenter. He ran again in 1861 and lost to O. Harvey.

Between 1856 and 1869, Douglass was involved in no fewer than 20 separate lawsuits (excluding the suit by the Railroad Company). These appear to have resulted out of his banking activities. In the majority of the cases, Douglass was the Plaintiff bringing charges against people who had borrowed from him and then been unable to repay the loan. In a large number of cases, the mortgaged property was ordered sold in Sheriff's sales to pay Douglass what was owed (Judgments, District Court Documents, Book D, various pages).

Douglass kept the ditch systems until 1874 when they were purchased by Charles E. McLane of San Francisco. McLane was described as "pursuing a more liberal policy toward the miners" (1883:197).

McLane owned and worked the Bell and Dorsey claim. Other successful claims in the vicinity during the mid-1880's were the mines of Burrows and Company, Bell and Murry, Lamb and Company and Patterson.

J. Ross Browne described the ditches of Indian Diggings as consisting of three ditches from the south and middle branches of the Middle fork of the American River, however, this is no doubt an error, as the water would have been supplied from the Cosumnes River. The water supplied Indian Diggings, Brownsville, Fairplay, Slug Gulch, and Cedarville with 1000 inches of water in the spring and decreasing to 150 inches in September. The ditches were completed in 1853 to 1855. The original cost was $125,000 and contained a mile and a half of flume (1868:196).

Henry's Diggings. No information is known about the man named Henry for whom the area was named (Walter and Palmer, 1992). Henry's Diggings is located on a gulch near the Middle Fork Cosumnes River about three miles south of Grizzly Flat. Nathan Aldrich had a dry claim here during the summer in 1852-53. Aldrich was a 30 year old miner from New York in 1852 (Special Census of 1852). A drift mine, active in 1894, was worked again in 1949. Several other mines were also worked intermittently and were still listed in 1956 as active (Gudde, 1975).

In 1856, the R.T. Jackson company constructed a seven mile long ditch to transport Middle Fork Cosumnes River water to the Diggins for five thousand dollars. Approximately 150 miners were prospecting in the Henry's Diggins area by that year and claims were selling for over one thousand dollars, a good indication that the claims were exceedingly prosperous considering the relatively small amounts of gold being retrieved by placer mining and poor hydraulicking methods. The most valuable claims were going for $7000 to $9000 dollar (Mountain Democrat, November 16, 1856 <u>in</u> Walter and Palmer, 1992).

Indian Diggins. Indian Diggins is located between Indian and On It creeks, both tributaries to the South Fork of the Cosumnes River. The Diggins were started in 1849 or 1850 when, as Sioli describes it, a group of white men found Indians panning for gold there. The area was a central point for Indians early on and, as Sioli states, "it was no uncommon sight at a "fandango" to see 1500 or more Indians...." (1883:197). In 1852, the camp had 50 log cabins, 2 hotels, stores, and gambling houses. The post office was established in 1853 with the name "Indian Diggings". In 1858, a mill for sawing marble was erected and was described as "successful" by Sioli in 1883. The name was changed to "Mendon" in 1869 and to "Indian Diggings" from 1888 to 1935. A very early miner's name for the area was "Whorehouse Gulch".

Ditches were constructed to bring water from the Cosumnes River and the camp grew rapidly to a population of 1500 by 1855. Aound 1900, it was still a center of drift mines and several mines operated into the 1920's and 1930's (Gudde, 1975).

Indian Diggings Creek, upon whose banks the town was built, was among the richest surface or creek diggings in that part of California. Both tunneling and hydraulicking methods were profitable (1883:196-197).

Omo Ranch. Omo Ranch is located on Perry Creek (first known as "Perry's Creek"), a tributary to the Middle Fork Cosumnes River. No early mining records exist for this area, but a post office was established in 1888 and in 1902 there were four stamp mills. The Oak Mine was active in 1894, the Omo in 1896, and the Potosi in 1908. The Omo and Potosi mines were active until 1938 (Gudde, 1975).

Brownsville. Brownsville, too, was located between Indian and On It creeks. In 1852, the Cedar and Indianville canal brought water to the town from the Middle Fork. Brownsville was named for Henry Brown. Of all the Browns listed in the 1852 Special Census, the most likely candidate for this particular Brown is the 29 year old miner from Maine. In 1867, J. Ross Browne described it as "deep diggings which will not be exhausted for many years" (Browne, 1869). In 1867, the post office was established and the town was renamed "Mendon" until 1888. Gudde (1975) states that the town was later called Indian Diggins; Sioli, however, distinguishes between Brownsville and Indian Diggins, which suggests they were actually two distinct towns. In 1869, one company in Brownsville had an eight stamp mill and took out about 50 ounces per week of gold. Additionally, a ten stamp mill was still in operation in 1905.

Fairplay. Fairplay is located near Perry Creek. In 1853, the mining camp was described as a "prosperous little mining town with several stores and hotels" (<u>Alta</u>, December 21, 1853 <u>in</u> Gudde, 1975). Later on the town became a trading center and post office for the numerous drift and hydraulic mines which developed in the area. In the 1880's agriculture prevailed, but a ten stamp mill was still in operation (Gudde, 1975).

Somerset. Somerset received its name in 1856 from settlers who came to California from Somerset, Ohio. Located at the crossroads to several other communities (Pleasant Valley, Mt. Aukum, Bucks Bar and Placerville, and Grizzly Flat), little information exists on it. Today it consists of a post office and a community of houses in a large surrounding area.

Perry Creek. Perry Creek appears to have received its name from the ranch settled by Charles and E.R., or E.H., Perry, ages 28 and 25. They are listed in the 1852 Special Census as being a rancher and butcher, respectively, from New York. E. H. Perry settled at the head of Perry Creek in 1850 and was described by Sioli as a "thrifty farmer". He was a deputy Indian Agent in 1851-52.

PiPi Valley. The PiPi Valley area was settled early in 1850 by Joseph Meyers, a Swiss immigrant. Meyers mined for many years in the area, as did a number of his relatives who joined him afterwards. The Meyers family also patented homesteads, built homes, farmed fruits and vegetables, and raised livestock (Lindstrom, 1982:39).

Two other early settlers in PiPi valley were John L. Morgan and John Wilson who homesteaded and farmed their land.

By 1883, Sioli was able to report that extensive mining had been undertaken at Dry Gulch, Henry's Diggins,...Brownsville, Fairplay and Indian Diggings. He felt strongly that mining would continue for years in this region. Rich ledges were owned and mined by the Crystal Mining Company whose mill was located on the Middle Fork of the Cosumnes River. The mill was operated by water provided by a ditch (1883:93).

Two sawmills between Grizzly Flat and Brownsville were owned originally by Loofbourrow, later by Hoskins of Grizzly Flat. The Tarr Brothers had a sawmill on the Cosumnes River from which they supplied Amador County with lumber. Sioli reported the Tarr brothers had built a railroad in order to carry logs to the mill and the total product of all the regional mills in 1877 was about 10,000,000 feet (1883:113).

The Tarr brothers were Daniel, Jefferson and Warner Tarr from Missouri who patented 320 acres of land in Township 8 North Ranges 13 and 14 East in 1882 and 1883. In 1880, Warren F. Tarr had received an additional 160 acres of land from Martha A. Irvine, a widow whose husband had been a volunteer in the Missouri Volunteers of 1837 and, as such, had received the land under the 1855 Act which granted bounty land to officers and soldiers in Military Service in the United States.

Demographics, Economics, and Ethnicity. Between 1866 and 1878, the population of Mountain and Cosumnes Townships for the towns of Indian Diggins, Brownsville, Perry's Creek, Fairplay, Spanish Creek, and Mt. Aukum totaled 478 according to the 1866 Great Register. The average age was 38 years with the range extending from the early 20's to a high of 84. Forty eight men were in their 50's, 18 were in their 60's, two were in their 70's, and the 84 year old was a laborer from Vermont who registered in 1873.

While occupations are listed in the Great Register, many probably indicated the occupation they held in their home states. This tells us what skills they brought to the gold fields where they may have reverted to that occupation during times when mining was not profitable. Within the 1866 Great Register, over half of the registrants are listed as miners (53 percent). The next highest figure is for rancher/farmer and that is 18 percent of the total population. Seven percent list themselves as laborers. Other occupations include merchant, hotelkeeper (and saloonkeeper), teacher, engineer (seven were engineers), mechanic, lumberman, teamster, shoemaker, stonecutter, carpenter, sawyer, physician (one), butcher, blacksmith, milkman, ditch agent, wine grower, hotel waiter, storekeeper, and millwright.

For the United States, the largest population (28 percent) entered California from the east (Maine, Massachusetts, New York, Vermont, Pennsylvania, New Jersey, Rhode Island, and New Hampshire). Almost 21 percent, the next largest population, came from the midwestern states of Missouri, Illinois, Ohio, Iowa, and Indiana. Nineteen percent came from the south/southeastern states of Virginia, North and South Carolina, Louisiana, Maryland, Florida, Alabama, Tennessee, Texas, Georgia, Kentucky, and Arkansas.

Representing Europe, 10 percent came from Ireland/Scotland/England and various areas of Germany (Prussia, Hanover, Wirtenberg, Bavaria, Baden, and Austria. Included in this was a very small percent from Holland). Switzerland, Scandanavia, and France were next with one percent each.

In contrast to much of the rest of the county which shifted from mining to agriculture during the decades of the 1860's to 80's, mining continued to increase in the Middle Fork watershed during this time. The general pattern, however, was to mine during the rainy season and to farm during the dry season.

By 1902 the Great Register showed the population of the watershed to be about 214 people, a decrease of over 50 percent in less than 25 years. The average age was 47. Twenty nine men were in their 50's, twenty were in their 60's, twenty five were in their 70's and three were in their 80's. The highest percentage, 34 percent, were farmer/ranchers. Miners were down to 22 percent. Laborers and lumbermen were about 9 percent each and surveyor/engineers were six percent of the population. Other representative occupations included blacksmith, carpenter, merchant, teacher, sawyer, teamster, sawfiler (most likely related to the lumber industry), railroad foreman, plumber, painter, mail contractor, ditch agent, jeweler, cook, and mill workers.

The background of those from other parts of the United States consisted of 21 percent from the midwest, 17 percent from the east, and 8 percent from the south/southeast. The largest number of the population came from California, however: 28 percent. For Europe, five percent came equally from Germany and the triad of Ireland/Scotland/England.

Ethnic diversity also included four Chinese. While no Mexicans are enumerated in population censuses, the General Land Office plat map of 1874 shows a "Mexican's cabin" in Township 8 North Range 11 East suggesting this or a related ethnic group was in the area.

The number of women recorded in the watershed was zero in 1852. By 1860, women represented about 10 percent of the population and were only up to 28 percent by 1880 (Lindstrom, 1982:36).

Population concentrations tended to be along the Middle Fork of the Cosumnes River and its tributaries.

Around 1910, the population rose to 406 as a result of the development of commercial logging in the region (Lindstrom, 1982:35).

Mining continued in the area and even saw a resurrgence of activity during the depression which was common throughout El Dorado County. Walter and Palmer (1992) report that by 1958 only six claims were being worked on federal lands in the Henry's Diggins area. Some mining activities are known to occur on private property on a seasonal basis.

Roads.

A number of roads were constructed in the Middle Fork Cosumnes River watershed during historic times. One of the earliest roads was the Indian Diggins Road Number 92. On April 21, 1857, J. P. McDaniel and John Cabal were appointed by the Board of Supervisors to locate a road, to be a public highway, from Indian Diggins to Bartrams Mill. The road was proposed to begin at Indian Diggins and to run to Cederville Creek, then to Fairplay and to the Middle Fork of the Cosumnes River at Buzans Bridge. From the bridge it would extend to Somerset House and the North Fork of the Cosumnes River at Bucks Bar Bridge, then on to Bartrams Mill. One section of this was known as the Fairplay Road Number 106 and another section was known as Mt. Aukum Road Number 78 (Trumbly, 1980).

In 1859 the road leading from Somerset House and crossing the Middle Fork Cosumnes River at Bryans Bridge, led to Church's Store, Fairplay, Cederville, and Jim and Stinsons Mill Ranch to Indian Diggins. It was declared a public highway.

The toll bridge at the Middle Fork of the Cosumnes River was known in 1866 as "Buyans Bridge". John Baker kept the toll bridge and estimated the rates of toll.

In 1867, a road was ordered constructed from Fairplay to Brownsville. Beginning in Fairplay, the road ran along the divide between Perry's Creek and Stoney Gulch, then on the divide between Cedar Creek and Perry's Creek. From this point it extended to the Slug Gulch and Brownsville Road to Brownsville. A portion of this road was known as Omo Ranch Road Number 35.

Caldor Road Number 118 was petitioned on June 7, 1882 by J. L. Morgan and 24 other citizens of Mountain Township to be a public highway. Beginning where Henry's Diggins Road left Grizzly Flat road, the road was planned to run east to Henry's Diggins, then east to the Giovanni and Peter Ansis ranches on the main ridge. It would then extend southeast across McKinney's Creek, then southeast through Antone Meyer's ranch and through J. L. Morgan's ranch to PiPi Valley. The road was planned to be about ten miles long.

By 1884, the Placerville and Brownsville Road was abandoned from Fairplay to and intersecting the road from Cederville to Brownsville. The abandonment was requested by George W. McKee and 25 other residents of Road District 8 due to a land slide at Slug Gulch which made that portion of the road impassable. The road was rerouted in Fairplay east two and a half miles. It then intersected with the old Cederville Road which led from Cederville to Brownsville. The Board of Supervisors approved this change.

In 1909 the Board approved a petition by J. R. Melson to change a portion of Fairplay Road on Melson's east line at the fork in the Plymouth and Fairplay Roads. The changes were granted and were to be at Melson's expense. This area was known as Melson's Corner and later was known as Gray's Corner.

Perry Creek Road was petitioned for in February of 1890 by G. F. McConbrey and others. This raod ran from the west end of the bridge crossing Perry's Creek to and intersected the road running from Fairplay to Moco in Road District No. 8. It crossed the land of the non-consenting land owner Henryetta Sweeney who, through her attorney, Charles F. Irwin, requested payment of $150.00 for a right of way across her land. The Board of Supervisors granted payment of $125.00. This road remains essentially the same as when first surveyed (Trumbly, 1980).

The California Door Company (Caldor).

Formed in the San Francisco Bay area in 1884, the California Door Company, also known as Caldor, was the result of a merger of companies owned by brothers Bartlett, John, and Charles S. Doe with companies owned by brothers George and Nat Wilson.

The California Door Company first operated at San Quentin Prison, using the low cost prison labor, for the manufacturing of doors, windows, and blinds. The plant was shifted to Oakland when it appeared prison labor might be abolished and the new plant, finished in 1888, was described as the largest of its kind in the west (Niles, 1989).

The plant operated in its new location for about ten years until rising costs of supplies and transportation created a need for the company to purchase its own timber supply; in 1900, Caldor purchased 30,000 acres of timberland plus a sawmill at a small mining camp known as Dogtown in the Middle Fork watershed. The camp usually had a population of about 200 seasonal employees who cut an average of 520 acres during the season between March to May through October. A small crew remained at the mill during the winter to maintain the plant and make equipment repairs which could not be made during the busy harvesting season.

Early logging which had begun in the 1850's furnished necessary timber and shafts to local mines as well as supply wood products to local ranchers and farmers. As Niles (1989) describes it:

> Logging methods were primitive from the 1850's to 1890's and ox teams were relied on to skid the logs short distances to the small mills. These rudimentary methods were dictated by the very nature of the Sierra Nevada themselves. In comparison, the abundant rivers and waterways in British Columbia and Washington provided ready transportation of logs, and so large, high production sawmills evolved. Logging there progressed up and along these waterways and logs were skidded directly to the rivers by ox teams or directed to flumes and chutes which carried them to the rivers by and down to the mills. The Sierra Nevada river drainage systems are steep and rough with low water volumes in the summertime and early attempts to drive logs down them resulted in failure. This lack of river transportation, therefore, limited early sawmilling operations to small local mills until rail transportation evolved in the 1890's.

Due to the fact that oxen were tremendously slow haulers, later operations brought in mules and horses, plus the newly invented Dolbeer steam donkey to move logs to millponds. Even with these "improvements", however, the process was still a slow one until the construction of narrow guage railroads and spurs for hauling large amounts of timber.

The Dolbeer Steam donkey was a small, upright steam engine used to power a single drum winch. It was used for unloading logs at the mill at first and later was used to pull logs to landings and to load logs onto log cars.

Lumber sawn at the sawmill at Caldor was then transported to the planing mill in Diamond Springs. At first the transportation was by lumber wagons using mules. Later a steam tractor replaced mules and oxen, although a county ordinance had to be passed requiring a horserider to proceed the noisy tractor by one quarter mile warning other road users of the approaching monster so that horses would not be scared (Niles, 1989).

It became apparent that a railroad would be the best solution to the transportation problem facing the industry and in 1903 and 1904, a route was surveyed across the North Fork of the Cosumnes River canyon to Caldor.

The Diamond and Caldor Railway Company (D&C Railway) was incorporated on February 9, 1904 and the railway was in operation by November (I.M. Cook, 1913 in Niles, 1989).

The railway line was almost 34 miles long, although in time spurs extended up every creek and ridge in the watershed between Ranges 13 to 15 East. About 30 miles of spurs reached to PiPi Valley and other branches reached to Gold Note Ridge. The lines extended east to the crest of Telephone Ridge (Ferrell, 1990).

The Juckes Ditch supplied water for the D&C Railway at Henry's Diggins. Various logging camps were located as each logging season moved the company further into the woods. Logging camps such as Myers Firetank, Twin Gulch, Camp Webster, Ridge Camp, Duncan Corral, and Leoni came into being.

Fire was a constant hazzard from the trains during the logging season though conversion of the locomotives to oil burners helped to reduce this problem (Ferrell, 1990).

In 1923, the Caldor sawmill was destroyed by a fire which also saw the destruction of many railroad cars as well as the mill and lumber. Rather than rebuild in the woods, the company's decision was to expand its planing mill in Diamond Springs to handle logs and the railroad was then used to haul logs from the loading spurs to Diamond Springs (Ferrell, 1990). For the next _____ years, the railroad hauled more than eight million board feet of logs each season.

Logging ceased in 1930 as a result of the Great Depression and during this time the Civilian Conservation Corps (CCC) used some of the Caldor skid shacks to establish a camp. The CCC planted trees to control erosion and burned off slash and undergrowth.

The plant was reopened in 1935 when Chalmers G. Price was brought in to head the start-up and act as General Manager. An additional function of the plant was the addition of box manufacturing for the shipment of the growing fruit industry in the county. The start-up began with restoration of equipment and rebuilding the railroad track. The old Caldor site became a division point and logging camp while logging techniques shifted from the steam donkey was replaced by internal combustion tractors. The greatest change, though, was the introduction of the diesel logging truck (Farrell, 1990). These gradually began to replace the locomotives and log cars.

During World War II, the logging company prospered and much of the work centered around Duncan Corral and Camp Webster. By the end of the war, the harvesting focus had shifted to Cat Creek whose timber had been purchased from the United States Forest Service (USFS). The company was cutting approximately 150,000 board feet a day by this time and the work was being performed by two Skagit Loaders, six D-8 Cats, four Carco arches for landing work and seven diesel logging trucks. Diesel fuel and oil for the Shay locomotives was hauled in a homemade tank car (Farrell, 1990).

The 1952 season was the final season for use of the D&C railway and the narrow gauge was sold to a scrap-iron dealer in San Francisco the next year. One final run was made in 1953 for the purpose of photographing this historic railroad.

Caldor sold its sawmill and timberlands to the Winton Lumber Company in 1956. That company sold out to American Forest Products Corporation in 1964. Some of the timberlands have since come into ownership by the USFS. Logging has continued on USFS lands according to Placerville District Timber Management Officer, Pat Farrell. Several green timber sales have taken place, including the Big Croft selection cut (non-clear cut) as well as clear cuts at Dogtown and McKinney Creeks east of Caldor. In the lower parts of the forest, around Henry's Diggings, the Leoni individual selection sale took place and in the last five or six years salvage logging of insect timber has occurred.

Summation.

The watershed of the Middle Fork of the Cosumnes River has had essentially a similar history to that of the rest of El Dorado County. It was settled relatively late in comparison with the rest of the county with a series of mining camps which either were abandoned for developed into small towns.

A rich area, numerous ditches were constructed in order to bring water to mines for ore processing. Some of the processing was done with stamp mills which utilized mercury, arsenic, and cyanide to retrieve gold from the host rock after crushing.

Following the decline of placer mining, drift and hydraulic mining became the predominant forms of mining. The latter form required thousands of gallons of water for blasting away at hillsides to free gold from the Tertiary gravels.

Gradually, the economy of the watershed shifted to that of agriculture, though mining continued to be a prevalent form of economic venture into the 20th century.

Agriculture consisted of cattle ranching, some dairy farming, viticulture, and orchard crops, primarily apples and pears. Between 1884 and 1900, Pierce's disease (a rickettsia-like pathogen) and the phylloxera louse heavily damaged the grape industry throughout California. Introduced on 1850 cuttings either from the east coast or Europe, the phylloxera louse went unnoticed and/or disregarded until large areas of vineyards were destroyed by 1878. Although the industry recovered, additional attacks by disease and pests combined with later economic recessions, Prohibition and the Great Depression to destroy the grape industry in El Dorado County until recently.

A 1950 pear blight damaged that crop for several years, although it, too, is beginning to make a comeback.

Dairy farming and cattle ranching have declined, also, primarily due to economic factors within those industries. As farms and ranches have been sold, the shift within the county has been toward development, although the development along the Middle Fork of the Cosumnes River has been less extensive than for other, more accessible, parts of the county.

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Appendix 5

State Department of Health Services
Correspondence, 1991

STATE OF CALIFORNIA - HEALTH AND W
DEPARTMENT OF HEALTH SER
OFFICE OF DRINKING WATER
8455 JACKSON ROAD, SUITE 120
SACRAMENTO, CA 95826
(916) 739-4034

PETE WILSON, Governor

RECEIVED
NOV 20 1991
EL DORADO IRRIGATION DISTRICT

November 13, 1991

System No.s 09-001
09-008
09-017
09-018
09-023

Robert Alcott, Manag
El Dorado Irrigation
2890 Mosquito Road
Placerville, CA 9566

Dear Mr. Alcott:

Subject: SURFACE WATER TREATMENT RULE

As required in Section 64650, Chapter 17, Title 22, California Code of Regulations, this letter shall formally serve as our notice of determination of El Dorado Irrigation District's compliance with the new treatment requirements contained in California's Surface Water Treatment Regulation (SWTR). This new regulation became effective on June 5, 1991.

The District has 90 days from the date of this notification to submit a plan and schedule to modify its system's facilities and operation in order to meet the requirements of the new regulation. If the District disagrees with the findings specified below, then it must submit its reasons for disagreement within 30 days from the receipt of this notification. We will then notify you of our final determination in writing within 30 days of receipt of the District's reasons for disagreement.

The following sections summarize the results of our evaluations of each treatment facility and surface water system that is operated by the El Dorado Irrigation District (EID).

RESERVOIR 1 TREATMENT PLANT

Watershed Sanitary Survey: A watershed survey is needed for this plant. An important part of the survey will be to determine the effect, if any, that the adjacent residential developments may have on the water flowing through the supply ditch. It will also allow for a more accurate determination as to what Giardia/virus reduction requirement should be applied to the treatment plant. The survey must initially be completed by January 1, 1996, or in conjunction with any significant plant modification or expansion, and then repeated at least once every 5 years.

Treatment Requirements: The SWTR focuses on a treatment plant's ability to effectively remove and inactivate (kill) Giardia lamblia cysts and enteric viruses. The minimum reduction requirements are a 99.9% (3-log) reduction of Giardia cysts and a 99.99% (4-log) reduction of viruses. These reductions are achieved by removal, via sedimentation and filtration, and inactivation through disinfection. In cases where source waters are vulnerable to greater bacteriological contamination hazards, a higher reduction requirement may be imposed.

Based on available raw water bacteriological data and on general knowledge of the source of supply for the Reservoir 1 treatment plant, it has been determined that the minimum reduction requirement can be applied (i.e. 3 Log Giardia/4 Log Virus reduction). Data collected during a watershed sanitary survey will be used to confirm the applicability of this treatment requirement.

The treatment process utilized by the Reservoir 1 treatment plant is conventional filtration. This is listed in the new regulation as an "approved" treatment technology. EID's Reservoir 1 treatment plant appears to provide the required Giardia and virus reduction efficiencies. This, however, is based on the assumption that the plant can continue to meet the filtration performance standards. The validity of this assumption will have to be confirmed by evaluating the raw and treated water turbidity monitoring data that are generated over the next 12 months. Compliance with the filter performance standards is necessary to allow the application of the maximum Giardia and virus removal credits.

Performance Standards: This plant has been found to be in compliance with the disinfection performance standards; however, in three of the past 12 months, the plant was not able to meet the filtration performance standard that requires a combined filter effluent of 0.5 NTU or less 95% of the time. This was due to initial fine tuning of the plant's operation. The plant also experienced problems with the chemical feed equipment during May and June of this year. The problems have since been corrected. As indicated above, this plant's ability to comply with the filtration performance standards will be confirmed through continued monitoring.

Monitoring Requirements: This plant has been found to be in compliance with the monitoring requirements that are specified in the SWTR.

Reliability Criteria: This plant has been found to be in compliance with the reliability criteria that are specified in the SWTR.

Design Standards: This plant does not meet all of the SWTR design standards in that solids removal from the waste backwash water is not provided prior to recycling it.

This design deficiency must be corrected. Otherwise, EID will be required to submit data demonstrating that existence of this deficiency does not adversely affect performance of the treatment plant.

Operation Requirements: The following are items that EID must address to either comply, or show compliance, with the operating requirements of the SWTR at the Reservoir 1 plant:

1. The plant's ability to continue to achieve an 80% raw water turbidity removal must be confirmed by data generated over the next year.

2. An emergency disinfection plan and an operations plan need to be developed and submitted.

3. Records of individual filter unit turbidities when brought back on-line after a backwash procedure or other interruption, filtration rates, and backwash rates need to be maintained.

RESERVOIR A TREATMENT PLANT

Watershed Sanitary Survey: A watershed sanitary survey needs to be performed for this plant's source of supply. The survey must initially be completed by January 1, 1996, or in conjunction with any significant plant modification or expansion, and then repeated at least once every 5 years.

Treatment Requirements: Based on available raw water bacteriological data and on general knowledge of the source of supply for the Reservoir A treatment plant, it has been determined that the minimum Giardia/virus reduction requirement (3 Log Giardia/4 Log Virus) can be applied. Data collected during a watershed sanitary survey will be used to confirm the applicability of this treatment requirement.

The treatment process utilized by the Reservoir A treatment plant is in-line filtration. This is not listed in the new regulation as an "approved" treatment technology. The regulation does not provide removal credits for non-approved filtration technologies; so, for the sake of performing the initial evaluation, it was assumed that the plant could provided the minimum 2 Log Giardia/1 Log virus removal that is required of all filter plants. The District must provide data to confirm this assumption. Because the raw water source is of relatively good bacteriological quality and the watershed has no known significant sanitary hazards associated with Giardia, turbidity data may be used in lieu of particle size analysis data for confirming the assumed removal efficiency. The data shall demonstrate compliance with all filtration performance standards and with the operation standard that requires at least an 80% reduction of the raw water turbidity.

Based on the assumed Giardia/virus removal efficiency and the estimated chlorine contact times, our initial evaluation indicates that this plant is able to provide the total Giardia reduction requirement. However, this initial evaluation is based on rough estimates of actual chlorine contact times. It is also subject to the plant's ability to meet the SWTR performance standards and operation requirements over the next 12 months.

The estimated CT values were relatively close to those that are required. Because of this, the actual contact times that are provided must be more accurately determined by means of a special study (i.e. tracer study). Alternatives to this would be to demonstrate greater than 2 Log (99%) Giardia removal via a particle size analysis or to provide pre-treatment or other plant modifications. One such modification might include the incorporation of a baffle wall system in the design of Reservoir A's proposed membrane cover to reduce the effect of short circuiting through the reservoir.

Performance Standards: The plant is now operating in compliance with the filtration and disinfection performance standards; however, it did have some difficulty producing 0.5 NTU 95% of the time during its first several months of operation. The plant's ability to continue to comply with all performance standards must be confirmed by raw and treated water turbidity data that is generated over the next year.

Monitoring Requirements: The chlorine residual entering the distribution system (i.e. leaving Reservoir A) should be monitored and recorded continuously, especially since residuals can fluctuate greatly as the water passes through the uncovered reservoir.

Reliability Criteria: This plant does not meet all of the reliability criteria in that is not equipped with alarm devices to warn of disinfection process failures. The continuous analyzer for the reservoir effluent should be able to activate an alarm and have the ability to cause an automatic plant shut-down. In addition, the chlorination equipment should be equipped with devices to warn of low and high vacuum failures or some other reliable means to instantaneously warn of a chlorinator failure. Other features may be used in lieu of these if they can be shown to provide an equal degree of reliability.

Design Standards: This plant is in compliance with the design standards that are specified in the SWTR.

Operation Requirements: The following are items that EID must address to either comply, or show compliance, with the operating requirements of the SWTR at the Reservoir A plant:

1. If the plant is ever operated at flows greater than 60 cfs with one filter unit out of service or greater than 67 cfs with all filters in operation, it will be out of conformance with the acceptable filtration rates (per SWTR). A demonstration study will be required if the plant is operated under these conditions.

2. As with the Reservoir 1 plant, this plant's ability to achieve an 80% raw water turbidity removal must be confirmed by data generated over the next year.

3. An emergency disinfection plan and an operations plan need to be developed and submitted.

4. Records of backwash rates, filtration rates, and individual filter unit turbidities when brought back on-line after a backwash procedure or other interruption need to be maintained.

RESERVOIR 7 TREATMENT PLANT

Watershed Survey: We are aware that the District is in the process of completing a watershed survey for this plant's source(s) of supply. The final report for the survey will have to be submitted before approval to activate the plant can be given.

Treatment Requirements: Based on available bacteriological data for the raw water supply of the Reservoir 7 treatment plant, it has been determined that a 4 Log Giardia/5 Log virus reduction requirement must be applied. Bacteriological data collected during the next year will be used to confirm the applicability of this treatment requirement.

The treatment process utilized by the Reservoir 7 treatment plant is conventional filtration. This is listed in the new regulation as an "approved" treatment technology. It has been determined that this plant will be able to provide the required Giardia and virus reductions specified above. This, however, is based on assumptions that were made to determine the inactivation efficiency that will be provided by the plant. The first assumption is that the plant will be able to meet the filtration performance standards. With this assumption, the maximum allowable Giardia/virus removal credit for this type of filtration technology was applied. Other assumptions that had to be made included pH and chlorine levels through each treatment process, water temperature, and anticipated peak flows through the plant. These assumptions must be confirmed through operational data once the plant is activated.
Performance Standards: The plant has not shown compliance with all filtration and disinfection performance standards because it is not yet operational.

Monitoring Requirements: The plant will meet the monitoring requirements that are specified in the SWTR once it becomes operational.

Reliability Criteria: The plant does not comply with the reliability criteria in that is does not have the ability to warn of a disinfection failure in the absence of an operator. It is understood that the reservoir effluent chlorine residual is monitored continuously. This, however, will not be able to detect a chlorination failure at the Reservoir 7 plant since its effluent is mixed with chlorinated water from the Pleasant Oak Main. The plant must be provided with either a continuous chlorine analyzer and alarm on the treatment plant effluent, a device that can detect high and low vacuum failures in the chlorine feed equipment, or some other equally reliable means of detecting a chlorination equipment failure. In either case, the equipment shall sound an alarm and cause an automatic shut-down of the plant.

Design Standards: It appears that this plant does not comply with two of the SWTR design standards. One questionable design feature is the lack of surface wash facilities for the filter backwash procedure. The other is the lack of solids removal from the waste backwash water prior to recycling it. As a result, EID must demonstrate that operating with these deficiencies will not adversely impact the quality of water produced by the plant. An alternative to the demonstration study would be to provide the waste backwash water with sufficient settling time prior to recycling it and to retrofit the filters with surface wash equipment.

Operation Requirements: This plant is expected to be able to comply will all operation requirements. A slight concern would arise, however, if the plant was operated with one pressure filter out of service during high flow conditions (greater than 6 cfs). This would result in a filter loading rate that exceeds the allowable limit of 3 gpm/sf. The plant must be operated such that the resulting filter loading rate is not greater than 3 gpm/sf. Otherwise, a demonstration study would be required.

EL DORADO HILLS TREATMENT PLANT

Watershed Survey: The District needs to perform a watershed sanitary survey prior to making the planned expansion and modifications to this plant. It is our understanding that EID plans to participate in a multi-water district study of the American River watershed and that this study is still in the planning stages.

Treatment Requirements: Based on available raw water bacteriological data and on general knowledge of the source of supply for the El Dorado Hills treatment plant, it has been determined that the 3 Log Giardia/4 Log virus reduction requirement can be applied. Data collected during the watershed sanitary survey will be used to confirm the applicability of this treatment requirement.

The existing El Dorado Hills plant is provided with the treatment processes that make up a conventional filtration plant. However, due to minimal detention times provided by the sedimentation basin at maximum flows, the plant was evaluated as a direct filtration plant. This reduced the allowable Giardia/virus removal credit that may be applied. Our evaluation of the existing plant showed that the disinfection process does not satisfy the remaining Giardia inactivation requirement. Therefore, the plant is not able to provide the total required Giardia reduction.
We are aware that significant plant modifications will be made when this facility is expanded, so an additional evaluation will be conducted. It is anticipated that the modified plant will be able to provide the required Giardia and virus reductions; however, sufficient design information for the expansion is not yet available to make that evaluation.

Performance Standards: The plant is currently in compliance with all filtration and disinfection performance standards.

Monitoring Requirements: The plant currently does not meet all of the SWTR monitoring requirements in that the filter effluent turbidity is not monitored prior to the clearwell. Also, the monitoring of turbidity from the individual filter basins needs to be better coordinated with backwash procedures and other interruptions.

Reliability Criteria: This plant is currently in compliance with the reliability criteria that are specified in the SWTR.

Design Standards: This plant currently does not meet all of the design standards in that the filters are not provided with surface or subsurface wash facilities. This design deficiency must be corrected. Otherwise, EID will be required to submit data demonstrating that the existence of this deficiency does not adversely affect the performance of the treatment plant.

Another SWTR design standard requires the provision of filter pre-conditioning following a backwash procedure by means of a filter-to-waste process or by the addition of a coagulant to the backwash source water. This plant is provided with a filter-to-waste capability although it is normally not utilized. Therefore, the District must also demonstrate that operating without the use of filter-to-waste after backwash does not adversely affect the performance of the plant.

Operation Requirements: EID still needs to develop and submit an operations plan and an emergency disinfection plan. Also, the practice of record maintenance needs to be modified by including records of filtration rates and backwash rates.

OUTINGDALE TREATMENT PLANT

Watershed Survey: The District needs to perform a watershed sanitary survey for this plant's source of supply. The survey must initially be completed by January 1, 1996, or in conjunction with any significant plant modification, and then repeated at least once every 5 years.

Treatment Requirements: Based on available raw water quality data and on general knowledge of Outingdale's source of supply, it has been determined that a 3 Log Giardia/4 Log virus reduction requirement can be applied to this system. Data collected during the watershed sanitary survey will be used to confirm the applicability of this requirement.

The Outingdale plant utilizes an in-line filtration process which is not an "approved" technology. It also is unable to meet the filtration performance standards. As a result, a removal credit cannot be assigned. EID must demonstrate that a minimum removal efficiency of 2 Log Giardia/1 Log Virus can be achieved. Otherwise, modifications to the plant will be required. Particle size analysis data must be provided if the existing removal efficiency is to be demonstrated.

For the sake of evaluating the disinfection process, it was assumed that the 2 Log Giardia/1 Log Virus removal could be demonstrated. The evaluation indicated that, if this minimum required removal rate can be provided (either through plant modifications or via a demonstration study), then the existing disinfection process can be considered to be adequate for providing the necessary Giardia and virus inactivations. This is also based on the application of a 3 Log Giardia/4 Log virus total reduction requirement.

Performance Standards: The plant is not in compliance with the filtration performance standard that requires a combined filter effluent of 0.5 NTU or less in 95% of the readings taken each month. It is, however, in compliance with remaining filtration and disinfection performance standards.

Reliability Criteria: The Outingdale plant does not comply with the following reliability criteria:

1. There are no alarms or automatic plant shutdown capabilities to respond to coagulation, filtration, or disinfection process failures.

2. There is no continuous monitoring and recording of the filter effluent turbidity.

3. There are no multiple filter units to provide redundant production capacity.

The plant must be provided with these reliability features or with features that would provide equal reliability.

Monitoring Requirements: This plant does not comply with the following monitoring requirements:

1. The filter effluent turbidity monitoring frequency is not adequate.

2. The filter is not monitored to determine the initial turbidity levels following a backwash sequence or other interruption.

3. Daily pH and temperature monitoring is not performed.

4. The monitoring frequency of chlorine residual delivered to the system is not adequate (continuous or two times per day is required).

Monitoring and record maintenance practices must be updated to satisfy these requirements.

Design Standards - This plant does not meet the following design standards:

1. It does not achieve an average daily effluent turbidity goal of 0.2 NTU.

2. The filter does not have a filter-to-waste capability nor does it have provisions for the addition of a coagulant to the backwash source water.

3. The filter is not equipped with surface wash facilities.

4. There is no provision for the future addition of pre-treatment facilities.

5. The filter is not protected from rapid changes in filter rates when it is brought on-line.

These design deficiencies must be corrected. Otherwise, EID will be required to submit data demonstrating that existence of these deficiencies does not adversely affect performance of the treatment plant.

Operation Requirements: The Outingdale plant does not meet the following operation standards and requirements:

1. The filter operates at a loading rate that is higher than those listed in the SWTR as acceptable.

2. The filtration process rarely provides the 80% raw water turbidity reduction and it is also unable to meet the alternative requirement of providing a monthly average effluent turbidity of less than 0.1 NTU.

3. An operations plan and an emergency disinfection plan have not yet been submitted for this plant.

4. One of the operators, Marc Honeycutt, needs to obtain a Grade 2 treatment plant operator certification.

In addition, evaluating the initial turbidity levels after backwash or other interruptions cannot be determined at this time due to a lack of monitoring data.

MONTE VISTA TREATMENT PLANT

Watershed Survey: The District needs to perform a watershed sanitary survey for this plant's source of supply. The survey must initially be completed by January 1, 1996, or in conjunction with any significant plant modification, and then repeated at least once every 5 years.

Treatment Requirements: Based on available raw water bacteriological data for Monte Vista's source of supply, it has been determined that the 3 Log Giardia/4 Log virus reduction requirement can be applied to this plant. Additional data collected during the watershed sanitary survey (if performed) will be used to confirm the applicability of this treatment requirement.

The Monte Vista plant utilizes an in-line filtration process which is not an "approved" technology. It also is unable to reliably provide the required turbidity removals. As a result, a removal credit cannot be assigned. EID must demonstrate that a minimum removal efficiency of 2 Log Giardia/1 Log Virus can be achieved. Otherwise, modifications to the plant will be required. Particle size analysis data is to be provided if the removal efficiency is to be demonstrated.

For the sake of evaluating the disinfection process, it was assumed that the 2 Log Giardia/1 Log Virus removal could be demonstrated. The evaluation indicated that, if this minimum required removal rate is provided (either through plant modifications or via a demonstration study), then the ability of the existing disinfection process to meet the remaining inactivation requirement is marginal. Therefore, tracer studies will be required to determine the actual chlorine contact times that are provided, unless a lesser inactivation requirement (less than 1 Log Giardia/3 Log virus) can be applied due to the demonstration of a greater removal efficiency through the filtration process.

Performance Standards: It has been determined that this plant is currently in compliance with the filtration and disinfection performance standards.

Reliability Criteria: The Monte Vista plant does not comply with the reliability criteria in that it does not have multiple filter units to provide redundant production capacity.

Monitoring Requirements: This plant does not comply with the monitoring requirements in that daily temperature and pH monitoring is not performed.

Design Standards: This plant does not meet the following design standards:

1. It does not achieve an average daily effluent turbidity goal of 0.2 NTU.

2. The filter does not have a filter-to-waste capability nor does it have provisions for the addition of a coagulant to the backwash source water.

3. The backwash rate that is provided is assumed to be insufficient and the filter is not equipped with surface or subsurface wash facilities.

4. There is no provision for the future addition of pre-treatment facilities.

5. The filter is not protected from rapid changes in filter rates.

These design deficiencies must be corrected. Otherwise, EID will be required to submit data demonstrating that existence of these deficiencies does not adversely affect performance of the treatment plant.

Operation Requirements: This plant does not meet the operation requirements in that it rarely provides an 80% raw water turbidity reduction nor is it able to meet the alternative requirement of providing a monthly average effluent turbidity of less than 0.1 NTU. Also, an operations plan and an emergency disinfection plan have not yet been submitted for this plant.

Evaluating the initial turbidity levels after backwash or other interruptions cannot be determined at this time due to a lack of monitoring data. Records of backwash rates that are provided also need to be maintained.

GROUP CAMPGROUND AND STRAWBERRY SERVICE AREAS

Both the Group Campground and Strawberry water systems are currently utilizing surface water sources without the provision of adequate treatment as required by the SWTR. Therefore, these systems are considered to be out of compliance with most, if not all, of the sections in the regulation. These sections include those that pertain to treatment requirements, performance standards, monitoring requirements, reliability criteria, design standards, and operation requirements. The most significant deficiencies include the lack of multi-barrier treatment and the provision of inadequate Giardia and virus reductions.

This office is aware that EID is presently in the process of developing ground water sources for the Strawberry system. If ground water sources of adequate quantity and quality can be developed, then the requirements of the SWTR will not be applied to this system. However, if the District is not successful in developing adequate ground water sources, then it will be required to develop a plan for compliance with the SWTR.

November 13, 1991

BASS LAKE TREATMENT PLANT

The Bass Lake water treatment plant was not included in our first round of surface water treatment plant evaluations. The plant was not evaluated because it has not been in operation for several years and its use is not anticipated in the near future. In fact, EID's intentions towards the use of the Bass Lake plant are not known. Please indicate when, or if, the District plans to reactivate this treatment facility. An evaluation of the plant's compliance with the SWTR must be performed prior to its reactivation. If the District does not plan to use this plant in the future, then a request that the plant be deleted from the system's water supply permit must be included with your response.

As was stated in the beginning of this letter, a plan and schedule to implementing physical and operational improvements for the purpose of achieving compliance with the SWTR must be submitted within 90 days from the date of this notification. Any reasons for disagreement with our findings must be submitted within 30 days of this notice.

Please contact me at (916) 739-4206 or Michael Crooks of my staff at (916) 739-4159 if you have any questions regarding this issue.

Sincerely,

Carl Lischeske

Carl Lischeske, P.E.
District Engineer
Office of Drinking Water

cc: Curtis E. Weidmer, M.D.
Director of Public Health Services
El Dorado County Health Department
931 Spring Street
Placerville, CA 95667

Dennis Otani
Manager of Environmental Health
El Dorado County Environmental Management Department
Environmental Health Division
7563 Green Valley Road
Placerville, CA 95667

MAC/mac

Appendix 6

Floating Cover Report

STATE OF CALIFORNIA HEALTH AND WELFARE AGENCY PETE WILSON, *Governor*

DEPARTMENT OF HEALTH SERVICES

DRINKING WATER FIELD OPERATIONS BRANCH
8455 JACKSON ROAD, SUITE 120
SACRAMENTO, CA 95826
(916) 387-3126 FAX (916) 387-3127

September 29, 1994
System Number 09-001

RECEIVED
OCT 03 1994
EL DORADO IRRIGATION DISTRICT

Wm. Robert Alcott
District Manager
El Dorado Irrigation District
2890 Mosquito Road
Placerville, Ca 95667

Dear Mr. Alcott:

Recently the Department conducted a public health inspection of five of El Dorado Irrigation District's (EID) subsurface floating covered reservoirs. The purpose of this inspection is to assess the condition of these facilities and to determine if those facilities are in compliance with California State laws and regulations regarding public water systems.

Reservoir 1, Moosehall Reservoir, Pollock Pines Reservoir, Reservoir B, and Reservoir C were the five subsurface floating covered reservoirs inspected. Several major defects and deficiencies were found that are considered to be a serious health hazard because highly contaminated water can enter the reservoir through areas where the watertight integrity of the hypalon cover has been compromised.

These deficiencies exist within the surface drainage facilities, vent structures, access hatches, and punctures in the floating cover itself. Another major concern is the lack of an effective cleaning and maintenance program for subsurface reservoirs with floating covers. These deficiencies are identified and described in the attached report. Also, we have discussed these deficiencies with District staff in both the Operations and Maintenance and Engineering Departments.

Unfortunately, to correct these deficiencies many features on the existing reservoir covers will have to be redesigned and reconstructed. Accordingly, the District is required to submit a plan and schedule to the Department by October 31, 1994, for eliminating these deficiencies.

If you have any questions regarding this requirement or wish to schedule a meeting to discuss these matters, please call me at 387-3141 or Daryl Noel at 387-3148.

Sincerely,

Jess Morehouse, Jr.

Jess Morehouse, Jr., P.E.
District Engineer

STATE OF CALIFORNIA HEALTH AND WELFARE AGENCY PETE WILSON, *Governor*

DEPARTMENT OF HEALTH SERVICES
DRINKING WATER FIELD OPERATIONS BRANCH
8455 JACKSON ROAD, SUITE 120
SACRAMENTO, CA 95826
(916) 387-3126 FAX (916) 387-3127

El Dorado Irrigation District Floating Covered Subsurface Reservoir Deficiency Report

September 29, 1994

The purpose of this report is to identify and discuss defects found on EID floating covered reservoirs that are considered to be serious health hazards. This information is intended to be used in the design of new water storage facilities and in the upgrade of existing reservoirs that utilize floating cover technology.

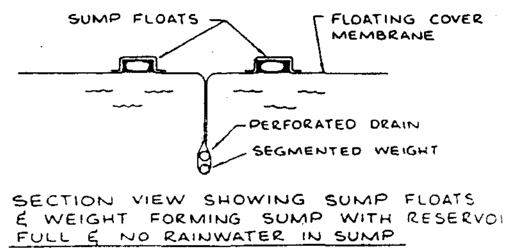
This report is divided into 4 sections. Section 1 identifies deficiencies found within the floating cover sump and gravity drain system. Section 2 addresses defects found with floating cover air vents and Section 3 identifies defects found in floating cover access hatches. Section 4 identifies routine maintenance deficiencies found at each reservoir such as holes in the floating cover, missing screens, and broken latches.

Surface water is conventionally treated (coagulation-flocculation, sedimentation, filtration, and disinfection) to remove suspended solids and disease producing organisms to provide safe and potable water to customers within El Dorado Irrigation District's Main System. EID routinely collects and analyzes water samples that are collected throughout the distribution system to ensure that this water complies with all state and federal water quality standards. Even if these water samples are found to be in compliance with all water quality standards it does not ensure that the water within the distribution system is adequately protected. Physical defects within the distribution system may allow contaminants (virus, bacteria, cysts, etc.) to enter and pollute the public water supply. Even if the water quality analyses indicate that the water quality requirements have been met, all known deficiencies in the system must be corrected before the water supply can be considered safe.

Section 1
Floating Cover Sump and Gravity Drain System

The sump and gravity drain system does not function as designed thus highly contaminated water is allowed to accumulate on the surface of the floating cover. The volume of water found on the surface of each hypalon covered reservoir varied from site to site. This highly contaminated water is comprised of rainwater and treated water that has passed through holes in the floating cover where it mixes with feces from birds, frogs, and other animals, as well as various airborne pollutants. Three of the five reservoirs (Reservoir 1, Moosehall Reservoir, and Pollock Pines Reservoir) were found to have willows, algae, frogs, and aquatic insects that were established within the water that had collected on the floating cover. This could suggest that contaminated water is present on the surface of the floating cover throughout most of the year.

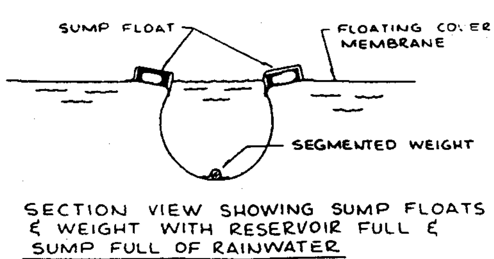
The sump is formed by placing segmented weights between a set of Styrofoam floats that are cemented to the floating cover as shown in figure 1 below.



This illustration has been taken from EID Moosehall Reservoir sump details.

Figure 1

During our inspection, we noted that the floating cover sumps remained collapsed regardless of the quantity of water that had accumulated on the surface of the floating cover. It appears that during the design of the floating cover it was assumed that the hydraulic pressure inside the sump created by the rainwater would be greater than the hydraulic pressure outside the sump created by the treated water from within the reservoir. Although incorrect, this assumption correlates with the Moosehall Reservoir sump detail shown in figure 2 below.



This illustration has been taken from EID Moosehall Reservoir sump details.

Figure 2

The gravity drain assembly directs highly polluted water from the floating cover through an elaborate array of couplings, adapters, bands, gaskets and hose surrounded by treated water within the reservoir intended for domestic consumption. There are several critical areas and components in the gravity drain assembly that cannot be inspected because they are located within the bottom of the sump or within the treated water under the floating cover. This problem is compounded because the floating cover is in constant motion, which may cause clamps or other critical components to work loose or fail. In areas where dissimilar materials are joined together, the movement of the floating cover has caused premature wear of the hypalon material. Highly polluted water has been observed to enter the reservoir where dissimilar materials are joined together (between the cap strip and the floating cover material). Figure 3 shows the gravity drain details from EID Reservoir B and C construction plans.

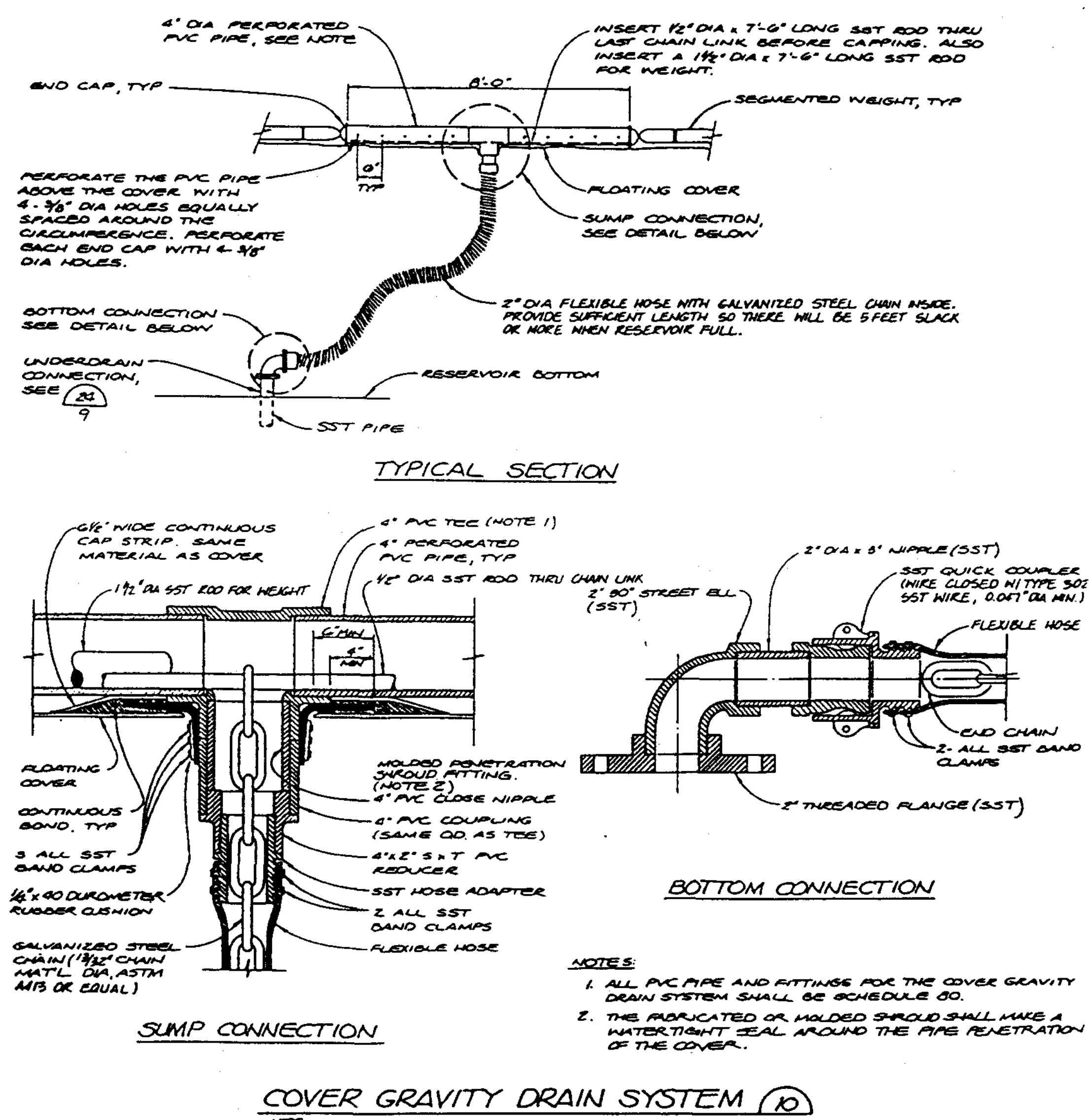
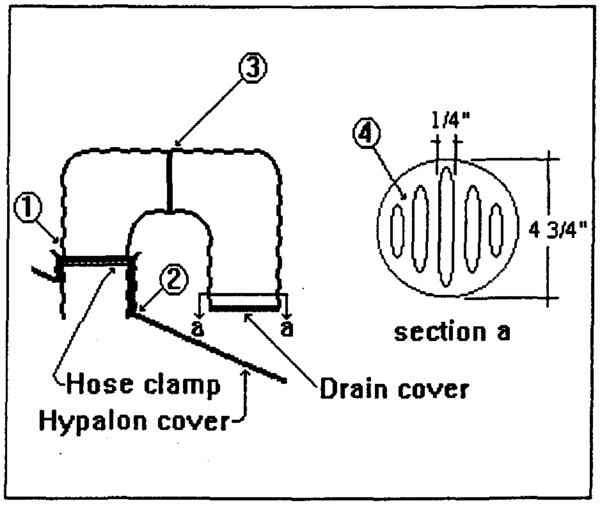


Figure 3

Section 2
Floating Cover Air Vents

Most of the floating cover air vents allow surface water and other pollutants to enter and contaminate the treated water supply within the reservoir. We have provided drawings of 6 types of floating cover air vents that have been reproduced from field sketches. These drawings have been included to help illustrate and explain the defects found on each air vent type. The numbers encircled in each drawing correspond to a brief description of the deficiency below each drawing.

Vent Type 1:



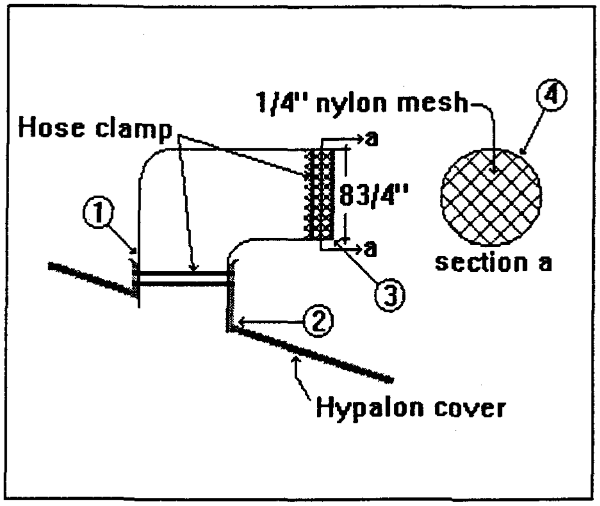
1. The top of the vent skirt on many of the air vents is secured to the air vent with one or more hose clamps approximately 1/2 inch below the top of the skirt fabric. The pocket created between the hose clamp and the top of the vent skirt fabric is somewhat filled with a sealing material. This pocket can trap and direct untreated water, bird feces, etc. into the reservoir, contaminating the water supply.

2. Many of the air vents were found to have defective seals between the base of the air vent skirt and hypalon cover, which allows contaminated water to enter the reservoir.

3. The joint where the two 90° segments of pipe are joined should be well sealed to ensure that bird feces and contaminated water do not enter the interior of the air vent. This is important because the quality of workmanship of each vent varied greatly.

4. The end of the vent should be fitted with a fine brass or stainless steel screen to keep out insects and other small animals that may contaminate the reservoir.

Vent Type 2:



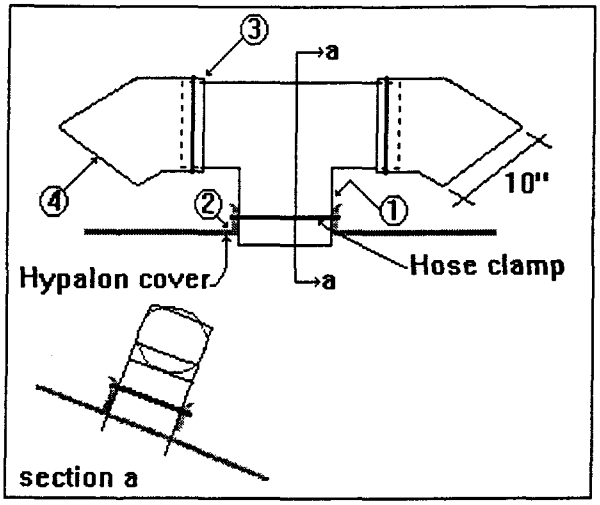
1. The top of the vent skirt on many of the air vents is secured to the air vent with one or more hose clamps approximately 1/2 inch below the top of the skirt fabric. The pocket created between the hose clamp and the top of the vent skirt fabric is somewhat filled with a sealing material. This pocket can trap and direct untreated water, bird feces, etc. into the reservoir, contaminating the water supply.

2. Many of the air vents were found to have defective seals between the base of the air vent skirt and hypalon cover, which allows contaminated water to enter the reservoir.

3. The air vent must be fitted with a downturned vent assembly to prevent contaminants from entering the reservoir.

4. The end of the vent should be fitted with a fine brass or stainless steel screen to keep out insects and other small animals.

Vent Type 3:



1. The top of the vent skirt on many of the air vents is secured to the air vent with one or more hose clamps approximately 1/2 inch below the top of the skirt fabric. The pocket created between the hose clamp and the top of the vent skirt fabric is somewhat filled with a sealing material. This pocket can trap and direct untreated water, bird feces, etc. into the reservoir contaminating the water supply.

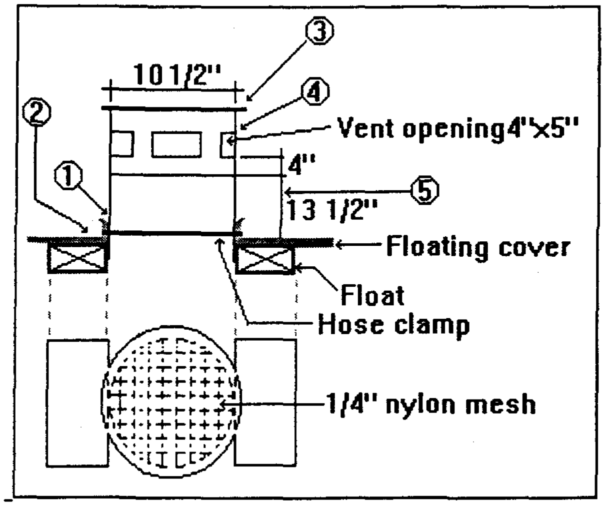
2. Many of the air vents were found to have defective seals between the base of the air vent skirt and hypalon cover, which allows contaminated water to enter the reservoir.

3. The joints where the end segments are joined to the tee section of the air vent should be well sealed to ensure that bird feces and contaminated water do not enter the interior of the air vent.

4. The end of the vent should be fitted with a fine brass or stainless steel screen to keep out insects and other small animals.

5. The elevation of the air vent may not be adequate because the floating cover sump and drainage system does not effectively remove water that accumulates on the reservoir's floating cover. Surface water can enter the reservoir through the air vent perforations when the depth of the water on the floating cover exceeds the elevation of the air vent perforations. This situation has been observed on some of EID floating covered subsurface reservoirs.

Vent Type 4:



1. The top of the vent skirt on many of the air vents is secured to the air vent with one or more hose clamps approximately 1/2 inch below the top of the skirt fabric. The pocket created between the hose clamp and the top of the vent skirt fabric is somewhat filled with a sealing material. This pocket can trap and direct untreated water, bird feces, etc. into the reservoir, contaminating the water supply.

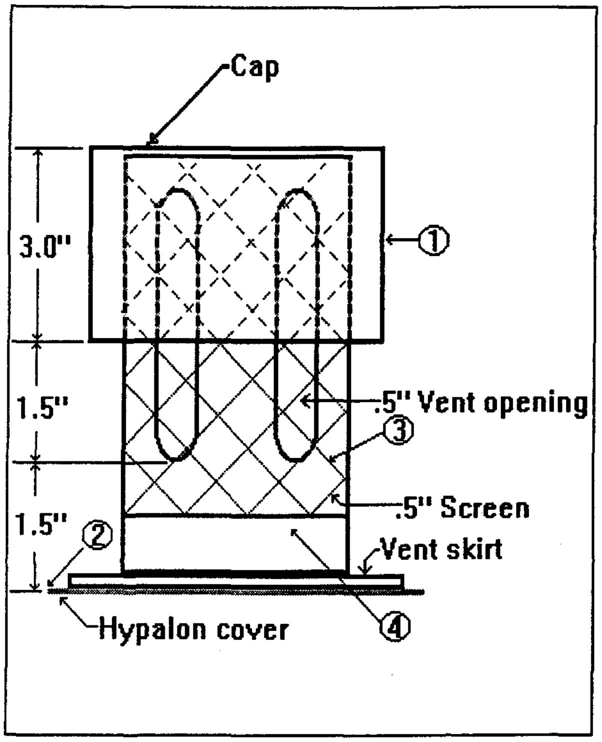
2. Many of the air vents were found to have defective seals between the base of the air vent skirt and hypalon cover, allowing contaminated water to enter the reservoir.

3. To prevent contaminants from entering the reservoir, the air vent must be fitted with a protective shroud that extends at least 6 inches below the bottom of the air vent openings

4. The vertical air vent openings must be covered with a fine brass or stainless steel screen to prohibit insects and other small animals from contaminating the water supply.

5. The elevation of the air vent may not be adequate because the floating cover sump and drainage system does not effectively remove water that accumulates on the reservoir's floating cover. Surface water can enter the reservoir through the air vent openings when the depth of the water on the floating cover exceeds this elevation. This situation has been observed on some of EID floating covered subsurface reservoirs.

Vent Type 5:



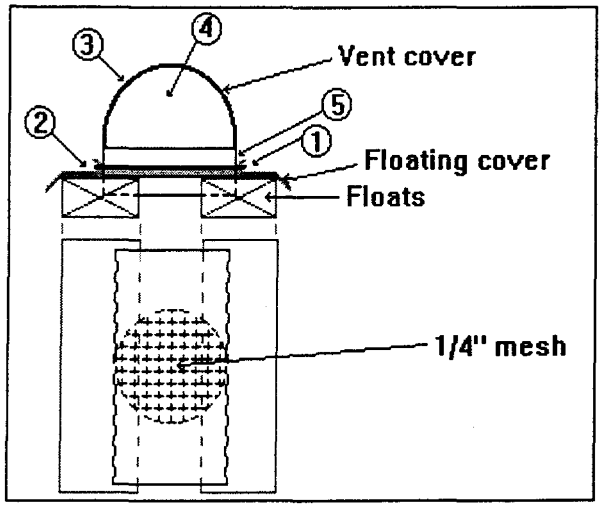
1. To prevent contaminants from entering the reservoir, the air vent must be elevated and fitted with a protective shroud that extends at least 6 inches below the bottom of the air vent openings

2. Many of the air vents were found to have defective seals between the base of the air vent skirt and floating cover, which allows contaminated water to enter the reservoir.

3. The air vent openings must be fitted with a fine brass or stainless steel screen to keep insects and other small animals from entering the reservoir.

4. The elevation of the air vent is not adequate because the floating cover sump and drainage system does not effectively remove water that accumulates on the reservoir's floating cover. Surface water can enter the reservoir through the air vent openings when the depth of the water on the floating cover exceeds that elevation. This situation has been observed on some of EID floating covered subsurface reservoirs.

Vent Type 6:



1. The top of the vent skirt on many of the air vents is secured to the air vent with one or more hose clamps approximately 1/2 inch below the top of the skirt fabric. The pocket created between the hose clamp and the top of the vent skirt fabric is somewhat filled with a sealing material. This pocket can trap and direct untreated water, bird feces, etc. into the reservoir, contaminating the water supply.

2. Many of the air vents were found to have defective seals between the base of the air vent skirt and hypalon cover allowing contaminated water to enter the reservoir.

3. The air vent cover must be modified to prevent animals from entering the space between the vent cover and vent opening that is covered by the 1/4 inch nylon mesh.

4. The elevation of the air vent is not adequate because the floating cover sump and drainage system does not effectively remove water that accumulates on the reservoir's floating cover. Surface water can enter the reservoir through the air vent openings when the depth of the water on the floating cover exceeds that elevation. This situation has been observed on some of EID floating covered subsurface reservoirs.

Section 3
Floating Cover Access Hatches

During our inspection, we noted a significant number of defects with floating cover access hatches that are public health hazard because they allow polluted water to enter the reservoir. We found frogs, black widow spiders, and other insects living within the access hatch cover as well as dead insects, dust, and pollen floating on the surface of the treated water within the access hatches of each reservoir.

In Figure 4 below, the padlock hasp is shown to be fixed to the exterior of the access hatch curb. Of the access hatches inspected, all but two had the padlock hasp installed in the interior of the curb allowing contaminated water to be diverted into the reservoir. There was also evidence that contaminated surface water had entered the reservoir between the hypalon cover and base of the access hatch curb. At every access hatch inspected, we observed treated water escaping from inside the reservoir around the base of the access hatch curb, stainless steel bar, and anchor bolts that secure the access hatch assembly to the floating cover. In addition, we also observed punctures, premature wear, or damage where dissimilar materials are joined together (floating cover membrane connected to the access hatch curb base, sump assembly base or vent base). We also noted similar damage to the floating cover membrane in some areas where a single layer of membrane was adhered to multiple layers of membrane.

The access hatches must also be elevated so that contaminated water will not be able to enter the reservoir when the sump and drainage system fails.

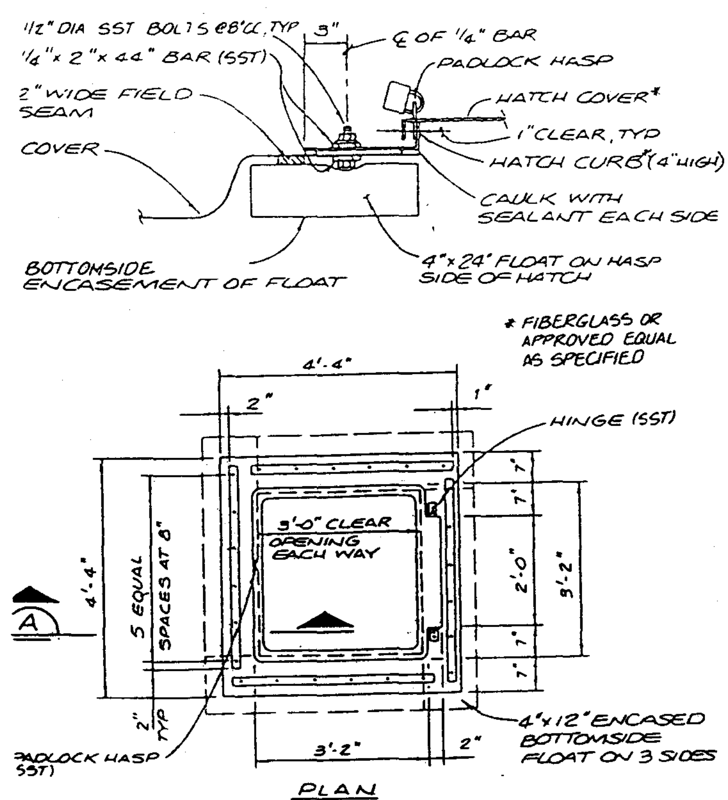
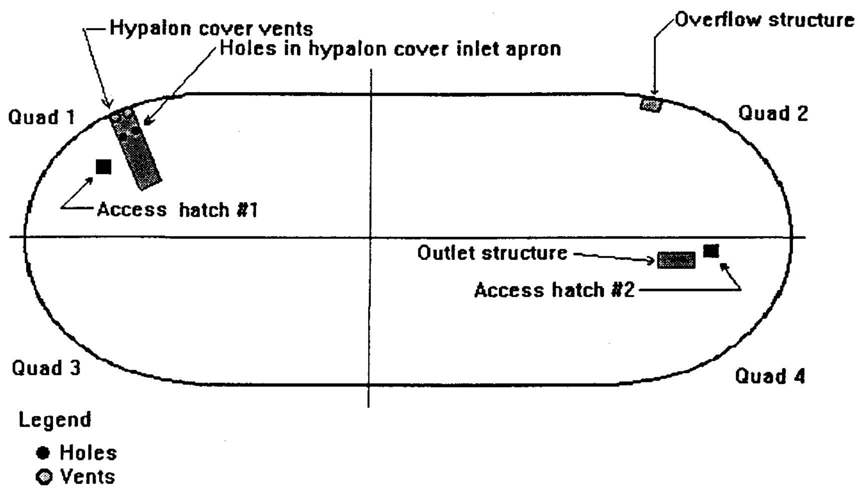


Figure 4

Section 4

Listed below are deficiencies found at each reservoir during our inspection that require immediate attention:

Reservoir 1



Reservoir 1 deficiencies:

1. Two holes on the inlet apron (location identified in the drawing above) must be repaired to prevent insects and contaminated water that has accumulated on the cover from entering the reservoir.

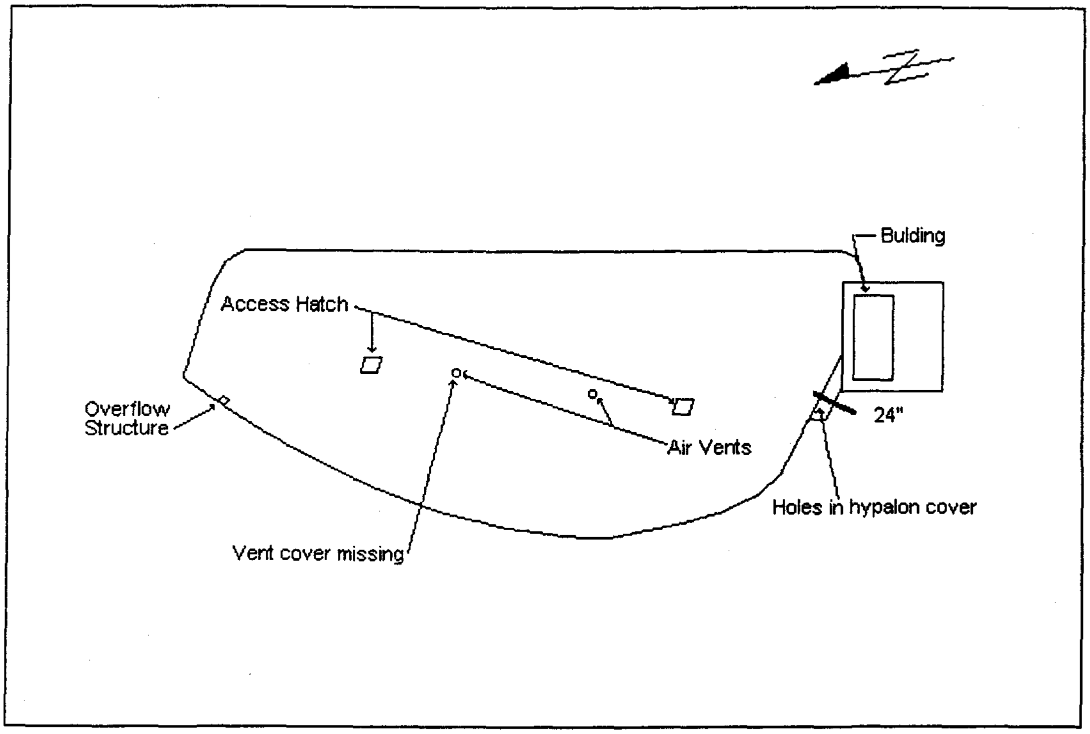
2. Two vents located on the inlet apron must be fitted with a fine metal screen which will exclude insects. These vents must also be elevated and a protective shroud must extend below the vent openings to prevent contaminants from entering the reservoirs

3. The padlock hasp must be fixed to the outside of the raised access hatch curb. Also, the padlock hasp opening in the access hatch lid must be modified so that contaminated water cannot enter the reservoir.

4. The access hatch curb assembly at both hatches must be modified to prevent untreated water and surface debris from entering the reservoir between the hypalon cover and hatch curb base.

5. Both access hatch must be modified to prevent insects from entering the reservoir between the hatch curb and hatch cover. During our inspection a black widow spider was noted inside the hatch cover. Pollen, dust, dead insects, and debris were also found suspended on the water surface within the access hatch.

Moosehall Reservoir



Moosehall Reservoir deficiencies:

1. Two holes in the hypalon apron (location identified in the drawing above) must be repaired to prevent insects and contaminated water from entering the reservoir. These vents must also be elevated and a protective shroud must extend below the vent openings to prevent contaminants from entering the reservoirs

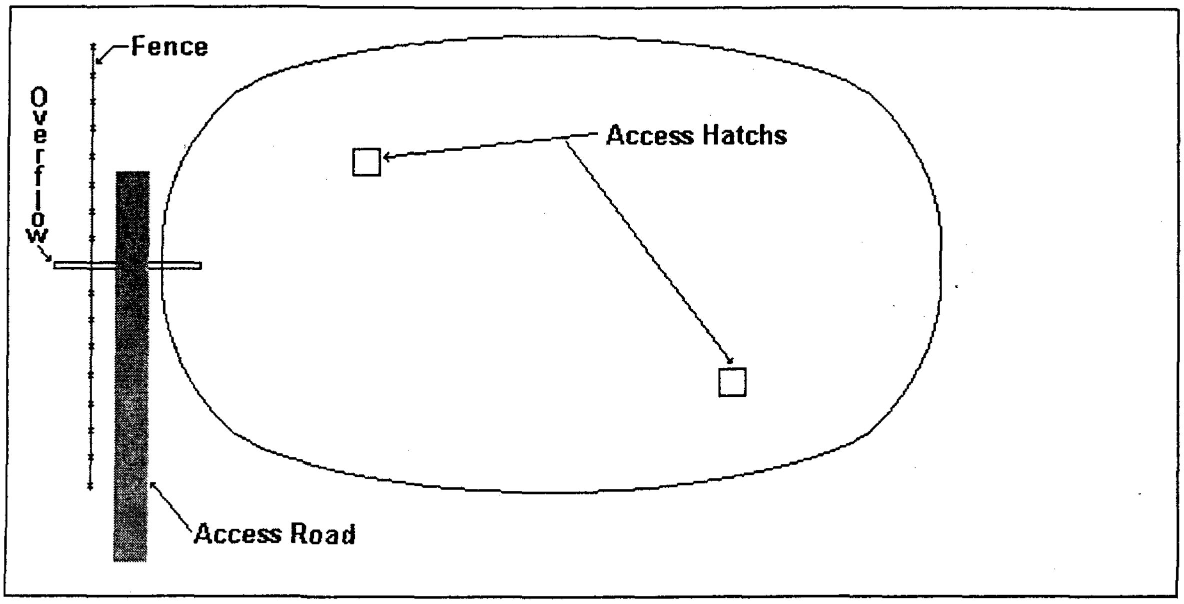
2. The cap on the air vent is missing and must be replaced to prevent insects and other contaminates from entering the reservoir and fitted with a fine metal screen which will exclude insects.

3. The access hatch curb assembly at both hatches must be modified to prevent untreated water and surface debris from entering the reservoir between the hypalon cover and hatch curb base.

4. Both access hatch must be modified to prevent insects from entering the reservoir between the hatch curb and hatch cover. During our inspection we found pollen, dust, dead insects, and debris floating on the water surface within the access hatch.

5. The 1/4" metal screen on the 6" galvanized metal vent must be covered with a fine metal screen which will exclude insects.

Pollock Pines Reservoir



Pollock Pines Reservoir Deficiencies:

1. The padlock hasp must be fixed to the outside of the raised access hatch curb. Also, the padlock hasp opening in the access hatch lid must be modified so that contaminated water cannot enter the reservoir.

2. The access hatch curb assembly at both hatches must be modified to prevent untreated water and surface debris from entering the reservoir between the hypalon cover and hatch curb base.

3. Both access hatch must be modified to prevent insects from entering the reservoir between the top of the access hatch curb and hatch cover. During our inspection we found frogs inside the access hatch cover and curb in addition to pollen, dust, insects, and debris floating on the water surface within the reservoir.

4. At the time of the inspection there were several inches of standing water on the floating cover. Therefore, we request that the water on the cover be removed, the floating cover cleaned and inspected for holes.

Reservoir B Detail Not Available

Reservoir B Deficiencies:

1. Some of the perimeter air vent openings are not screened. The air vent opening must be covered with a fine brass or stainless steel screen to prohibit insects and other small animals from contaminating the water supply.

2. Most of the vent openings were fitted with a loosely attached 1/4" nylon mesh. The nylon mesh must be replaced with a fine brass or stainless steel screen to keep out insects and other small animals.

3. We observed a backsiphonage condition around a crack in the 1/2" schedule 40 PVC chlorine feed line near the outlet structure. The chlorine feed line must be repaired to eliminate the potential of contaminants being drawn into the reservoir.

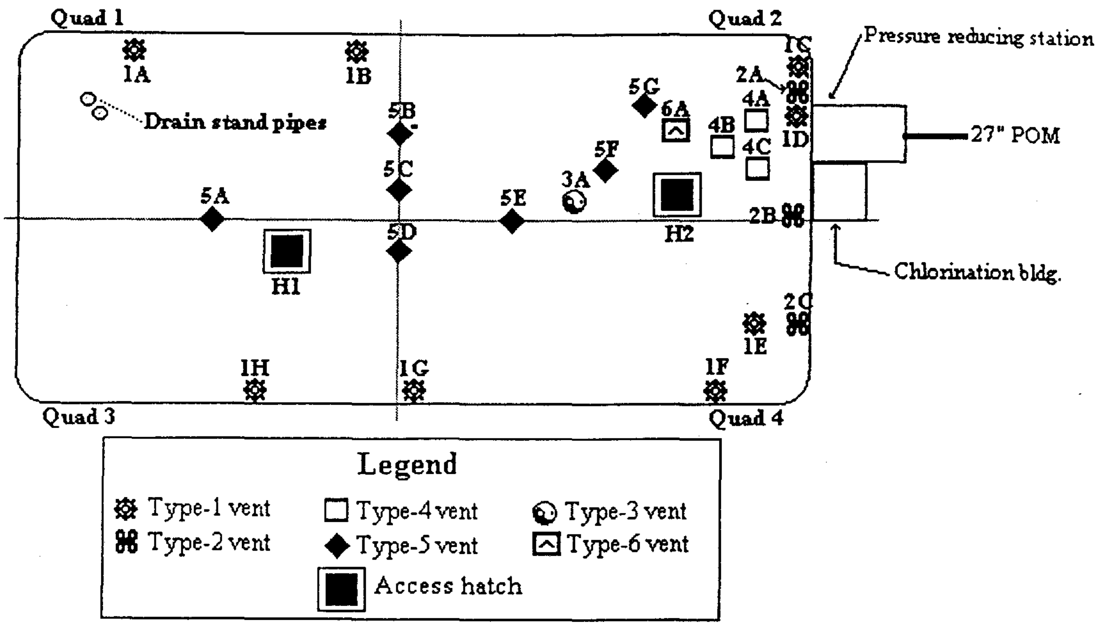
4. Several areas on the floating cover near the spillway and outlet structures must be repaired. Currently bird feces, surface water, and other pollutants can enter the reservoir through voids between the floating cover and the spillway and outlet structure apron. Contaminated water can also enter the reservoir through poorly sealed areas around sluice gate operator stem and anchor curb.

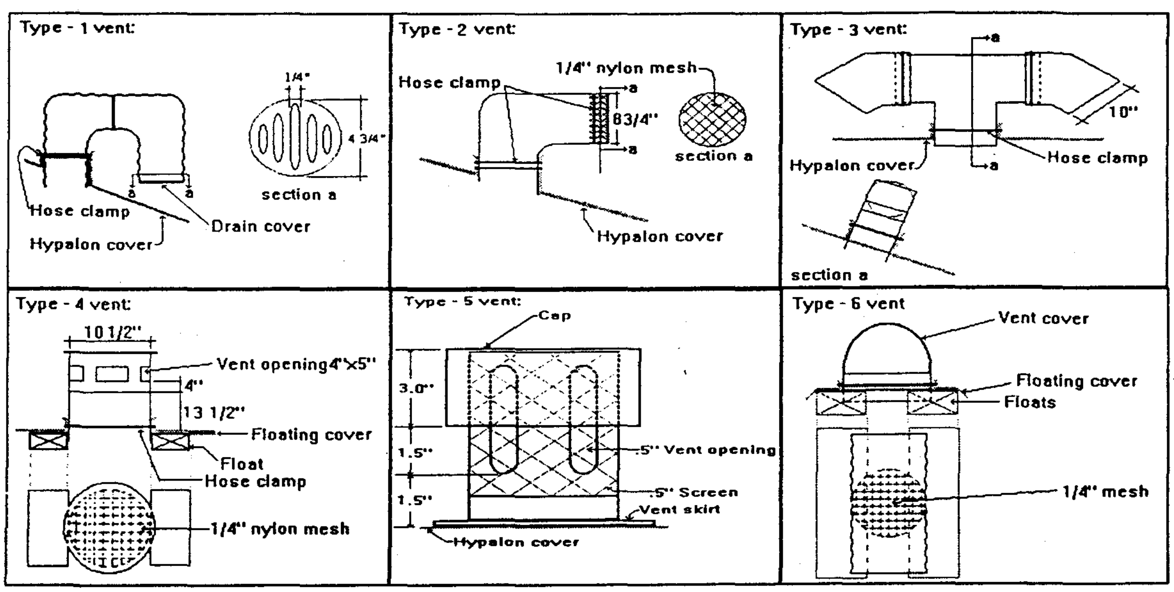
5. The access hatch curb assembly at both access hatches must be modified to prevent untreated water and surface debris from entering the reservoir between the hypalon cover and hatch curb base.

6. Both access hatches must be modified to prevent insects, pollen, and debris from entering the reservoir between the top of the access hatch curb and hatch cover. During our inspection we noted a substantial amount of pollen, dust, insects, and debris floating on the water surface within the reservoir.

7. The 1/4" metal screen on the 6" galvanized metal vents must be covered with a fine metal screen which will exclude insects.

Reservoir C





Reservoir C Deficiencies:

1. The 1/4" metal screen on the 6" galvanized metal vents must be covered with a fine metal screen which will exclude insects.

2. Repair the hole in the floating cover at the base of vent "5B" as identified in the diagram above.

3. Repair the hole in the floating cover membrane located at the base of vent "1A" as identified in the diagram above.

4. Repair hole in the floating cover membrane located at the base of the access hatch "H1" as identified in the diagram above.

5. A two inch segment of the access hatch apron seal has failed and must be re-glued to the floating cover. Treated water from within the reservoir was found to be exiting from this void.

6. Several areas on the floating cover near the overflow and outlet structures must be repaired. Currently bird feces, surface water, and other pollutants can enter the reservoir through voids between the floating cover and the spillway and outlet structure aprons. Contaminated water can enter the reservoir through poorly sealed areas around sluice gate operator stem and anchor curb .

7. The access hatch curb assembly at both hatches must be modified to prevent untreated water and surface debris from entering the reservoir between the hypalon cover and hatch curb base.

8. Both access hatches must be modified to prevent insects, pollen, and debris from entering the reservoir between the top of the access hatch curb and hatch cover. During our inspection we noted a substantial amount of pollen, dust, insects, and debris floating on the water surface within the reservoir.

Appendix 7

Gold Ridge Forest Waste Discharge Permit

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

RECEIVED
AUG 03 1995
EL DORADO IRRIGATION DISTRICT

ORDER NO. 89-172

WASTE DISCHARGE REQUIREMENTS
FOR
GOLD RIDGE FOREST UNIT NO. 3
GOLD RIDGE FOREST OWNERS ASSOCIATION
EL DORADO IRRIGATION DISTRICT
EL DORADO COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) finds that:

1. Gold Ridge Forest Owners Association submitted a Report of Waste Discharge, dated 14 June 1989. The property is owned by Gold Ridge Forest Owners Association. Gold Ridge Forest Owners Association, owner, and El Dorado Irrigation District, operator, are hereafter referred to jointly as Discharger.

2. The Board, on 26 May 1972, adopted Order No. 72-267 which prescribed requirements for a discharge from up to 48 homes to a community septic tank/leachfield disposal system.

3. Waste discharge requirements are being reviewed to ensure compatibility with the Board's current plans and policies.

4. Currently, 30 homes are connected to the community leachfield system. A maximum of 48 homes may be connected to the system at some point in the future.

5. The septic tank/leachfield system currently consists of one 9,000 gallon septic tank and over 1,100 feet of leachline. An additional 600 feet are currently in the design approval stage and should be installed by the end of 1989.

6. Present waste discharge requirements established by Order No. 72-267 are neither adequate nor consistent with plans and policies of the Board.

7. The Discharger discharges an average of 8,500 gallons per day to the sewage disposal system.

8. The sewage disposal system is in Section 5, T10N, R13E, MDB&M, with surface water drainage to Jenkinson Lake.

9. The beneficial uses of Jenkinson Lake are municipal, industrial, and agricultural supply; recreation; esthetic enjoyment; navigation; ground water recharge; and preservation and enhancement of fish, wildlife, and other aquatic resources.

10. The Board, on 25 July 1975, adopted a Water Quality Control Plan for the Sacramento-San Joaquin Delta Basin (5B) which contains water quality objectives for all waters of the Basin. These requirements are consistent with that Plan.

11. The action to adopt waste discharge requirements for this facility is exempt from the provisions of the California Environmental Quality Act in accordance with Section 15301, Title 14, California Code of Regulations (CCR).

12. The Board has notified the Discharger and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge.

13. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that Order No. 72-267 be rescinded and Gold Ridge Homeowners Association and El Dorado Irrigation District, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following:

A. Discharge Prohibitions:

1. The direct discharge of wastes to surface waters or surface water drainage courses is prohibited.

2. The by-pass or overflow of untreated or partially treated waste is prohibited.

3. Surfacing of wastewater percolating in the leachfield is prohibited.

B. Discharge Specifications:

1. Neither the treatment nor the discharge shall cause a nuisance or condition of pollution as defined by the California Water Code, Section 13050.

2. The discharge shall not cause degradation of any water supply.

3. The discharge shall remain within the designated disposal area at all times.

4. The 30-day average daily dry weather discharge flow shall not exceed 10,000 gallons.

5. Collected screening, sludges, and other solids removed from liquid wastes shall be disposed of in a manner approved by the Executive Officer.

C. Provisions:

1. The Discharger may be required to submit technical reports as directed by the Executive Officer.

2. The Discharger shall comply with the attached Monitoring and Reporting Program No. **89-172.**

3. The Discharger shall comply with the Standard Provisions and Reporting Requirements, dated 1 September 1985, which are a part of this Order.

4. The Discharger shall report promptly to the Board any material change or proposed change in the character, location, or volume of the discharge.

5. In the event of any change in control or ownership of land or waste discharge facilities presently owned or controlled by the Discharger, the Discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be forwarded to this office.

6. The Board will review this Order periodically and may revise requirements when necessary.

I, WILLIAM H. CROOKS, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on **22 September 1989**.

William H. Crooks

WILLIAM H. CROOKS, Executive Officer

8/24/89:RJB:gs

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. 89-172

FOR
GOLD RIDGE FOREST UNIT 3
GOLD RIDGE FOREST OWNERS ASSOCIATION
EL DORADO IRRIGATION DISTRICT
EL DORADO COUNTY

The Discharger shall submit an annual status report which shall include, as a minimum, the following:

1. Monthly description of leachfield surface conditions for each field that received effluent during the month.
2. The dates, duration, and volume of any leachfield failure events.
3. An update on the number of homes connected to the system.
4. Any other significant events or changes which may have water quality implications.

The annual report shall be submitted to the Board by **30 January** of each year.

The Discharger shall implement the above monitoring program as of the date of this Order.

William H. Crooks

WILLIAM H. CROOKS, Executive Officer

22 September 1989
(Date)

8/24/89:RJB:gs

INFORMATION SHEET

GOLD RIDGE FOREST UNIT NO. 3
GOLD RIDGE FOREST OWNERS ASSOCIATION
EL DORADO IRRIGATION DISTRICT
EL DORADO COUNTY

The Gold Ridge Forest Subdivision is about 1/2 mile north of Jenkinson Lake and about two miles southeast of Pollock Pines in El Dorado County. Homes in this area, which is fairly densely populated, are typically sewered to individual septic tank/leachfield systems. However, a portion (48 lots) of this subdivision sits atop an impervious agglomerate, locally called lava caprock. Because of this impervious rock, a community leachfield has been utilized outside the caprock area. At the present time, 30 homes are sewered to the system. The District is currently expanding the system with an additional 600 feet of leachline. This expansion was deemed necessary due to distribution problems with some of the existing lines, and should provide capacity to handle the system's needs for the next 5 to 10 years. Surface water drainage is to Jenkinson Lake.

8/24/89:RJB:gs

Appendix 8

Hazel Creek Mine
Waste Discharge Permit

STATE OF CALIFORNIA - Environmental Protection Agency PETE WILSON, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
3443 Routier Road, Suite A
Sacramento, CA 95827-3098
PHONE: (916) 255-3000
FAX: (916) 255-3015

EL DORADO COUNTY
RECEIVED
FEB 20 1996
ENVIRONMENTAL MANAGEMENT

13 February 1996

Mr. Ronald P. Monk, Resource Manager
Georgia-Pacific West, Incorporated
P.O. Box 66, Highway 49
Martell, CA 95654

TENTATIVE WASTE DISCHARGE REQUIREMENTS, HAZEL CREEK MINE, EL DORADO COUNTY

Attached is a copy of tentative Waste Discharge Requirements for the closure of the Hazel Creek Mine site. The results of chemical testing on the tailings ponds demonstrate that the tailings in Pond #1 have the potential to adversely affect water quality in Hazel Creek. Therefore, tailings Pond #1 must be closed as a Group B waste management unit, as defined in Article 7, Chapter 15, Title 23, California Code of Regulations.

We intend to bring these WDRs before the Board at the 22 March 1996 public hearing. Any comments or recommendations you may have concerning the enclosed tentative order should be submitted to this office by **29 February 1996** in order for us to give them full consideration prior to the meeting of the Regional Board.

If you have any questions, please call me at (916) 255-3142.

Greg Vaughn

GREG K. VAUGHN
Senior Engineer

JEB:lsb

Attachments: Tentative Order
Standard Provision (Discharger only)

cc: Department of Health Services, Office of Drinking Water, Sacramento
Department of Health Services, Environmental Management Branch, Sacramento
Department of Fish and Game, Region 2, Rancho Cordova
Ms. Betsy Jennings, Office of Chief Counsel, State Water Resources Control Board, Sacramento
Ms. Liz Haven, Division of Clean Water Programs, State Water Resources Control Board, Sacramento
Mr. David Johnston, El Dorado Environmental Management Department, Placerville
Mr. Douglas Zanini, El Dorado Planning Department, Placerville
Mr. Roy Liede Georgia-Pacific West Inc., Martell

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
WASTE DISCHARGE REQUIREMENTS
ORDER NO. 96--
FOR
GEORGIA-PACIFIC WEST, INCORPORATED
HAZEL CREEK MINE CLOSURE
EL DORADO COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) finds that:

1. Georgia-Pacific West, Incorporated, Martell Operations (hereafter Discharger) submitted a Report of Waste Discharge (RWD) on 25 October 1995 for Waste Discharge Requirements for reclamation and closure of the Hazel Creek Mine facility in El Dorado County.

2. The Board rescinded Waste Discharge Requirements No. 83-002, on 27 March 1992, for Hazel Creek Mine, Michael W. Mahaffey, American Forest Products, El Dorado County due to abandonment by the mining operator in February 1987. On 1 May 1988, the Discharger acquired American Forest Products Company and, as a consequence, the surface ownership of the Hazel Creek Mine properties. On 24 February 1995, the Discharger purchased all mineral rights to the Hazel Creek Mine at public auction for back taxes. At that time the Discharger became the sole owner of the Hazel Creek Mine properties.

3. The mine site is 15 east of Placerville, 1 mile upstream of Sly Park Reservoir, and straddles Hazel Creek in Sections 2 and 3, T10 N, R13E, MDB&M (Attachment A). The mine and tailings impoundments are identified as being within El Dorado County Assessor's Parcel Numbers: 42-021-02-10, 42-021-03-10, 42-021-05-10, and 42-021-07-10.

4. In 1985 El Dorado County issued Special Use Permit No. 85-37 and prepared a Negative Declaration in compliance with the California Environmental Quality Act.

5. Only limited mining activity prior to the 1900s. 75,000 tons of ore were mined and processed on-site between 1948 and 1959. The mine was reactivated between 1984 and 1987. No estimates of the tons of ore processed during this time is available. The mine has been inactive since February 1987.

Proposed Closure Activities

6. Each of the mine adits and the mine shaft will be collapsed to eliminate any safety hazards and to reduce the potential discharge of seepage to the Hazel Creek drainage.

7. The Discharger has proposed to close Waste Management Unit 1 (approximately 0.35 acres and 50,000 cubic yards) with an engineered alternative to the prescriptive standards by the use of geosynthetic clay liner (gcl) for use as the barrier layer in the final cover. The design specifications of specific materials to be used for closure will be submitted to the Executive Officer for approval prior to construction. Section 2574, Chapter 15, Title 23, California Code of Regulations states that Regional boards shall issue waste discharge requirements which incorporate the relevant provisions of an approved mining reclamation plan.

8. The alternative engineering design and materials for the barrier component of the final cover demonstrated compliance with the prescriptive standards contained in Chapter 15, Article 8. The Discharger also demonstrated that the design was in accordance with Subsections 2510(b) and (c) of Article 1. Subsections 2510(b) and (c) describe the Board's authority to consider alternatives to construction or prescriptive standards. The Discharger demonstrated that the engineered alternative is feasible and consistent with the performance goal and affords equivalent protection against water quality impairment; that the prescriptive standard is unreasonable and unnecessarily burdensome and will cost substantially more.

WASTES AND THEIR CLASSIFICATION

9. Group B mining wastes are classified such that the wastes consist of or contain nonhazardous soluble pollutants of concentrations which exceed water quality objectives for, or could cause, degradation of waters of the state. Chemical analysis of surface sample from WMU #1 yielded 4.1 mg/l lead using DI (deionized water) extract. This test simulates rainfall percolating through the tailings and demonstrates that the waste in WMU#1 is a Group B mining waste.

10. Group C mining wastes are classified such that the wastes do not pose a threat to water quality other than sedimentation. The Discharger has assumed the remaining tailings ponds are Group C mining waste. These management units shall be closed in a manner that will minimize erosion and the threat of water quality degradation from sedimentation. When operating, the series of ponds in Attachment B had a capacity of approximately 7,000,000 gallons.

DESCRIPTION OF THE SITE

11. The Third Edition of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins was adopted on 9 December 1994, approved by the State Water Resources Control Board on 16 February 1995 and approved by the Office of Administrative Law on 9 May 1995. The existing beneficial uses of Hazel Creek and Jenkinson Lake are Municipal and Domestic Supply, Agriculture, Recreation, Freshwater Habitat, Spawning and Wildlife Habitat.

12. The facility is within a 100-year floodplain.

13. Surface water drainage from the site is to Hazel Creek and 1 mile above Jenkinsen Lake (Sly Park Reservoir), which is tributary to the Cosumnes River, which is tributary to the San Joaquin River.

14. Normal flow of Hazel Creek is 1 cubic foot per second (cfs), with portions of the stream drying up during late summer. The previous operator submitted a streambed alteration permit to the Department of Fish and Game stating that the 100 year flood flow was 120 cubic feet per second.

15. The Department of Water Resources rainfall data at the Pacific House station indicates that 6.21 inches for the 24-hour 10 year storm event, and 8.75 inches 24-hour 100 year storm. Average annual rainfall is approximately 53 inches.

16. The drainage area (rainfall catchment basin) for Hazel Creek basin above the mine is approximately 1,200 acres. Elevations range from 3,744 ft.msl at the mine to 4,750 ft. at the divide above the mine.

CEQA CONSIDERATIONS

17. The action to adopt WDRs for this facility is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21000, et seq.), in accordance with Title 14 CCR, Section 15301 for existing facilities.

OTHER LEGAL CONSIDERATIONS

18. This Order implements

    a The Water Quality Control Plan, Third Edition, for the Sacramento River Basin and the San Joaquin River Basin, and

    b. The prescriptive standards and performance goals of Chapter 15, effective November 1984, and subsequent revisions.

19. All local agencies with jurisdiction to regulate land use and to protect public health have approved the use of this site for the discharges of waste to land stated herein.

20. The Board has notified the Discharger and interested and persons of its intention to issue waste discharge requirements for this facility.

21. In a public hearing, the Board heard and considered all comments pertaining to this facility and discharge.

IT IS HEREBY ORDERED that Georgia Pacific-West, Incorporated, their agents, successors, and assigns, in order to meet the provisions of Division 7 of the California Water Code, and the regulations adopted thereunder, shall comply with the following:

A. PROHIBITIONS

1. The discharge of 'hazardous waste' at this facility is prohibited. For the purposes of this Order, the terms 'hazardous waste', 'mining waste' and 'designated waste' are as defined in Chapter 15.

2. The discharge of waste pile runoff water to surface water or any surface water drainage courses, or ground water, is prohibited.

3. The discharge of solid or liquid waste or leachate to surface waters, surface water drainage courses, or ground water is prohibited.

4. The discharge of any new source of waste at this facility is prohibited.

5. The discharge of hazardous waste or designated waste at this facility, is prohibited. For the purposes of this Order, the terms 'hazardous waste' and designated waste' are defined in Chapter 15.

6. The discharge of waste to ponded water from any source is prohibited.

B. CLOSURE SPECIFICATIONS

General WMU Construction

1. All waste management unit closure shall be under the direct supervision of a California registered civil engineer or certified engineering geologist.

2. The closed waste management units shall be provided with at least two permanent monuments, installed by a licensed land surveyor, from which the location and elevation of all wastes, containment structures, and monitoring facilities can be determined throughout the post-closure maintenance period.

3. At closure, each waste management unit shall receive a final cover which is designed and constructed to function with minimum maintenance and consists. at a minimum, a two-foot thick foundation layer, overlain by a one-foot thick clay cover, and finally by a one-foot thick protective layer, or an engineered equivalent final cover approved by the Board pursuant to Subsections 2510(b) and (c) of Chapter 15 (See finding No. 7).

4. Water used for facility maintenance shall be limited to the minimum amount necessary for dust control and vegetative maintenance..

Waste Management Units Specifications

5. Engineered barrier layers within the WMU cover shall have a maximum hydraulic conductivity of 1×10^{-6} cm/s and a minimum relative compaction of 90 percent. Hydraulic conductivities of cover materials shall be determined by laboratory tests using water. Construction methods and quality assurance procedures shall be sufficient to ensure that all parts of the cover meet the hydraulic conductivity and compaction requirements.

6. The closed WMU cover shall consist, at a minimum, of a foundation layer compacted to the maximum density obtainable at optimum moisture content, on foot of clay soil with a maximum hydraulic conductivity of $1x10^{-6}$ cm/s, and a minimum of three inches of soil for vegetation.

7. Closed landfill units shall be graded to at least a 3 percent as an engineered alternative and shall maintain slopes to prevent ponding.

8. New and existing Group C mining waste managements shall be closed in a manner that will minimize erosion and the threat of water quality degradation from sedimentation.

Supervision and Certification of Construction

9. During the closure process, any containment structure, retrofitting, remediation, or engineered alternative shall be designed and constructed under the direct supervision of a California registered civil engineer or a California certified engineering geologist, and shall be certified by a registered professional as meeting the prescriptive standards and performance goals of Chapter 15.

Protection from Storm Events

10. The waste management unit and related containment structures shall be constructed and maintained to prevent, to the greatest extent possible, ponding, infiltration, inundation, erosion, slope failure, washout, and overtopping under 10-year, 24-hour precipitation conditions. Precipitation and drainage control systems shall be designed and constructed to accommodate the anticipated volume of precipitation and peak flows from the surface runoff under 10-year, 24-hour precipitation conditions.

11. Surface drainage from tributary areas and internal site drainage from surface or subsurface sources shall not contact or runoff from wastes that are left in place after closure.

12. Annually, prior to the anticipated rainy season, but no later than 1 November, any necessary erosion control structures shall be implemented, and any necessary construction, maintenance, or repairs of precipitation and drainage control facilities shall be completed to prevent erosion or flooding of the landfill area and to prevent surface drainage from contacting or percolating through wastes during the post-closure period. The Discharger shall submit an annual report to the Regional board by **1 December** describing measures taken to comply with this specification.

C. RECEIVING WATER LIMITATIONS

Water Quality Protection Standards

1. The concentrations of indicator parameters or waste constituents in waters passing through the Point of Compliance as defined in Section 2550.5 of Chapter 15 shall not exceed the "Water Quality Protection Standards" established pursuant to and enumerated in Monitoring and Reporting Program No. ___, which is attached to and made part of this Order.

D. FINANCIAL ASSURANCE

1. The Discharger shall maintain assurances of financial responsibility for initiating and completing corrective action for all known and reasonably foreseeable releases from the waste management units.

E. PROVISIONS:

1. The Discharger shall, in a timely manner, remove and relocate any wastes discharged at this facility in violation of prohibitions of this Order.

2. Wastes shall be discharged only into temporary containers, with adequate protection from leakage into surface waters or onto the ground surface, that are designed for the purpose of temporary storage for removal to an appropriate repository.

3. The Discharger shall notify the Board in writing of any proposed change in ownership or responsibility for operation, closure, or maintenance of the landfill or facility.

4. The Discharger shall comply with Monitoring and Reporting Order No.___ which is attached to and made part of this Order. A violation of Monitoring and Reporting Program No.___ is a violation of these waste discharge requirements.

5. The Discharger shall immediately notify the Board of any flooding, equipment failure, slope failure, or other change in site conditions which could impair the integrity of waste or leachate containment facilities or of precipitation and drainage control structures.

6. The Discharger shall comply with the Standard Provisions and Reporting Requirements, dated September 1993, which are hereby incorporated into this Order. The Standard Provisions and Reporting Requirements contain important provisions and requirements with which the Discharger must comply. A violation of any of the Standard Provisions and Reporting Requirements is a violation of these waste discharge requirements.

7. The Discharger may file a written request (including appropriate supporting documents) with the Regional Board Executive Officer, proposing appropriate modifications to the Monitoring and Reporting Program. The request may address changes to:

   a. any statistical method, non-statistical method, or retest used with a given constituent or parameter.

   b. the manner of determining the background value for a constituent or parameter,

   c. the method for displaying annual data plots,

   d. the laboratory analytical method used to test for a given constituent or parameter,

   e. the media being monitored,

   f. the number or placement of Monitoring Points or Background Monitoring points for a given monitored medium, or

   g. any aspect of monitoring or QA/QC.

8. The owner of the site shall have the continuing responsibility to assure protection of usable waters from discharged wastes and leachate generated by discharged waste during closure, assessment and cleanup, and post-closure maintenance period and during subsequent use of the property for other purposes.

9. The Discharger shall implement any changes in the Monitoring and Reporting Program ordered by the Regional Board Executive Officer upon receipt of a revised Monitoring and Reporting Program.

10. The post-closure maintenance period shall continue until the Board determines that remaining wastes in all WMUs will not threaten water quality.

11. The Discharger shall maintain waste containment facilities and precipitation and drainage controls, and shall continue to monitor ground water and surface waters per Monitoring and Reporting Program No.___ throughout the post-closure maintenance period.

12. The Discharger shall comply with all applicable provisions of Chapter 15 that are not specifically referred to in this Order.

F. REPORTING REQUIREMENTS

1. The Discharger shall comply with the reporting requirements specified in this Order, in Monitoring and Reporting Program Order No.___, and in the Standard Provisions and Reporting Requirements which are attached hereto and made part of this Order.

2. The Discharger shall submit to the Board for approval a postclosure maintenance plan by **15 August 1996**. The postclosure maintenance plan shall describe the ground waters of the area during final operations and during any proposed subsequent use of the land.

3. The Discharger shall submit a status report regarding the financial assurances for corrective action and closure every 5 years after adoption date of these requirements that either validates the ongoing viability of the financial instrument of proposes and substantiates any needed changes. For example, a documented increase in the monitoring system's ability to provide reliable early detection of a release can cause a decrease in the financial coverage.

4. The Discharger shall notify the Board in writing of any proposed change in ownership or responsibility for construction or operation of the WMUs. The Discharger shall notify the succeeding owner or operator in writing of the existence of this Order. A copy of that notification shall be sent to the Board.

5. The Discharger shall notify the Board in writing of any proposed change in post-closure land use.

6. Compliance with these waste discharge requirements dose not release the discharger from any more stringent closure requirements that may be imposed by the local enforcement agency.

7. The Board will review this Order periodically and will revise Waste Discharge Requirements when necessary.

I, WILLIAM H. CROOKS, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 22 March 1996.

WILLIAM H. CROOKS, Executive Officer

JEB:jeb/lsb

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
MONITORING AND REPORTING PROGRAM
ORDER NO 96-
FOR
GEORGIA-PACIFIC WEST, INCORPORATED
HAZEL CREEK MINE CLOSURE
EL DORADO COUNTY

The Discharger shall maintain water quality monitoring systems that are appropriate for detection and evaluation monitoring and that comply with the provisions of Title 23, California Code of Regulations (CCR), Division 3, Chapter 15, Article 5.

Compliance with this Monitoring and Reporting Program, and with the companion Standard Provisions and Reporting Requirements, is ordered by Waste Discharge Requirements Order No. 96-_____. Failure to comply with this Program, or with the Standard Provisions and Reporting Requirements, constitutes noncompliance with the WDRs and with the Water Code, which can result in the imposition of civil monetary liability.

A. REPORTING

The Discharger shall report monitoring data and information as required in this Monitoring and Reporting Program and as required in the Standard Provisions and Reporting Requirements. Reports which do not comply with the required format will be **REJECTED** and the Discharger shall be deemed to be in non-compliance with the WDRs. In reporting the monitoring data required by this program, the Discharger shall arrange the data in tabular form so that the date, the constituents, the concentrations, and the units are readily discernible. The data shall be summarized in such a manner so as to illustrate clearly the compliance with waste discharge requirements or the lack thereof. A short discussion of the monitoring results, including notations of any water quality violations, shall precede the tabular summaries.

Field and laboratory tests shall be reported in the semi-annual monitoring reports. Semi-annual monitoring reports shall be submitted to the Board by the **15th day of the month** following the calendar quarter in which the samples were taken. The results of any monitoring done more frequently than required at the locations specified herein shall be reported to the Board. An annual report shall be submitted to the Board which contains both tabular and graphical summaries of the monitoring data obtained during the previous twelve months, so as to show historical trends at each well. The report shall include a discussion of the progress toward re-establishment of compliance with waste discharge requirements and water quality protection standard.

Method detection limits and practical quantitation limits shall be reported. All peaks shall be reported, including those which cannot be quantified and/or specifically identified. Metals shall be analyzed according to the methods listed in Attachment D.

B. REQUIRED MONITORING REPORTS

1. **Water Quality Protection Standard Report**

The Discharger shall develop water quality protection standards and submit them in the Annual Monitoring Summary Report.

2. **Detection and Evaluation Monitoring Report**

The Discharger shall submit reports of the results of detection and evaluation monitoring in accordance with the schedules specified in this Monitoring and Reporting Program.

3. **Annual Monitoring Summary Report**

The Discharger shall submit the Annual Monitoring Summary Report as specified in the Standard Provisions and Reporting Requirements.

4. **Constituents-of-Concern (COC) 5 Year Report**

In the absence of a *new* release being indicated, the Discharger shall monitor all Constituents of Concern for all Monitoring Points for each monitored medium for all COCs every fifth year, beginning with the first quarterly sampling event after the adoption date of this monitoring and reporting program, with subsequent COC monitoring efforts being carried out every fifth year thereafter alternately in the summer (Reporting period ends 30 September) and winter (Reporting Period ends 31 March). The COC Report may be combined with a Detection Monitoring Report or an Annual Summary Report having a Reporting Period that ends at the same time.

Standard Observations

Each monitoring report shall include a summary and certification of completion of all Standard Observations for the waste management unit, for the perimeter of the WMU, and for the receiving waters. The standard observations shall be performed on a weekly basis and shall include those elements as defined in the Standard Provisions and Reporting Requirements.

C. MONITORING

If the Discharger, through a detection monitoring program, or the Board finds that there is a statistically significant increase in indicator parameters or waste constituents over the water quality protection standards (established pursuant to Monitoring and Reporting Program No. 96-_____) at or beyond the Points of Compliance, the Discharger shall notify the Board or acknowledge the Board's finding in writing within seven days, and shall immediately resample for the constituent(s) or parameter(s) at the point where the standard was exceeded. Within 90 days, the Discharger shall submit to the Board the results of the resampling and either:

a. a report demonstrating that the water quality protection standard was not, in fact, exceeded; or

b. an amended Report of Waste Discharge for the establishment of a verification monitoring program, per Section 2557 of Chapter 15, which is designed to verify that water quality protection standards have been exceeded and to determine the horizontal and vertical extent of pollution.

If the Discharger, through an evaluation monitoring program, or the Board verifies that water quality protection standards have been exceeded at or beyond the Points of Compliance, the Discharger shall notify the Board or acknowledge the Board's finding in writing within seven days. Within 180 days, the Discharger shall submit to the Board an amended Report of Waste Discharge for the establishment of a corrective action program, per Section 2558 of Chapter 15, which is designed to achieve compliance with the water quality protection standards.

D. REQUIRED MONITORING PROGRAMS

1. Detection and Evaluation Monitoring Program

For each monitored medium, all Monitoring Points assigned to detection monitoring and/or evaluation monitoring shall be monitored once each calendar quarter for the Monitoring Parameters listed in this Program, unless otherwise specified. The Discharger shall report, in writing, to the regional board on the extent and nature of the release. The Discharger shall submit these reports at least semi-annually.

For any given monitored medium, a sufficient number of samples shall be taken from all Monitoring Points to satisfy the data analysis requirements for a given Reporting Period, and shall be taken in a manner that ensures sample independence to the greatest extent feasible.

Ground water sampling shall also include an accurate determination of the ground water surface elevation and field parameters (pH, temperature, electrical conductivity, turbidity) for that Monitoring Point. Ground water elevations taken prior to purging the well and sampling for Monitoring Parameters shall be used to fulfill the ground water gradient/direction analyses required. For each monitored ground water body, the Discharger shall measure the water level in each well and determine ground water gradient and direction at least quarterly, including the times of expected highest and lowest elevations of the water level for the respective ground water body. Ground water elevations for all upgradient and downgradient wells for a given ground water body shall be measured within a period of time short enough to avoid temporal variations in ground water flow which could preclude accurate determination of ground water gradient and direction. This information shall be included in the semi-annual monitoring reports.

Statistical or non-statistical analysis should be performed as soon as the monitoring data are available.

5. **Surface Water Monitoring**

The surface water monitoring network includes six sampling points described below and identified on Attachment B:

S-1 is located in Hazel Creek just above the Squirrel Hunters Lidge Adit Portal.

S-2 is located at the entrance of squirrel Hunters Ledge Adit Portal.

S-3 is located at the entrance of the East Drift Adit Portal.

S-4 is located at the Hazel Creek Mine Shaft.

S-5 is located on the tributary to Hazel Creek just up stream from the confluence.

S-6 is located on Hazel Creek just downstream the above confluence.

Surface water samples are to be collected after the first storm of the rainy season which produces significant flow and quarterly thereafter when water is present. Samples shall be collected from all stations and analyzed at the frequency and for the monitoring parameters specified in Table 3 - Surface Water Monitoring Program.

Surface water monitoring reports shall be submitted with the corresponding semi-annual ground water monitoring and shall include evaluation of potential impacts of the facility on surface water quality and compliance with the Water Quality Protection Standard.

TABLE 3 - SURFACE WATER MONITORING PROGRAM

Parameter	Units	Frequency
Field Parameters*		
Temperature	°C	Quarterly
Specific Conductance	μmhos/cm	Quarterly
pH	pH units	Quarterly
Turbidity	Turbidity units	Quarterly
Monitoring Parameters*		
Total Dissolved Solids (TDS)	mg/L	Quarterly
Lead	mg/L	Quarterly
Sulfates	mg/L	Quarterly
Iron	mg/L	Quarterly
Dissolved oxygen	mg/L	Quarterly

D. WATER QUALITY PROTECTION STANDARD

The Water Quality Protection Standard (Standard) consists of the following elements:

a. Constituents of Concern;

b. Concentration Limits;

c. Monitoring Points;

d. Points of Compliance; and

e. Compliance Period.

Each of these is described as follows:

1. Constituents of Concern

The 'COC list' (list of Constituents of Concern required under 23 CCR 2550.3) shall include all constituents listed in Tables 1, 2, and 3 (above), the Waste Discharge Requirements No. 96-_____, and all constituents listed in Attachment D. The Discharger shall monitor all COCs every five years, or more frequently as required under the detection and evaluation monitoring program.

2. Concentration Limits

The Concentration Limit for any given Constituent of Concern or Monitoring Parameter in a given monitored medium (i.e., surface waters) at the closed mine site shall be as follows, and shall be used as the basis of comparison with data from the Monitoring Points in that monitored medium:

a. The background value established in the WDRs by the Board for that constituent and medium;

b. The constituent's background value, established anew during each Reporting Period using only data from all samples collected during that Reporting Period from the Background Monitoring Points for that monitored medium. Either:

(1) The mean (or median, as appropriate) and standard deviation (or other measure of central tendency, as appropriate) of the constituent's background data; or

(2) The constituent's MDL, in cases where less than 10 percent of the background samples exceed the constituent's MDL; or

c. A concentration limit greater than background, as approved by the Board for use during or after corrective action.

Surface Water

The surface water monitoring locations shall be monitored quarterly until four quarters of data have been obtained in order to determine the concentration limits for surface water.

3. Monitoring Points

The ground water monitoring points for detection and evaluation monitoring shall be S-1 through S-6.

4. Points of Compliance

The points of compliance for surface water is S-5 and S-6.

5. Compliance Period

The Compliance Period is the number of years equal to the active life of the landfill plus the closure period. Each time the Standard is exceeded (i.e., a release is discovered), the landfill begins a Compliance Period on the date the Board directs the Discharger to begin an Evaluation Monitoring Program. If the Discharger's Corrective Action Program (CAP) has not achieved compliance with the Standard by the scheduled end of the Compliance Period, the Compliance Period is automatically extended until the landfill has been in continuous compliance for at least three consecutive years.

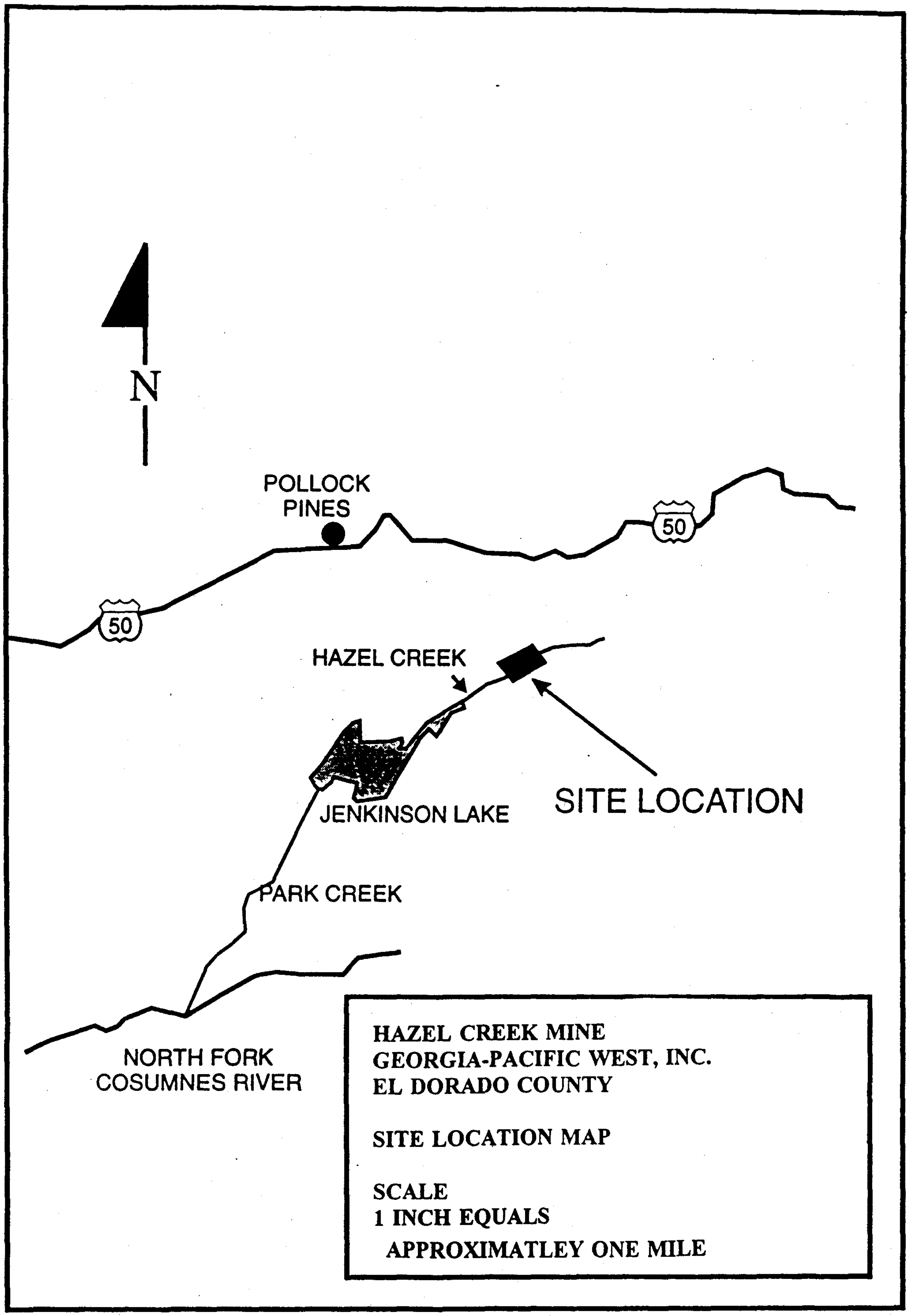
The Discharger shall implement the above monitoring program on the effective date of this Order.

Ordered by:____________________
WILLIAM H. CROOKS, Executive Officer

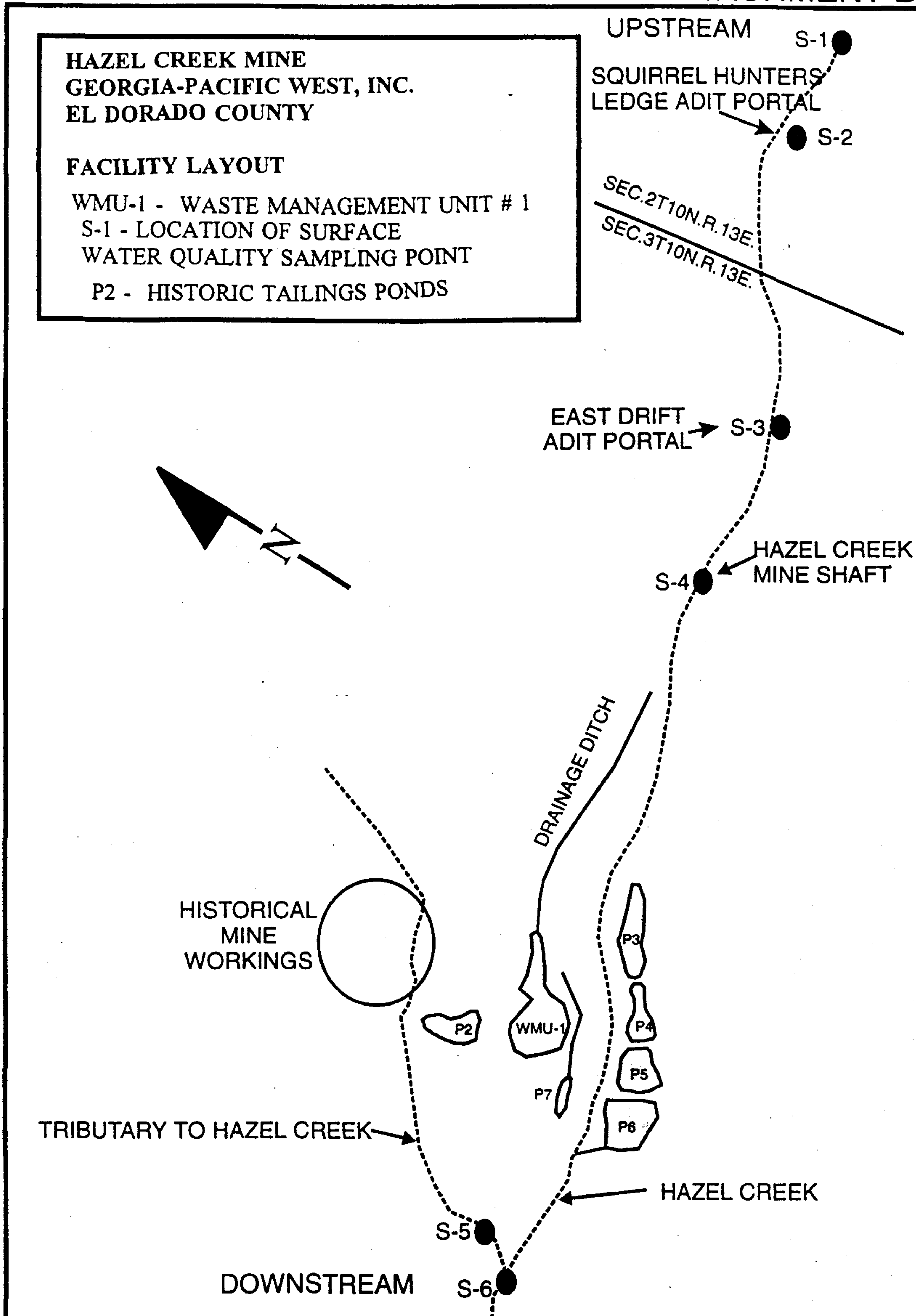
22 March 1996
(date)

JEB:jeb/lsb

ATTACHMENT A



ATTACHMENT B



INFORMATION SHEET

HAZEL CREEK MINE
GEORGIA- PACIFIC WEST, INC.
EL DORADO COUNTY

The Hazel Creek Mine is a dormant underground gold mine and processing mill approximately 1/2 mile upstream to Jenkinson Lake (Sly Park Reservoir), which is a major recreation and water supply reservoir for El Dorado County. Mining activity occurred prior to the 1900s, between 1948 and 1959, and again between 1984 and 1987. Gold ore was brought to the surface and crushed and ground in a ball mill and then gravity separated, with the country rock (schist and quartzite) sand-sized tailings slurried to settling ponds.

In 1992, the Regional board rescinded WDRs No 83-002 for Hazel Creek Mine, Michael W. Mahaffey, American Forest Products due to abandonment of the mine and bankruptcy of the operator. Georgia Pacific acquired the property through the El Dorado County delinquent tax sale with the intent to reclaim the mine site and manage the forest. The original reclamation plan called for the tailings ponds to have soil cover added and then vegetated.

Chemical analysis of the No. 1 tailings pond showed elevated levels of soluble lead in a deionized water extract. The results of the testing demonstrated that the tailings in pond No. 1 have the potential to adversely affect water quality in the adjacent Hazel Creek if just graded and seeded. The soil data showed that the waste in Tailings pond No. 1 should be closed as a Group B waste, as defined in Article 7, Chapter 15, Title 23, California Code of Regulations.

These requirements require the Discharger to place a clay cap barrier (or engineered equivalent) on tailings pond No.1 (WMU 1), and to monitor surface water and potential adit discharges for constituents historically associated with the hard rock mining.

JEB: 2/13/96

STATE OF CALIFORNIA - Environmental Protection Agency PETE WILSON, *Governor*

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
3443 Routier Road, Suite A
Sacramento, CA 95827-3098
PHONE: (916) 255-3000
FAX: (916) 255-3015

EL DORADO COUNTY
RECEIVED
OCT 23 1995
ENVIRONMENTAL MANAGEMENT

20 October 1995

Mr. Roy Leidy
Georgia-Pacific Corporation, Martell Operations
P.O. Box 66
Martell, CA 95654-0066

REQUEST FOR REPORT OF WASTE DISCHARGE, HAZEL CREEK MINE TAILINGS CLOSURE, EL DORADO COUNTY

On 27 March 1992, the Regional Board rescinded Waste Discharge Requirements No. 83-002 for Hazel Creek Mine, Michael W. Mahaffey, American Forest Products, El Dorado County due to abandonment of the property and bankruptcy of the operator. We understand that Georgia-Pacific acquired the property through the El Dorado County delinquent tax sale with the intent to reclaim the site and manage the forest. El Dorado County Environmental Management Department Directive on 4 April 1995 requested, in part, that certain chemical analyses be performed on tailings in ponds #1 and #6 prior to reclamation activities. The results of these tests demonstrate that the tailings in pond #1 have the potential to adversely affect water quality in the adjacent creek if just graded and seeded.

On 27 June 1995 you requested a closure permit from this office and were anxious to initiate the reclamation of the mine site. After review of the existing chemical data, staff concluded that Tailings Pond #1 should be closed as a Group B waste, as defined in Article 7, Chapter 15, Title 23 California Code of Regulations. You informed us by telephone that you were costing various native borrowed or manufactured geosynthetic clay liner/cap options. You also indicated that your office was submitting an annual fee check for $3,000 for the Report of Waste Discharge (RWD). To date, we have not received a complete RWD application nor the annual fee. We are notifying Georgia-Pacific of the need to submit the fee, the capping designs and sufficient closure information which will allow us to draft closure requirements for the Hazel Creek Mine tailings.

We hereby request that you submit a complete Report of Waste Discharge to this office by **30 November 1995**, pursuant to Section 13260 of the California Water Code. Again, the RWD must include sufficient design details (grading, capping, drainage, etc.) and the annual fee.

If you have any questions, please call James Brathovde at (916) 255-3137.

Greg Vaughn

GREG K. VAUGHN
Senior Engineer

JEBjb

Enclosures: Form 200 Report of Waste Discharge

cc: Mr. David Johnston, El Dorado Environmental Management Department, Placerville
Mr. Douglas Zanini, El Dorado Planning Department, Placerville
Mr. Ron Monk , Georgia-Pacific, Martell

ENVIRONMENTAL MANAGEMENT DEPARTMENT

COUNTY OF
EL DORADO

ENVIRONMENTAL HEALTH DIVISION
AIR POLLUTION CONTROL DISTRICT
SOLID WASTE & HAZARDOUS MATERIALS DIVISION

MAIN OFFICE:
2850 Fairlane Court
Placerville, CA 95667
(916) 621-5300

SOUTH LAKE TAHOE OFFICE:
3368 Lake Tahoe Blvd. #303
South Lake Tahoe, CA 96150
(916) 573-3450

April 4, 1995

Ron Monk
Georgia-Pacific Corporation
Po Box 66, Highway 49
Martell, CA 95654

COPY

Subject: Hazel Creek Mine Remediation, April 4, 1995 Meeting and Directive

Dear Mr. Monk:

As a result of our meeting on April 4, 1995, you are hereby advised to perform the following tasks in order to proceed with the mitigation of potential environmental hazards at the Hazel Creek Mine property:

1. Perform deionized water WET (Waste Extraction Tests) tests for lead on the water in the creek at the lower edge of the mining site and for the tailings in ponds #1 and #6, prior to initiating reclamation activities. A follow up test should be run on the water in the creek after reclamation is completed.

2. Tailings on the north side of the creek which are not in the ponds should be moved to pond #1. Ponds 1, 3, 4, 5, 6 and 7, shall be graded to a final slope of 2:1 stabilized and seeded with a mixture approved by the Resource Conservation District. Pond #2 appears to be well established with vegetation and is currently providing wildlife habitat and should not be disturbed further.

3. Remove all liquid petroleum products, chemicals and batteries from the site for reuse, recycling or disposal.

4. Mine shafts shall be fenced capped or filled in so as to eliminate any safety hazard to wildlife or humans.

5. Remove all materials and structures on site.

6. Crush the two septic tanks and fill them with gravel.

Once these activities have been completed, an inspection of the site will be performed by our Department staff. If you have any questions, please call me at (916) 621-5896.

Respectfully,

Dave Johnston

Dave Johnston
Senior Environmental Health Specialist

COUNTY OF
EL DORADO

PLANNING DEPARTMENT

MEMORANDUM

DATE: April 21, 1995

TO: Dave Johnston, Environmental Management

FROM: Doug Zanini, Senior Planner DMZ

SUBJECT: Hazel Creek Mine Clean Up

I inspected the Hazel Creek Mine site with John Pricer of Georgia Pacific on April 19th. From the standpoint of the reclamation plan, the Planning Department has identified three tasks that have to be completed to satisfy the Planning Department concerns:

1. Remove all materials and structures that exist on-site,
2. Secure the mine shaft(s),
3. Apply a layer of topsoil to the upper settling pond and seed with a mixture approved by the Resource Conservation District.

The lower pond appears to be well established with vegetation and is currently providing wildlife habitat and should not be disturbed further. Any contamination issues will be deferred to your department.

cc: file
John Pricer

Appendix 9

CT Table for Chlorine Disinfection

GUIDANCE MANUAL

for
Compliance With the
Filtration and
Disinfection Requirements
for Public Water Systems
Using Surface Water
Sources

The C·t values in the final SWTR are 0-10 percent lower than in the proposed SWTR. Table 8 presents representative C·t values determined by application of the above described approach.

TABLE 8. CALCULATED C·T VALUES FOR GIARDIA INACTIVATION USING USING EQUATION 14 AT 0.5°C and 5°C

Values for Inactivation of Giardia Cysts by Free Chlorine at 0.5°C

-ine ration L	pH = 6 Log Inactivation				pH = 7 Log Inactivation				pH = 8 Log Inactivation				pH = 9 Log Inactivation			
	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.8
	23	46	91	137	33	65	130	195	46	92	185	277	65	130	260	390
	25	49	99	148	35	70	140	210	51	101	203	304	73	146	291	437
	28	55	110	165	39	79	157	236	58	115	231	346	83	167	333	500
	30	60	121	181	44	87	174	261	64	127	255	382	92	184	368	552

Values for Inactivation of Giardia Cysts by Free Chlorine at 5°C

-ine ration L	pH = 6 Log Inactivation				pH = 7 Log Inactivation				pH = 8 Log Inactivation				pH = 9 Log Inactivation			
	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.8
	16	32	65	97	23	46	93	139	33	66	137	198	47	93	186	279
	18	35	70	105	25	50	99	149	36	72	144	216	52	104	208	312
	19	39	77	116	28	55	110	165	41	81	162	243	59	118	235	353
	21	42	84	126	30	61	121	182	45	89	179	268	65	130	259	389

Because calculations for the SWTR C·t values are the upper limit on the error bounds associated with equation 14 (Table 8), an equation was developed to estimate these C·t values for 0.5 and 5°C directly. C·t values above 5°C can be estimated by using the method given below to estimate C·t values at 5°C, then the assumption that there is a twofold decrease in C·t values for every 10°C increase in temperature can be applied. The equation for the estimated C·t values at 0.5 and 5°C is as follows:

$$C \cdot t = 0.36\ pH^{2.69} temp^{-0.15} C^{0.15} (-\log I)^{1.00} \qquad R = 0.988 \tag{15}$$

where the variables in equation 15 are as defined previously.

Table 9 compares the values estimated by equation 15 and the SWTR values shown in Table 8.

TABLE 9. CALCULATED C·T VALUES FOR GIARDIA INACTIVATION USING EQUATION 15 AT 0.5 AND 5°C

Values for Inactivation of Giardia Cysts by Free Chlorine at 0.5°C

Chlorine Concentration mg/L	pH = 6 Log Inactivation				pH = 7 Log Inactivation				pH = 8 Log Inactivation				pH = 9 Log Inactivation			
	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.
0.4	22	43	86	129	33	65	131	196	47	94	187	281	64	129	257	3
1	25	49	99	148	37	75	149	224	54	107	214	321	74	147	294	4
2	27	55	109	164	41	83	165	248	59	118	137	355	81	163	325	46
3	29	58	116	174	44	88	175	263	63	126	251	377	86	173	345	5

Values for Inactivation of Giardia Cysts by Free Chlorine at 5°C

Chlorine Concentration mg/L	pH = 6 Log Inactivation				pH = 7 Log Inactivation				pH = 8 Log Inactivation				pH = 9 Log Inactivation			
	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.
0.4	15	31	61	91	23	46	92	138	33	66	132	198	46	91	182	2
1	17	35	70	104	26	53	106	158	38	76	151	227	52	104	208	3
2	19	39	77	116	29	58	117	175	42	84	167	251	58	115	320	3
3	20	41	82	123	31	62	124	186	44	89	178	266	61	122	244	3