AMERICAN RIVER WATERSHED

SANITARY SURVEY

FINAL REPORT

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07140-022-018

in association with
Montgomery Watson

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SECTION I

EXECUTIVE SUMMARY

The State Surface Water Treatment Regulations (SWTR) requires all water purveyors to conduct a sanitary survey of their watersheds at least once every five years. The first survey is to be completed by January 1, 1996.

This report presents the findings of the American River Watershed Sanitary Survey conducted to comply with the SWTR.

This chapter is a summary of the major points and highlights from each section of this sanitary survey conducted for the City of Sacramento, San Juan Suburban Water District, the City of Folsom, the City of Roseville, Arcade Water District, Carmichael Water District, El Dorado Irrigation District, Placer County Water Agency, California State Prison at Folsom, Arden-Cordova Water Service Area, and Folsom Lake State Recreation Area.

SECTION II - INTRODUCTION

- The U.S. EPA adopted the SWTR in June 1989. The State of California subsequently adopted its own SWTR in June 1991. The SWTR establishes treatment techniques in lieu of maximum contaminant levels for turbidity, *Giardia lamblia*, viruses, heterotrophic plate count bacteria, and Legionella.

- Among the requirements of the SWTR are two which require: (1) conducting sanitary surveys of the watershed and of its surface water supply, and (2) an evaluation of the system's ability to meet the requirements for turbidity and microbiological contaminants treatment.

- The primary objectives of this watershed sanitary survey are to:
  - survey and assess the microbiological contaminant loads at the raw water diversions located within the watersheds for the agencies participating in the study.
  - Assess the degree of treatment required in terms of log removals of *Giardia* cysts and viruses.
  - Review and identify management practices which are economically feasible and within the legal authority of the participating agencies and which may reduce the level of contaminants in the American River.
- The scope of the study included the following key tasks:
  - Collect and review available information on the American River watershed.
  - Define and characterize the watershed with respect to geographical location, physical features, hydrology, water intake and supply systems, water rights and land ownership and use.
  - Identify and characterize natural and human activities within the watershed affecting water quality and estimate the microbial contaminant loadings.
  - Conduct a detailed review of available microbiological water quality data, and assess the degree of treatment required.
  - Review existing management practices used by the agencies participating in the study.
  - Identify management practices which are implementable.

SECTION III - WATERSHED DESCRIPTION

- The American River watershed is a major drainage of the Sierra Nevada Mountains of Central California. The watershed is approximately 1,900 square miles in size; it extends from the Sierra Nevada west of Lake Tahoe to the confluence of the American River with the Sacramento River. Elevations in the watershed range from over 10,000 feet above sea level at the headwaters to 23 feet at its mouth.

- The American River watershed was divided into five subbasins:
  - the South Fork
  - the Middle Fork
  - the North Fork
  - Folsom Reservoir and Lake Natoma, and
  - the Lower American River

- Each subbasin was described in terms of its geography, topography, geology, soils, vegetation, climate, hydrology, water supply systems, land use and land ownership.

SECTION IV - IDENTIFICATION OF WATERSHED ACTIVITIES AND CHARACTERISTICS DETRIMENTAL TO WATER QUALITY

- Erosion and wild animals are natural characteristics in the watershed which could significantly degrade the water quality of the American River. Erosion potential in the North, Middle and South Fork of the American River are 75, 81, and 87 percent respectively, rated as high to very high. Erosion can increase the turbidity of the water. While turbidity by itself is not a public health threat, higher turbidity can mask microbiological contaminants and make disinfection more difficult.

- Wild animals could be carriers of *Giardia*. There are large numbers of animal species in the watershed. There are no regular counts made of any animals except deer.

Beaver can be found in all perennial streams tributary to the American River. Other mammals, including coyote, mountain lion, and bear also frequent the watershed.

- Significant land uses and human activities in the watershed related to potential surface water contamination by microbiological contaminants and turbidity include:
  - recreation
  - septic tanks
  - grazing animals
  - wastewater discharges, and
  - storm runoff

- The entire American River watershed is well known for its scenic beauty and available recreational facilities. Recreation activities include camping, picnicking, hiking, horseback riding, water contact recreation, fishing, biking, skiing, and off-highway vehicle use.

  The area attracts millions of people every year. Approximate numbers of visitors to the watershed and each of its sub-basins are listed in Table I-1.

Table I-1. Approximate Number of Visitors in the Watershed Per Year

Sub-Basin	Number of Visitors (million/year)
South Fork	1.4
Middle Fork	0.1
North Fork	0.5
Folsom Reservoir and Lake Natoma	1.8-2.8
Lower American River	5.7

- Septic tanks are scattered throughout the watershed at individual homesites as well as small and large subdivisions. Table I-2 includes a summary of the estimated number of septic tank-leachfield systems (STS) in the watershed.

Table I-2. Septic Tanks in the American River Watershed		
Sub-Basin	No. of STS Private Homesites	No. of STS on Forest Land
South Fork	13,000	950
Middle Fork	4,200-6,200	42
North Fork	7,000-12,000	11
Folsom Reservoir and Lake Natoma	1,400-2,000	-
Lower American River	500	-

- Grazing animals can be carriers of *Giardia* and *Cryptosporidium*. The El Dorado and Tahoe National Forests provide grazing allotments and place limitations on the number of animals and grazing periods. There is also open grazing in each county, but there are no reliable estimates of the number of animals involved.

- The American River receives only a limited amount of sewage effluent. There is only one wastewater discharger in the South Fork sub-basin, the City of Placerville. The City is permitted to discharge up to an average of 1.6 mgd during dry weather periods. The City provides filtration and disinfection and meets a permit limit of 2.2 MPN/100 mL maximum 30-day median value. In the North Fork subbasin the City of Colfax is permitted to discharge 0.13 mgd average dry weather flow to Smuthers Ravine. The discharge permit limits total coliform counts to a median of 23 MPN/100 mL for a 30-day period.

- Significant stormwater runoff from urban areas occurs in the Folsom Reservoir and Lake Natoma subbasin and in the Lower American River subbasin. The City of Folsom, City of Sacramento and Sacramento County are part of the metropolitan area presently operating its stormwater systems under an NPDES permit.

- Other activities and facilities discussed include: watershed collection systems, landfills and transfer stations, and logging.

SECTION V - MICROBIAL WATER QUALITY REVIEW AND ASSESSMENT OF CONTAMINANT LOADS

- Source water quality criteria and related water treatment requirements have been defined in the California SWTR and Guidance Manual. Those criteria, specifically related to *Giardia*, coliform and viruses are explained in this section and compared to the results of raw water samples taken at intakes of the utilities drawing water from the American River.

- While utilities drawing water from the American River have analyzed their source water for total coliforms and turbidity, there is only minimal data on concentrations of *Giardia* and *Cryptosporidium* oocysts and no viral analyses have been conducted.

- Insufficient data is available at present to draw a correlation between activities in the watershed and concentrations of microbiological contaminants other than coliform.

- Coliform and turbidity data available indicate that treatment provided by utilizing American River water and providing a 3 log *Giardia* cysts removal/inactivation and 4-log virus removal/inactivation will satisfy the requirements of the SWTR, until additional data for *Giardia* and *Cryptosporidium* concentrations is available.

- There are no requirements for *Cryptosporidium* removal/inactivation in effect at the present time. However, EPA is evaluating available data and may change treatment requirements in the event that *Cryptosporidium* is regulated.

SECTION VI - WATERSHED MANAGEMENT AND CONTROL PROGRAM

- Existing controls over watershed activities through regulations and permitting authorities were summarized for the following agencies:

  Federal Agencies

  - U.S. Environmental Protection Agency

- U.S. Department of Agriculture
  - U.S. Forest Service
  - Soil Conservation Service
- U.S. Department of Interior
  - U.S. Geological Survey
  - U.S. Bureau of Land Management
- U.S. Department of the Army
  - U.S. Army Corps of Engineers

State Agencies

- California Environmental Protection Agency
  - State Water Resources Control Board and Central Valley Regional Water Quality Control Board
  - Department of Pesticide Regulation
- State of California, Resources Agency
  - Department of Fish and Game
  - Department of Forestry and Recreation
- Department of Health Services
  - Environmental Health Division

- Currently applied best management practices for watersheds were reviewed and summarized. A table of most-promising BMPs was prepared for consideration in the American River Basin and its component sub-basins.

SECTION VII - SPECIAL ISSUES

- Special issues covered in this section are focused on water quality associated with mines, natural disasters, and transportation corridors. Natural disasters investigated include floods, wildfires, mud slides, and earthquakes.

- The objectives of the investigation in this section were to: (1) identify constituent loads in the American River associated with mine sources and natural disasters and suggest

potential remediation efforts, and (2) assess the risk of major spills from transportation corridors and suggest an action plan.

- Information has been obtained for approximately 2,100 mines, ten floods of record, ten wildfires, one major mudslide and 11 minor earthquakes occurring within the watershed. In most cases, there are no quantitative water quality data or flows associated with these developments and events, and load calculations were not considered valid.

- Levels of risk of contamination of the American River and its tributaries were assessed from the three major transportation corridors. Highway 50 was found to pose the highest level of risk with Highways 80 and 49 posing much lower levels of risk. Overall, the annual probability of an accidental spill involving hazardous materials was assessed to be just over 25 percent.

SECTION II

INTRODUCTION

This report presents the findings of a watershed sanitary survey conducted on the American River for the City of Sacramento, San Juan Suburban Water District, the City of Folsom, the City of Roseville, Arcade Water District, Carmichael Water District, El Dorado Irrigation District, Placer County Water Agency, California State Prison at Folsom, Arden-Cordova Water Service, and Folsom Lake State Recreation Area. The sanitary survey was conducted to comply with California Department of Health Services (DHS) requirements in its Surface Water Treatment Rule (SWTR). The study purpose, scope, limitations, and report organization are described in this chapter.

BACKGROUND

Providing customers with high quality water is a critically important objective and a legal requirement for water suppliers in the United States. The 1962 Public Health Service Drinking Water Standards stated that "water supply should be obtained from the most desirable source which is feasible and an effort should be made to prevent or control pollution of the source." Passage of the 1986 Amendments to the SDWA and adoption of an ever increasing number of water quality related regulations by the states are indicative of the public concern for obtaining and maintaining the best drinking water quality. To meet these requirements water purveyors can look at two things--the initial quality of the source water supply and the treatment processes to treat that supply.

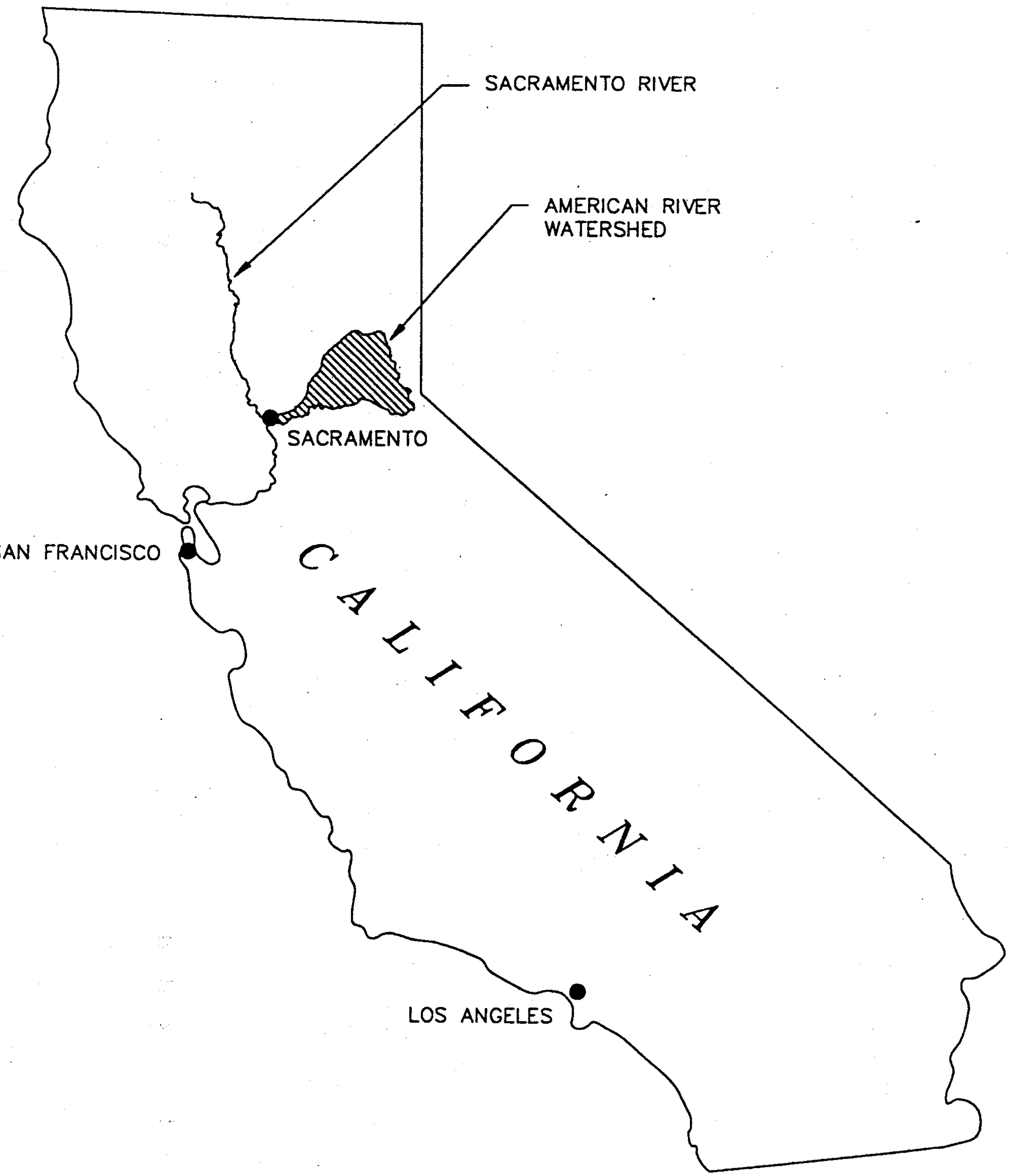
Water treatment processes can reduce concentrations of contaminants, but the costs and potential risks of residual contaminants can be high. To maximize public health protection, the best available source water should be obtained.

The SDWA includes maximum contaminant level goals (MCLGs) for *Giardia lamblia,* viruses and Legionella. *Giardia* is an organism carried by a wide range of warm blooded animals such as man and beavers. The *Giardia* organism has been isolated from many "controlled" raw water reservoirs and streams. This fact is not surprising since absolute control of carriers (human and animal) in even "controlled" watersheds is virtually impossible. The *Giardia* organism is difficult to kill by low disinfectant doses and is more effectively removed if the water is filtered. Publicity on outbreaks of *Giardiasis* spurred Congress to consider requiring that all surface waters be filtered.

EPA published proposed rules regarding viruses and *Giardia* on November 3, 1987, and the final SWTR was adopted in June 1989. The State of California subsequently adopted its own Surface Water Treatment Regulation, including requirements for watershed sanitary surveys, which are defined in Article 7 of the state's regulation.

The state Surface Water Treatment Regulation requires all water purveyors to conduct a sanitary survey of their source water watersheds by January 1, 1996 or earlier if requested by the DHS. DHS may request a sanitary survey if a water purveyor applies for an amendment to a water supply permit. Sanitary surveys emphasize the characterization of existing and potential contaminant sources, and watershed management, rather than merely the monitoring and analysis of the finished drinking water.

The American River watershed drains the Sierra Nevada mountains of central California. The watershed is approximately 1,900 square miles in size; it extends from the Sierra Nevada west of Lake Tahoe to the confluence of the American River with the Sacramento River. Figure II-1 illustrates the location of the American River watershed in the State of California. Figure II-2 illustrates the American River watershed and its sub-basins. As shown by the contours elevations in the watershed range from above 10,000 feet at its headwaters to 23 feet above sea level at its mouth.



AMERICAN RIVER LOCATION MAP

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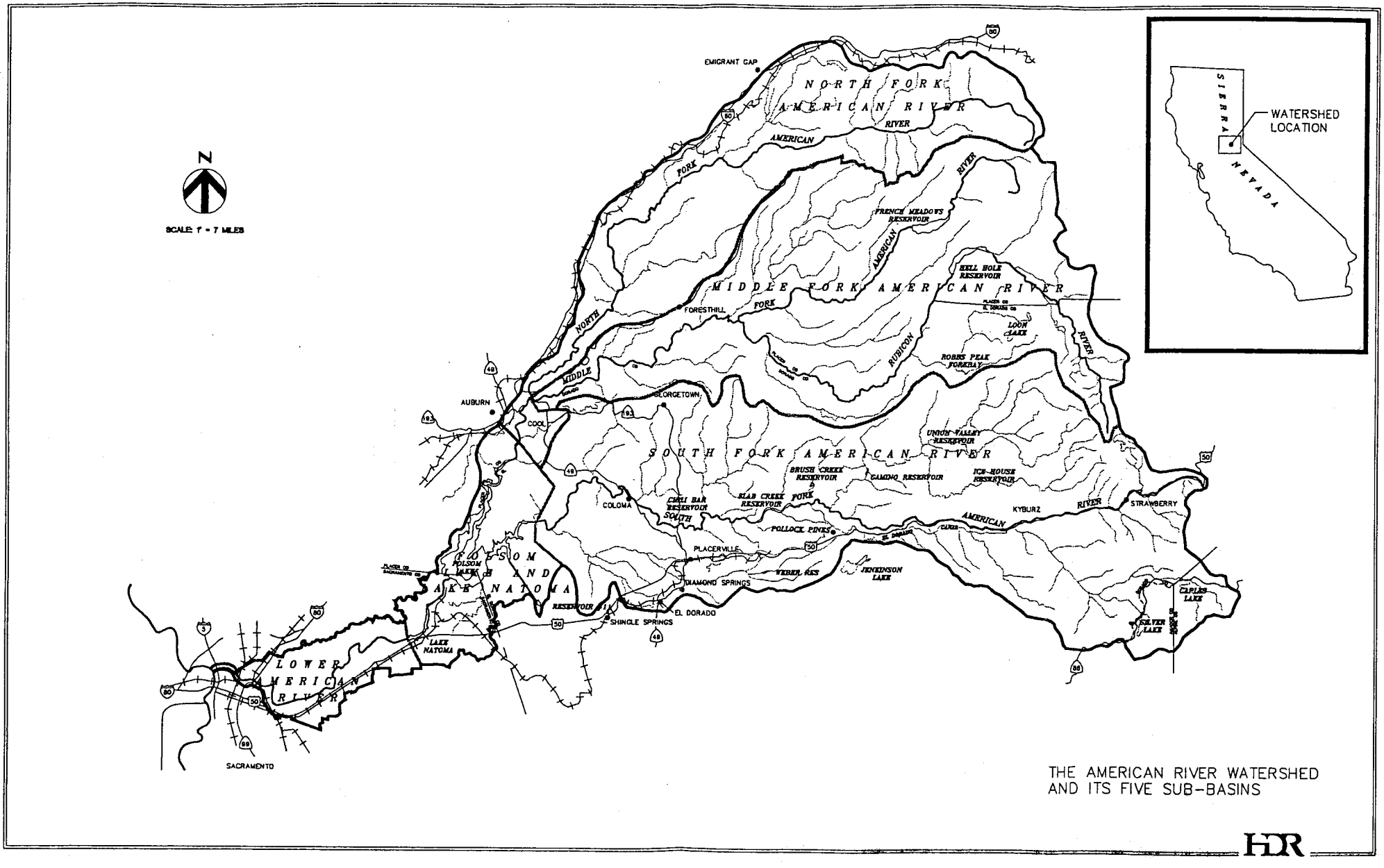
Figure II-1



THE AMERICAN RIVER WATERSHED
AND ITS FIVE SUB-BASINS

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Figure II-2

PURPOSE AND OBJECTIVES

The basic purpose of this watershed sanitary survey is to comply with the Section 64665 Watershed Requirements of the California SWTR. The primary objectives of the survey designed to achieve compliance are:

1. Survey and assess the microbiological contaminant loads at the raw water diversions located within the watersheds for the agencies participating in the study

2. Assess the degree of treatment required in terms of log removals of *Giardia* cysts and viruses

3. Review and identify management practices which are economically feasible and within the legal authority of the participating agencies and which may reduce the level of contaminants in the American River.

SCOPE OF STUDY

The scope of the American River watershed study included the following major tasks:

- Collect and review available information on the American River Watershed.
- Define and characterize the watershed with respect to geographical location, physical features, hydrology, water intake and supply systems, water rights and land ownership and use.
- Identify and characterize natural and human activities within the watershed affecting water quality and estimate the microbial contaminant loadings.

- Conduct a detailed review of available microbiological water quality data, and assess the degree of treatment required.
- Review existing management practices used by the agencies participating in the study.
- Identify management practices which are implementable.

CONDUCT OF STUDY AND LIMITATIONS

The sanitary survey of the American River watershed was conducted by HDR Engineering, Inc. with assistance from Montgomery Watson Consulting Engineers, Inc. A technical committee consisting of one representative of each participating agency developed the scope of work, reviewed and commented on the work products, helped identify and develop management practices and provided guidance to the project team.

HDR staff met with the participating agencies to gather documents and water quality data. In addition, HDR staff met with the DHS, Central Valley Regional Water Quality Control Board (CVRWQCB), California Department of Fish and Game, U.S. Forest Services, California Department of Parks and Recreation, U.S. Geological Survey, California Department of Transportation, California Department of Water Resources, the county Health Departments and Planning Departments, and reviewed pertinent literature regarding watershed features and activities. Water quality data from the water agencies were incorporated into a computerized data base, analyzed and the results displayed in appropriate statistical formats.

The study has the following limitations:

- The funding level precluded a detailed field or aerial survey.
- The amount of microbiological water quality data is limited. The participating agencies have no monitoring data on viruses and *Giardia*. Raw water coliform data have not been required in the past and most of the participating agencies have very little data available.

- A number of agencies interviewed did not have their data organized and summarized in a usable format so an in-depth search of their files was outside the scope of this study.

REPORT ORGANIZATION

This report contains eight chapters, and is organized in the following manner:

Chapter I	Executive Summary
Chapter II	Introduction to Study, Scope, Conduct and Limitations of the Study
Chapter III	Watershed Description (includes a discussion of the geography, hydrology, water supply systems, land use and land ownership for the overall watershed and each sub-basin)
Chapter IV	Identification of Watershed Activities. Detrimental to Water Quality is a description of contaminant sources in the watershed
Chapter V	Microbiological Water Quality Review. Assessment of contaminant concentrations at intakes and treatment level requirements for *Giardia* and viruses
Chapter VI	Discussion of Best Watershed Management Practices and a Summary of Recommended Short-term and Long-term Management Plans
Chapter VII	Discussion of Special Issues (These include mine discharges, natural disasters, transportation corridor risks, and recommended controls)
Chapter VIII	Presentation of Conclusions and Recommendations

SECTION IV

IDENTIFICATION OF WATERSHED ACTIVITIES AND CHARACTERISTICS DETRIMENTAL TO WATER QUALITY

INTRODUCTION

Information in this section was obtained from several sources including physical surveys of the American River watershed, discussions both with staff of participating water supply systems and the staff of other public agencies with jurisdiction in the watershed, and review of data and reports published by public agencies or contained in their files, as shown on the reference list at the end of this Section. The natural characteristics and human activities described for each sub-basin in the watershed are listed and briefly discussed below.

Natural Characteristics

Erosion, factors contributing to erosion, fires, and wild animals are natural characteristics potentially causing pollution of the American River water supply by increasing turbidity, or concentrations of coliform, and other bacteria, *Giardia*, or viruses. While turbidity by itself is not a public health threat, higher turbidity makes both the detection and disinfection of microbial contaminants more difficult.

Human Activities

The number and types of human activities which are potentially detrimental to the quality of surface supplies of drinking water in the American River Basin are far greater than potentially detrimental natural characteristics. The following paragraphs summarize the types, location, and magnitude of both point sources and diffused, non-point sources, of (1) turbidity, and (2) microbiological contaminants (the two factors of interest in the Surface Water Treatment Rule (SWTR)).

SOUTH FORK AMERICAN RIVER

Natural Characteristics

Erosion--

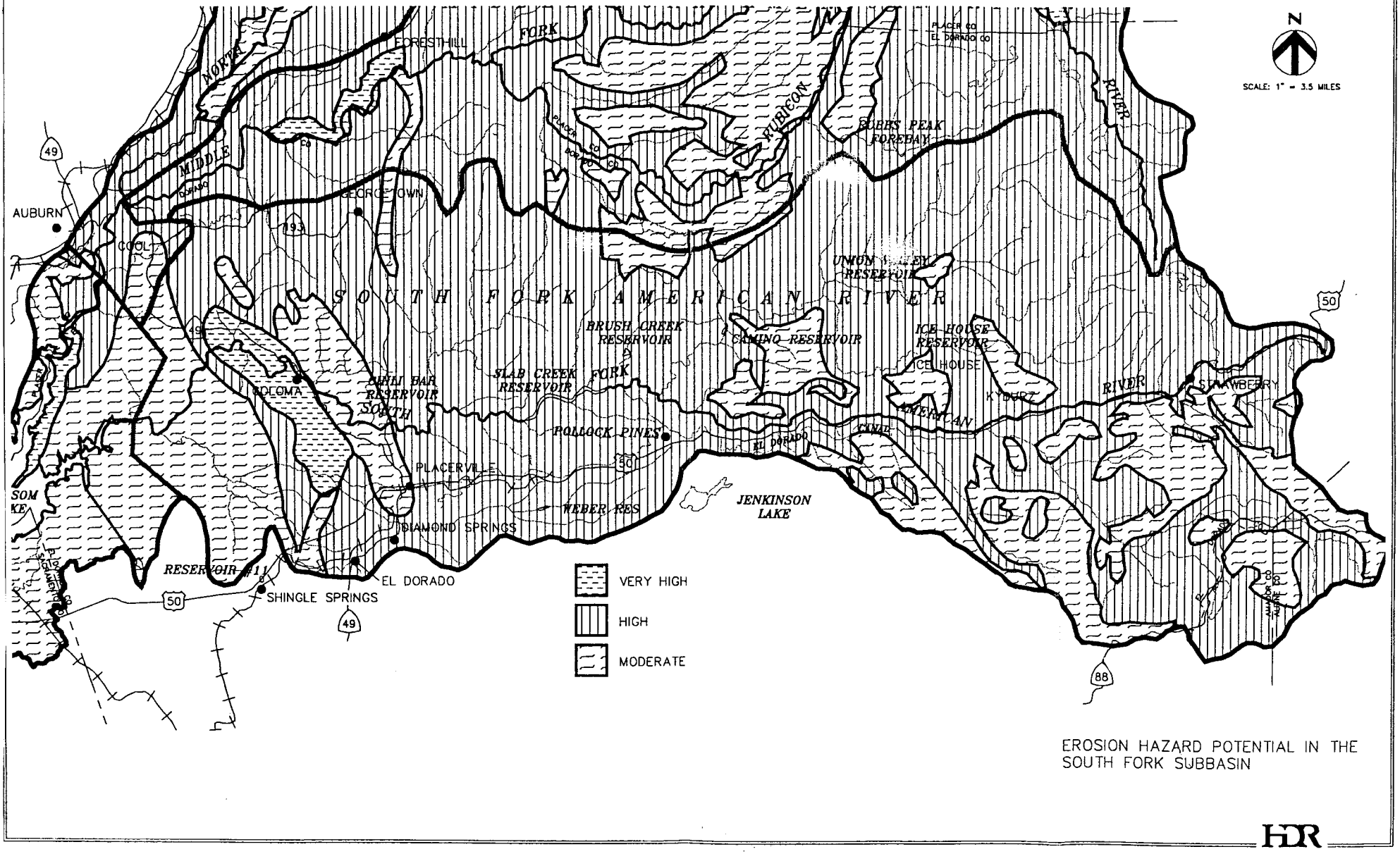
The potential for erosion in the South Fork American River sub-basin is based on the combined effects of precipitation, slopes, and soil types as described in Section III. The relative erosion potential of American River watershed soils has been established by the Soil Conservation Service (SCS), assuming that a protective cover of vegetation is not present. This potential represents the combined effect of slope, climate, and soil erodibility. In the SCS evaluation, erodibility is determined by detachability and transportability of soil particles, and is influenced by soil structure, infiltration capacity, and permeability. Slope and climate are evaluated and integrated with soil erodibility to form an inherent erosion hazard. A four-class scale of erosion hazard is used: slight, moderate, high, and very high.

Table IV-1 summarizes the area within each erosion hazard class for the South Fork sub-basin.

Table IV-1. Erosion Hazard Class Percentages in the South Fork American River Sub-Basin

Erosion Hazard Potential	Area, Percent
Very High	2
High	73
Moderate	25

Figure IV-1 illustrates the general locations of each of the erosion hazard groups of soils in the sub-basin. As for most Sierra Nevada upland regions, the South Fork sub-basin is predominantly high in erosion hazard potential in areas above approximately 1,500 feet in elevation. The sub-basin does have a band of soils with a very high hazard rating along the South Fork main stem near Coloma, but the sub-basin is fortunate to have 20 percent of its



EROSION HAZARD POTENTIAL IN THE SOUTH FORK SUBBASIN

HDR

Figure IV–1

soils with a moderate erosion potential at elevations between 3,000 feet and 10,000 feet. In relation to tributaries in the sub-basin, these moderate erosion hazard areas occur in the vicinity of the Silver Creek and Alder Creek drainages in the southeast portion of the watershed.

Soils within California tend to exhibit greater variability to erosion with slight and high erosion potential soils occurring in close proximity to each other.

The existence of significant erosion potential is addressed by the U.S. Forest Service. Erosion control policies and standards are specifically included in forest service management plans prepared for the American River watershed, and detailed control designs and procedures are part of the management practices manuals and handbooks used by Forest Service personnel. The Land and Resource Management Plan for the Eldorado National Forest, for example, incudes activities to control erosion throughout the sub-basin.

On private lands in the western portion of the sub-basin the El Dorado Resource Conservation District assists with erosion control practices.

Fires--

Wildfires can occur in all woodland, range, and urban areas, and they do occur in the South Fork American River watershed. Major individual fires which have occurred are not discussed here, but are included in Section VII.

The number of fires and the acreage burned within the Eldorado National Forest each year is highly variable. Aside from the major fires, about 25 to 35 small wildfires occur each year, nearly all of which burn 10 acres or less. These are caused both by lightning and human activity. Most occur in the 3,000-foot to 7,000-foot elevation range, in areas of concentrated commercial and public use.

Primary responsibility for fire management and control in the National Forest belongs to the Forest Service. On private lands the responsibility is shared by the California Department of Forestry and Fire Protection (CDF) and local fire districts.

Wild Animals--

There are large numbers of animal species in the South Fork American River watershed which could be carriers of the *Giardia* organism. Due to the similarity in environmental conditions, the species of interest to this study and their populations, are very similar to those in the Middle Fork and North Fork watersheds. Information obtained from the staffs of the Eldorado National Forest, Tahoe National Forest, California Fish and Game Department, and trappers working for County Agricultural Commissioners Offices revealed that:

- There are no regular counts made of any animals except deer.

- The wide variety of animal species which occur in the basin include beaver, coyote, mountain lion, bear and other mammals.

- Beaver can be found in all perennial streams tributary to the South Fork American River.

- A particular herd of mule deer, known as the Pacific deer herd, occupies most of the South Fork watershed. As shown in Figure IV-2, the herd tends to occupy higher elevations during the summer months, and follows relatively well-defined migration routes to the lower-elevation winter range.

- Estimates of the population of the Pacific deer herd by the Department of Fish and Game indicate that the herd size has varied between 3,600 and 6,000 deer, most of which would tend to congregate near streams. (CDFG, 1981).

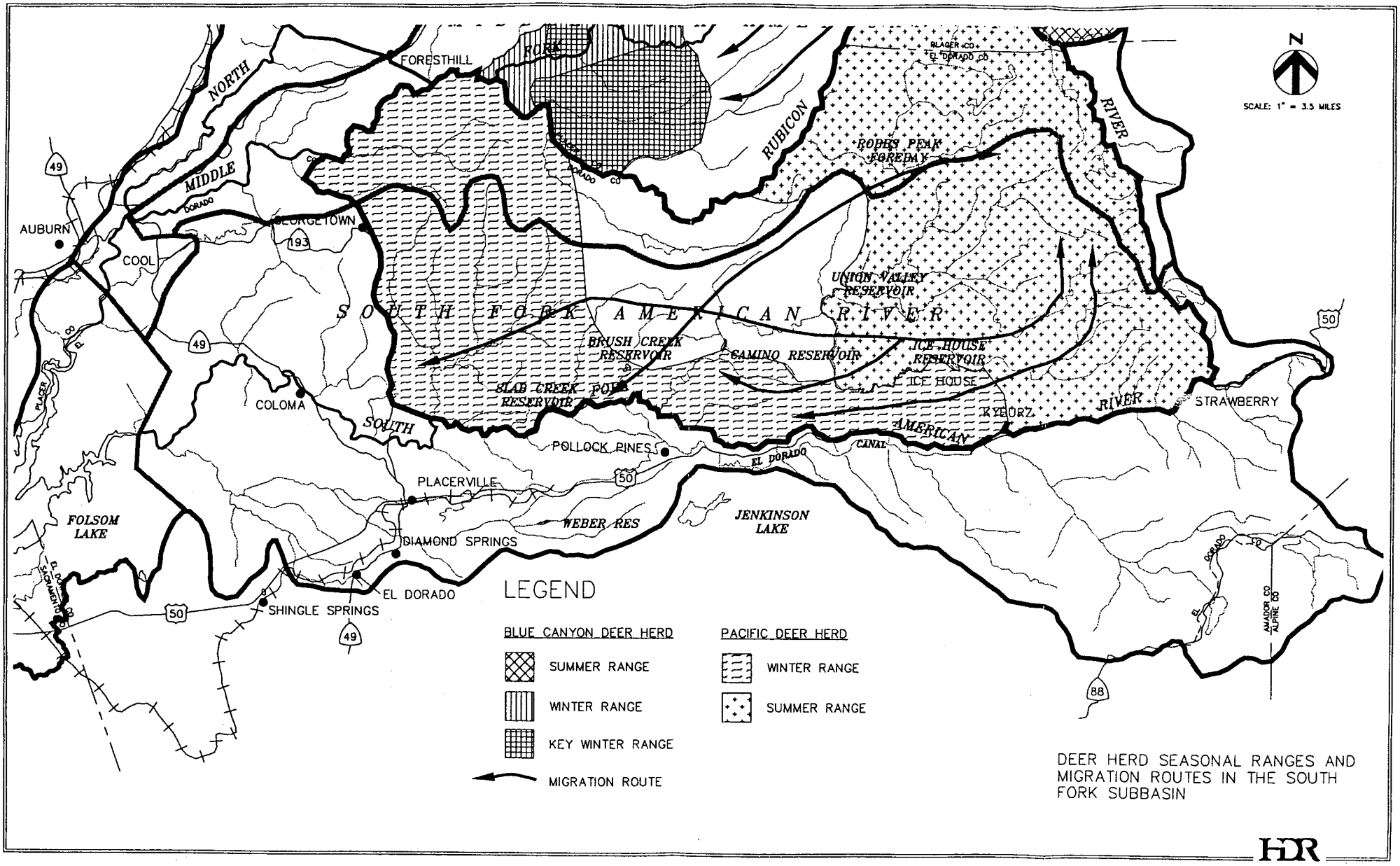

N
SCALE: 1" = 3.5 MILES
FORESTHILL
NORTH FORK
MIDDLE FORK
RUBICON RIVER
PLACER CO
EL DORADO CO
RODES PEAK
FOREBAY
AUBURN
COOL
GEORGETOWN
193
49
UNION VALLEY RESERVOIR
SOUTH FORK AMERICAN RIVER
BRUSH CREEK RESERVOIR
SAMINO RESERVOIR
ICE HOUSE RESERVOIR
ICE HOUSE
SLAB CREEK FOREBAY
RESERVOIR
COLOMA
SOUTH FORK AMERICAN RIVER
RYBURZ
STRAWBERRY
50
POLLOCK PINES
EL DORADO CANAL
PLACERVILLE
FOLSOM LAKE
WEBER RES
JENKINSON LAKE
DIAMOND SPRINGS
EL DORADO
SHINGLE SPRINGS
88
AMADOR CO
ALPINE CO
LEGEND
BLUE CANYON DEER HERD
SUMMER RANGE
WINTER RANGE
KEY WINTER RANGE
MIGRATION ROUTE
PACIFIC DEER HERD
WINTER RANGE
SUMMER RANGE
DEER HERD SEASONAL RANGES AND MIGRATION ROUTES IN THE SOUTH FORK SUBBASIN
HDR

Figure IV–2

Human Activities

Point Sources--

The list of potential types of point sources, and the types actually present in the South Fork sub-basin are both shown in Table IV-2. As noted there, the only significant types of point sources present include wastewater discharges and wastewater collection systems.

Table IV-2. Potential and Actual Point Sources of Contaminants in the South Fork American River Sub-Basin

Potential Point Source Types	Point Sources Actually Present
1. Wastewater discharges	1. Wastewater discharges
2. Wastewater collection systems	2. Wastewater collection systems
3. Storm runoff	
4. Landfills and transfer stations	
5. Feedlots	
6. Land spreading of sludges	

Wastewater Discharges--There are a number of wastewater systems which collect and treat municipal wastewater (containing microbiological contaminants) in the South Fork sub-basin. There is only one however, the City of Placerville, which is permitted to discharge its treated effluent to a surface water. The Michigan-California Lumber Company is also permitted to discharge a wastewater effluent to a surface water near the town of Camino. The effluent is treated runoff resulting from spraying logs in storage piles (log deck runoff), and contains no known chemical or biological contaminants. For that reason, it is not discussed further in this survey report.

Wastewater systems which collect, treat, and dispose of municipal wastewater without discharge to any surface water are described under the subsequent topic of wastewater collection systems. Therefore, the only wastewater discharger of interest in the South Fork drainage is the City of Placerville. As shown in Figure IV-3, the Placerville wastewater treatment plant discharges to Hangtown Creek, a tributary of Weber Creek and the South Fork. The City possesses a National Pollutant Discharge Elimination System (NPDES)

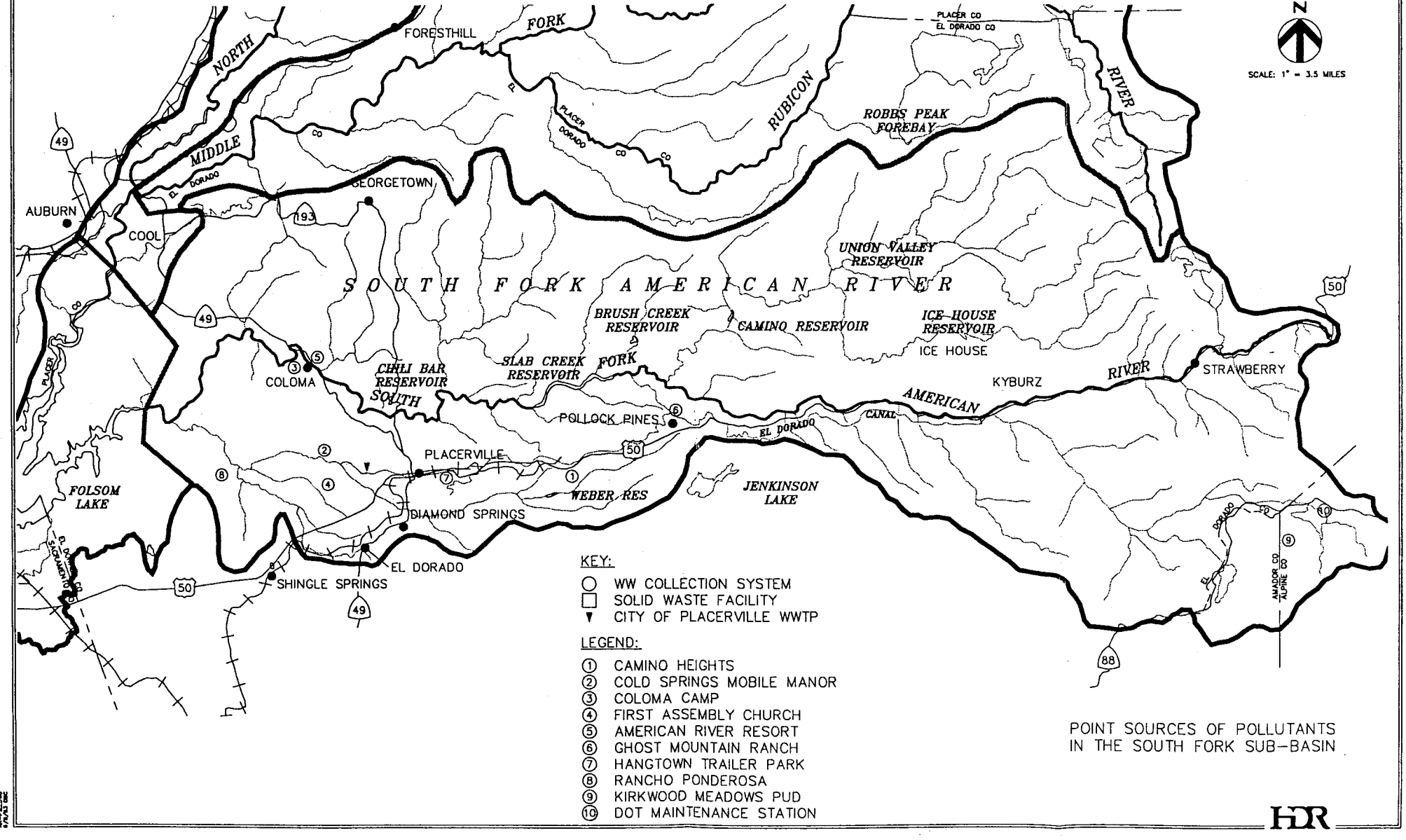

SOUTH FORK AMERICAN RIVER
NORTH FORK
MIDDLE FORK
RUBICON RIVER
AMERICAN RIVER
SOUTH FORK
FORESTHILL
GEORGETOWN
AUBURN
COOL
COLOMA
CHILI BAR RESERVOIR
SLAB CREEK RESERVOIR
BRUSH CREEK RESERVOIR
CAMINO RESERVOIR
ROBBS PEAK FOREBAY
UNION VALLEY RESERVOIR
ICE HOUSE RESERVOIR
ICE HOUSE
KYBURZ
STRAWBERRY
POLLOCK PINES
PLACERVILLE
DIAMOND SPRINGS
EL DORADO
SHINGLE SPRINGS
FOLSOM LAKE
WEBER RES
JENKINSON LAKE
AMERICAN RIVER CANAL
PLACER CO
EL DORADO CO
AMADOR CO
ALPINE CO
SCALE: 1" = 3.5 MILES
KEY:
WW COLLECTION SYSTEM
SOLID WASTE FACILITY
CITY OF PLACERVILLE WWTP
LEGEND:
1 CAMINO HEIGHTS
2 COLD SPRINGS MOBILE MANOR
3 COLOMA CAMP
4 FIRST ASSEMBLY CHURCH
5 AMERICAN RIVER RESORT
6 GHOST MOUNTAIN RANCH
7 HANGTOWN TRAILER PARK
8 RANCHO PONDEROSA
9 KIRKWOOD MEADOWS PUD
10 DOT MAINTENANCE STATION
POINT SOURCES OF POLLUTANTS
IN THE SOUTH FORK SUB-BASIN
HDR

Figure IV-3

permit to discharge up to an average of 1.6 million gallons per day (mgd) during dry weather flow periods. The permit also limits total coliforms in the effluent to a maximum 30-day median value of 2.2 MPN/100 ml, and sets other limitations on the concentrations of biochemical oxygen demand (BOD), total suspended matter, chlorine residual, and pH.

Responsibility for policies, procedures, and enforcement regarding wastewater dischargers in the South Fork sub-basin, and the entire American River watershed, rests with the Central Valley Regional Water Quality Control Board (CVRWQCB) of the State of California.

Wastewater Collection Systems--As shown on Figure IV-3, there presently are 10 nondischarging small community wastewater systems in the South Fork drainage. All of these have collection sewer systems as well as some type of treatment process and surface or subsurface disposal methods which prevent the treated effluent from reaching a surface water body. The characteristics of the 10 systems are listed in Table IV-3. All except two of the systems are located in the southwestern portion of the South Fork sub-basin. They provide service for a variety of developments including mobile home parks, a ski resort, a highway maintenance station, campgrounds, and subdivisions. Five of the systems provide subsurface disposal in leachfields, while five systems provide evaporation and percolation from ponds together with spray disposal of the remaining effluent.

Each of the wastewater systems has a non-discharging system permit from the Central Valley RWQCB, and the RWQCB also has primary responsibility for monitoring, inspection, and enforcement proceedings for the five systems with surface disposal methods. The El Dorado County Department of Environmental Management (DEM) has primary responsibility for those systems with sub-surface disposal.

Storm Runoff--There are no areas with significant urban runoff in the South Fork sub-basin. The City of Placerville has a storm sewer system, but most communities and developing areas in the South Fork drainage use ditches and intermittent streams as their drainage conveyance facilities.

Table IV-3. Non-Discharging Small Community Wastewater Systems in the South Fork American River Sub-Basin		
Name	Type of Development	Wastewater Facilities
1. Camino Heights	Residential sub-division	Ponds, spray
2. Cold Springs Mobile Manor	Mobile home park	Septic tanks, ponds
3. Coloma Camp	Campground	Ponds, spray
4. First Assembly Church	Subdivision, church, school	Package treatment, ponds, spray
5. American River Resort	Restaurant, store, cabins	STS[1]
6. Ghost Mountain Ranch	Recreation facility	STS
7. Hangtown Trailer Park	Mobile home park	STS
8. Rancho Ponderosa	Subdivision	Ponds
9. Kirkwood Meadows PUD	Ski resort	Treatment plant, leachfield
10.CA Dept. of Transportation Maintenance Station	Highway maintenance station for DOT workers	STS

Stormwater discharges became part of the U.S. EPA NPDES regulations in October 1990. Since that time, large municipal areas have been conducting water quality monitoring programs as part of the process of filing for NPDES permits. Specific industries with significant site areas also must obtain permits. General industrial permits are also required for sites such as wastewater treatment plants, airports, and landfills. The City of Placerville, for example, is not large enough (>100,000 population) to require a municipal permit at the present time, but it is performing monitoring and developing information to obtain an NPDES permit for the storm runoff from its wastewater treatment plant on Hangtown Creek.

Landfills and Transfer Stations-- There are no active landfills in the South Fork drainage area, and no known closed or inactive landfills (CIWMB, 1992; CIWMB, 1991). The Union Mine Landfill in El Dorado County, near Placerville, lies just south of the watershed

boundary and serves most of the sub-basin. There also are no existing transfer stations in the South Fork sub-basin (CIWMB, 1992).

Control of the solid wastes in the sub-basin is the responsibility of El Dorado County. The County is currently in the process of preparing an Integrated Waste Management Plan, mandated by State laws enacted in 1990.

Feedlots--There are no existing feedlots in the South Fork drainage area. Small corrals can be found in agricultural and rural residential areas of El Dorado County, but commercial feedlots are not permitted.

Land Spreading of Sludges--There are no locations in the South Fork sub-basin where land spreading is used as the final disposal method for wastewater sludges. The wastewater treatment facilities in the sub-basin use sludge lagoons and/or drying beds on the treatment site, but all solids are then hauled to a landfill or other permitted solids handling facilities.

Non-Point Sources--

The list of potential types of non-point sources, and the types actually present in the South Fork sub-basin are both shown in Table IV-4. As shown there, the existing types of non-point sources include all of the non-point source types related to microbiological contamination, i.e., septic tank systems, logging, recreation, and grazing animals.

Table IV-4. Potential and Actual Non-Point Sources of Contamination in the South Fork Sub-Basin

Potential Non-Point Source Types	Non-Point sources Actually Present
1. Septic Tank Systems 2. Logging 3. Recreation 4. Grazing Animals	1. Septic Tank Systems 2. Logging 3. Recreation 4. Grazing Animals

Septic Tank Systems--Septic tank-leachfield systems (STS) serving scattered individual homes and ranch houses, as well as homes in small and large subdivisions are located throughout

the privately owned portion of the South Fork sub-basin. A review of an El Dorado County computer printout of existing STS on a lot-by-lot basis indicates that the systems are dispersed widely throughout the county. The listing also indicates that there were approximately 13,000 dwellings in the South Fork sub-basin that were using STS in 1992.

In addition to dwellings on private land, there are approximately 950 recreational residences in the South Fork sub-basin on Eldorado National Forest land. These residences are owned by private individuals through Special Permits from the Forest Service. Essentially all these residences use STS for wastewater disposal. Forest Service records show that the largest group of these residences (688) are built along the South Fork off Highway 50. Significant numbers are also found around Silver Lake (78) and Wrights Lake (68).

On private lands in the South Fork sub-basin, the El Dorado County Department of Environmental Management (DEM) is responsible for setting design criteria for new and repaired STS. The DEM also inspects the construction of all systems. While the Forest Service is not required to comply with County STS regulations, Eldorado National Forest staff normally do coordinate with the DEM in the repair of failed systems. No new recreational residences have been built for many areas along the South Fork, but County DEM regulations will be used in rebuilding residences destroyed by the Cleveland Fire (ENF, 1993).

Logging--Logging is a major activity in the South Fork sub-basin, but precise data on locations and number of acres logged in any given year is difficult to obtain. More information is presently available for the South Fork than other sub-basins, but the combination of the numbers of both public agencies and private companies involved, the variety of logging methods being used, and the watershed area involved make mapping of locations logged very difficult.

In the South Fork drainage area, significant logging has been taking place both on Eldorado National Forest lands, as well as on private land in the eastern half of the sub-basin. The two private companies with the largest land ownership in the South Fork are Michigan-

California Lumber (approximately 75,000 acres),and the Georgia-Pacific Corporation. Data on acres logged in recent years was provided by the Eldorado National Forest, and clearcut acreage was provided by Michigan-California Lumber, but no information was provided by Georgia-Pacific. Table IV-5 lists the acres logged as provided.

Table IV-5. Available Data on Acres Logged in the South Fork Sub-Basin

Year	Eldorado National Forest		Michigan-California Lumber, Clearcut
	Salvage Harvest[1]	Green Harvest[2]	
1988	2,360	1,630	478
1989	11,120	1,440	437
1990	10,530	1,470	548
1991	12,190	1,340	*
1992	16,460	1,150	+

[1]Based on harvest of 5 million board feet (MBF)/acre in 1988-90, and 2.5 MBF/acre in 1991-92.
[2]Based on harvest of 20 MBF/acre.
*Michigan-California sawmill burned down.
+Data not available yet.

On National Forest lands, the Forest Service is primarily responsible for erosion control and control of other potential pollutant sources. The Eldorado National Forest uses both national standards and guidelines for this purpose, as well as management practices developed for all forests in California, and specific policies and procedures in its own Land and Resource Management Plan (USDA draft, 1988; ENF, 1988).

On private lands, the California Department of Forestry and Fire Protection is responsible for enforcing the California Forest Practice Act. Portions of these regulations require private timber companies to submit Timber Harvest Plans (THP) for approval, for 3-year periods, for all planned significant harvesting. Many trees are harvested by either Exemptions from the THP or Emergency Notices. Exemptions apply only to areas less than 3 acres, while emergency notices can be issued, for 60 days or less, if dead and dying trees in an area

constitute more than 10 percent of the total. During operation under a THP, a private owner is strictly limited by the area and cutting methods specified, but has no set schedule for the work or any minimum area which must be harvested. Consequently, private companies often harvest less than is specified in their THP, and could cut nothing if desired.

California Forest Practice Regulations are similar to Forest Service regulations and require the implementation of detailed Best Management Practices (BMPs). Included among these are limitations on operations in stream protection zones, on steep or unstable slopes, and during winter weather.

Recreation--The entire American River watershed is well known for its scenic beauty and its available recreation facilities. The South Fork sub-basin is one of the three most heavily used areas of the watershed for recreation purposes. The South Fork drainage incudes not only large numbers of campgrounds and picnic areas, but also an abundance of hiking and horseback riding trails, sites with water-contact recreation, two popular ski areas (Sierra Ski Ranch and Kirkwood), a number of Off-Highway Vehicle (OHV) areas, and the Marshall Gold Discovery State Historic Park.

While these facilities provided enjoyment for approximately 1.4 million people in 1992, they all are potential sources of pollutants in several ways. Water-contact recreation could directly cause microbiological contamination, while improper care or use of restroom facilities at any location could indirectly lead to water supply contamination. On the other hand, both skiing and OHV use can produce significant erosion problems.

The locations of all significant recreational facilities in the South Fork drainage are shown on Figure IV-4. Details regarding the size, types of facilities, and attendance in 1991 and 1992 are listed in Table IV-6, based on data provided by the Eldorado National Forest and the California Department of Parks and Recreation. Designated OHV trails are dispersed throughout most of the National Forest area.

Table IV-6. Recreation Facilities in the South Fork Sub-Basin						
Recreation Facility	Units or Group Size	Toilet Type	Boat-ing	Swim	Recreation Visitor Days	
					1991	1992
Eldorado National Forest						100
Bear Creek	4P	V	-	-	200	
Bridal Veil	26P	V	-	X	15,700	15,700
Caples Lake	35C	V	X	X	9,700	12,200
China Flat	25C	V	-	X	16,300	12,400
Cleveland Corral	5P	F	-	-	600	(closed)
Digger Indian Springs	4P	V	-	X	700	350[1]
Eagle Rock	10P	V	-	-	1,000	460
Fashoda	30C,5P	V	X	X	(closed)	(closed)
Ice House Reservoir	83C,10P	V	X	X	62,100	48,100
Kirkwood Lake	12C	V	X	-	2,800	3,900
Northwind	9C	V	-		7,900	4,500
Sand Flat	29C	V	-	X	20,600	17,200
Silver Creek	11C	V	-	X	3,300	2,800
Silver Fork	35C	V	-	X	11,500	13,000
Silver Lake	62C	V	X	X	23,000	27,000
Strawberry Point	10C	V			9,200	5,500
Sunset	131C	V	X	X	41,300	51,400
Union Valley Reservoir	Boating-Parking	V	X	X	3,700	2,600
Wench Creek	100C,100G	F/V	X	X	25,800	19,500
Woods Lake	25C,8P	V	X	X	7,200	11,000
Wrights Lake	71C,10P	V	X	X	28,000	30,500
Yellowjacket	40C	F/V	X	X	11,000	8,500

Table IV-6. Recreation Facilities in the South Fork Sub-Basin

Recreation Facility	Units or Group Size	Toilet Type	Boat-ing	Swim	Recreation Visitor Days 1991	Recreation Visitor Days 1992
42-Mile	4P	V	-	-	1,000	440[1]
Subtotals					302,600	287,200
Recreational Residences, including:	955				+	235,700
South Fork	688					
Silver Lake	78					
Woods Lake	5					
Caples Lake	13					
Kirkwood Lake	26					
Sciots	70					
Wrights Lake	68					
Dark Lake	7					
Special Permits						
1. Caples Lake Resort	-	F	X	X	10,400	10,50
2. Kirkwood Ski Area	-	W	-	-	77,000	117,000
3. Two Sentinels Camp	-	+	X	X	4,900	3,600
4. Stockton Muni Camp	-	F	X	X	16,500	11,700
5. Camp Minkalo	-	+	X	X	(closed)	(closed)
6. Camp Silverado	-	+	X	X	15,100	11,300
7. Twin Bridges Resort	-	F	-	-	1,900	1,900
8. Sierra Pines Baptist Camp	-	+	-	X	17,500	18,700
9. Camp Sacramento	-	F	-	X	11,000	32,200
10. Sierra Ski Ranch	-	F	-	-	113,800	105,400
11. Echo Summit Ski Area	-	F	-	-	(closed)	(closed)
Echo Summit Sno Park	-	PC	-	-	(not open)	7,000
12. Camp Cody	-	+	X	X	3,700	3,7

Table IV-6. Recreation Facilities in the South Fork Sub-Basin						
Recreation Facility	Units or Group Size	Toilet Type	Boat-ing	Swim	Recreation Visitor Days	
					1991	1992
13. Porcupine Club	-	+	-	-	500	500
14. Kaleva Ski Lodge	-	+	-	-	900	900
15. Kit Carson Lodge	-	F	X	X	17,500	17,700
16. SMUD Employees Assoc.	-	F	X	X	9,600	21,500
17. Mountain Camp II	-	F	X	X	13,000	12,500
18. Ferguson Point (PG&E)	10P	V	X	-	+	+
19. Oyster Creek (PG&E)	6P	V	-	-	+	+
Subtotals					313,300	376,100
State Park Marshall Gold Discovery State Historic Park	-	F	-	-	500,000	500,000
GRAND TOTALS					-	1,400,000

Notes: P = Picnic area; C = Campground; G = Group; V = Vault; F = Flush With STS; W = Collection and treatment plant; PC = Portable chemical.

[1]Sites closed temporarily for maintenance; limited use.
+Data not available from Forest Service.

Controls for pollution prevention within the Eldorado National Forest lands are primarily the responsibility of the Forest Service. These controls begin with standards, policies, and guidelines set forth in the Forest's Land and Resource Management Plan. They are then carried out through procedures established in both the Forest Supervisor's Office and Individual Ranger District offices.

As indicated in Table IV-6, about 36 percent of the estimated 1.4 million visitor days in 1992 were accommodated at the Marshall Gold Discovery Site, while 27 percent used special permit sites, 20 percent used Forest Service camping and picnicking areas, and the remaining 17 percent stayed in the recreational residences.

Grazing Animals--As noted in previous paragraphs, it is a relatively recent discovery that *Giardia* carried by wild animals such as beavers and muskrats can cause enteric diseases in humans. Even more recent, however, is the finding that domestic grazing animals, including cows, can be carriers of *Cryptosporidium*, also pathogenic to humans. For this reason, an estimate of the number and locations of grazing animals in the American River watershed is also included in this survey.

The Eldorado National Forest provides Grazing Allotments, which designate specific areas to be used for grazing of particular types of animals by private owners. Figure IV-5 shows the current allotment areas for the South Fork sub-basin, and limitations on the numbers of animals and grazing period are listed in Table IV-7. It should be understood that the animals permitted into the allotment areas do not spread out over the entire allotment area, and may not occupy portions of the allotment areas for several years.

Contacts were also made with El Dorado County agricultural personnel. Staff in the Agricultural Commissioner's office report that there definitely is open grazing in El Dorado County, but there are no estimates of the number of head involved.

Potential for Unauthorized Activity--

Unauthorized activities in this survey are defined as those activities detrimental to water quality which defy or ignore procedures, laws, or policies. The potential for such unauthorized activities varies almost directly with human access to, or occupancy of, the watershed. As described in the preceding pages of this Section, and in Section III, there are no significant areas of the South Fork sub-basin which are off limits to human access, and development has encroached on many river segments from its origin in the Sierra Nevada almost continuously to Folsom Lake. In addition to the permanent development and

Table IV-7. Grazing Allotments on National Forest Lands in the South Fork Sub-Basin

Allotment Area	Maximum Number of Animals[1]		Season of Use
	Forest Service	Private	
Eldorado National Forest			
Big Hill	291	180	06/01-10/25
Bryan Meadows	100	0	08/01-10/15
Cody Meadows	271	79	06/16-09/20
Old Pino	165	75	04/10-10/15
Pardoe	45	9	07/16-10/10
Pearl Lake	130	0	08/10-10/15
Pryamid	163	40	07/10-10/10
Rodoni	43	32	06/22-10/15
Sherman	178	0	07/01-09/30
Silver Lake	165	185	09/21-10/04
Soldier Creek	-	-	Vacant
Tells Peak	160	0	07/20-10/05
Wrights Lake	320	24	07/15-10/15

[1]All cattle allotments.

population in the sub-basin, there is a heavy influx of tourists and campers in the summertime and skiers in the wintertime to the watershed.

The result of the present level of development in the South Fork sub-basin is a very high potential for unauthorized activity, despite the increasing breadth of controls being implemented by regulatory agencies.

Anticipated Growth Within the Watershed

Existing land use and ownership in the South Fork sub-basin are shown and described in Section III. As indicated there, at least 50 percent of the sub-basin area is presently owned by federal and state agencies. In addition, very little of the private land in the central portion of the sub-basin is available for near-term development both because: (1) the land is heavily forested and listed as Williamson Act Agricultural Preserve under California law, and (2)

most of that same land is presently owned by lumber companies. Therefore, future growth is basically limited to the western private lands in the sub-basin.

Present development in urban and suburban areas in the South Fork drainage is limited to two general areas: (1) along Highway 50 and the southwestern border of the sub-basin, from Placerville to El Dorado Hills; and (2) in the northwest corner of the sub-basin along Highway 193 between Georgetown and Cool. While the General Plan for El Dorado County is presently being updated, it can be assumed that any significant near-term growth in this sub-basin will be located within and adjacent to presently developed areas. In the southwestern portion of the sub-basin, a substantial portion of new growth will actually be just outside of the watershed boundary to the south, in the vicinity of Cameron Park and El Dorado Hills.

In recent years the relative rate of growth has been higher in foothill counties (including El Dorado County) than in Sacramento County. That trend can also be anticipated to continue. Actual growth rates that will occur cannot be determined at the present time however, due to the uncertainties that both current economic conditions and new regulations regarding water supplies in California add to normal difficulties in predicting short-term local growth rates.

Projected Changes in Sources of Contamination

The following paragraphs under this heading for the South Fork sub-basin and the other four sub-basins present descriptions of only those sources of contamination which are anticipated to change in the next 5 to 10 years. Natural characteristics, human activities, and potentials for unauthorized activity which are not expected to change significantly, are therefore not discussed below.

Natural Characteristics--

Erosion--The area burned by the 25,000-acre Cleveland Fire could produce significant sediment loads despite efforts to control them. These loads would enter the South Fork American River above Placerville, as shown in Section VII of this survey.

Human Activities--

Wastewater Collection Systems--EID is presently preparing a wastewater master plan for its service area. The final version of that plan might call for changes to some of the collection systems there.

Storm Runoff--Present and near-future monitoring programs conducted for the NPDES permit regulations could result in the need for additional controls and management of stormwater discharges in the South Fork sub-basin.

Landfills and Transfer Stations--One possible outcome of present integrated waste management planning would be the construction of one or two solid waste transfer stations in the South Fork drainage area.

Logging--Measures taken to preserve the habitat of the spotted owl and other endangered species will significantly change the number of acres that are harvested for timber each year. For some harvesting methods, the acreage will have to increase to obtain the same volume of lumber being cut now, because of management practices requiring that more trees be left standing. Other harvesting methods will be eliminated for the same reason. Forest Service staff expect that the overall impact of new regulations will be better erosion control during timber harvesting (ENF, 1993). In addition, there will be a significant harvest for the next two years or so in and around the area burned by the Cleveland Fire.

Recreation--The Eldorado National Forest is planning to add recreational areas to provide for anticipated growth in demand. A number of specific sites in the South Fork sub-basin are being considered as part of this increase.

MIDDLE FORK AMERICAN RIVER

Natural Characteristics

Erosion--

The potential for erosion in the Middle Fork American River sub-basin is based on the combined effects of precipitation, slopes, and soil types as described in Section III. The relative erosion potential of American River watershed soils has been established by the Soil Conservation Service assuming that a protective cover of vegetation is not present. A four-class scale of erosion hazard is used: slight, moderate, high, and very high.

Table IV-8 summarizes the area within each erosion hazard class for the Middle Fork sub-basin.

Table IV-8. Erosion hazard Class Percentages in the Middle Fork Sub-Basin

Erosion Hazard Potential	Area, Percent
Very High	20
High	61
Moderate	19

Figure IV-6 illustrates the general locations of each of the erosion hazard groups of soils in the sub-basin. In the Middle Fork drainage area, approximately 80 percent of the soils have high or very high erosion hazard potentials, and these soil conditions occur throughout the sub-basin. Unlike the South Fork sub-basin, the soils with moderate erosion potential are found almost entirely in one region. In this case, the moderately erosive soils occur in the central portion of the sub-basin, generally between the Rubicon River and the Middle Fork

main stem. Figure IV-6 also confirms the fact that soils within California tend to exhibit greater variability to erosion with slight to high erosion potential soils in close proximity to each other.

The existence of significant erosion potential is addressed by the U.S. Forest Service. Erosion control policies and standards are specifically included in forest service management plans prepared for the American River watershed, and detailed control designs and procedures are part of the management practices manuals and handbooks used by Forest Service personnel. The Land and Resource Management Plans for both Eldorado National Forest, and the Tahoe National Forest, for example, include activities to control erosion throughout the sub-basin.

On private lands in the western portion of the sub-basin Resource Conservation Districts assist with erosion control practices.

Fires--

Major wildfires that have occurred in the Middle Fork American River watershed are discussed in Section VII. Most fires that occur are relatively small, i.e., less than 20 acres in area. In the National Forest portion of the watershed, roughly 40 to 60 wildfires occur annually.

Because both the Eldorado National Forest and the Tahoe National Forest manage land in the Middle Fork watershed, they share responsibility for fire protection on National Forest lands. On private lands in the western portion of the watershed, the responsibility is shared by CDF and local fire districts in both El Dorado and Placer counties.

Wild Animals--

There are large numbers of animal species in the Middle Fork American River watershed which could be carriers of the *Giardia* organism. Due to the similarity in environmental conditions, the species of interest to this study and their populations, are very similar to those in the South Fork and North Fork watersheds. Information obtained from the staffs

of the Eldorado National Forest, Tahoe National Forest, California Fish and Game Department, and trappers working for County Agricultural Commissioners Offices revealed that:

- There are no regular counts made of any animals except deer.

- Any of the wide variety of animal species which could be in the basin are there, including beaver, coyote, mountain lion, bear and other mammals.

- Beaver can be found in all perennial streams tributary to the Middle Fork American River.

- A particular herd of mule deer, known as the Blue Canyon deer herd, occupies most of the Middle Fork watershed. As shown in Figure IV-7, the herd tends to occupy higher elevations during the summer months, and follows relatively well-defined migration routes to a lower-elevation winter range.

- Estimates of populations of the Blue Canyon deer herd by the Department of Fish and Game indicate that the herd size has varied between 4,000 and 6,000 deer, most of which would tend to congregate near streams (CDFG, 1982). Approximately one-half of the herd occupies lands in the Middle Fork watershed.

Human Activities

Point Sources--

The list of potential types of point sources,and the types actually present in the Middle Fork sub-basin are both shown in Table IV-9. As shown there, the only significant type of point source present is the category of landfills and transfer stations.

Table IV-9. Potential and Actual Point Sources of Contaminants in the Middle Fork American River Sub-Basin	
Potential Point Source Types	Point Sources Actually Present
1. Wastewater discharges 2. Wastewater collection systems 3. Storm runoff 4. Landfills and transfer stations 5. Feedlots 6. Land spreading of sludges	4. Landfills and transfer stations

Wastewater Discharges--There are no municipal wastewater systems in the Middle Fork drainage area which are permitted to discharge treated effluent to a surface water. Wastewater systems which collect, treat, and dispose of municipal wastewater without discharge to a surface water are described below.

Wastewater Collection Systems--As shown on Figure IV-8, there is only one wastewater collection system in the Middle Fork drainage. That system serves the Sky View Terrace Mobile Home Park in Todd Valley. The treatment and disposal system for the Park consists of three ponds connected in series, with final disposal by evaporation and percolation from the same ponds.

The mobile home park operates under Waste Discharge Requirements and a Monitoring and Reporting Program approved and enforced by the CVRWQCB. Monitoring requirements include sampling from groundwater monitoring wells near the ponds.

Storm Runoff--There are no areas with significant urban runoff in the Middle Fork drainage area. Land ownership and land use in the watershed is predominantly National Forest, State Recreation area, and open space.

Landfills and Transfer Stations--There are no active landfills in the Middle Fork drainage area (CIWMB 1992). As shown on Figure IV-8, there is one closed and inactive landfill near Foresthill, as well as one transfer station in the same area (CIWMB 1991; CIWMB 1992).

When operating, the inactive landfill accepted construction and demolition materials, mixed municipal refuse, and tires. The transfer station accepts agricultural wastes, construction/ demolition materials, mixed municipal refuse, tires, and wood mill wastes.

Control of solid waste in this sub-basin is the shared responsibility of both El Dorado and Placer Counties. Both counties have county Solid Waste Management Plans, and are presently preparing Integrated Waste Management Plans mandated by State law enacted in 1990.

Feedlots--There are no existing feedlots in the Middle Fork drainage area. Small corrals can be found in agricultural and rural residential areas of El Dorado and Placer Counties, but commercial feedlots are not present.

Land Spreading of Sludges--There are no locations in the Middle Fork sub-basin where land spreading is used as the final disposal method for wastewater sludges. The wastewater treatment facilities in the sub-basin use sludge lagoons and/or drying beds on the treatment site, but all solids are then hauled to a landfill or other permitted solids handling facility.

Non-Point Sources--

The list of potential types of non-point sources, and the types actually present in the Middle Fork sub-basin are both shown in Table IV-10. As shown there, the existing types of non-point sources include all four potential types related to microbiological contamination.

Table IV-10. Potential and Actual Non-Point Sources of Contaminants in the Middle Fork Sub-Basin

Potential Non-Point Source Types	Non-Point Sources Actually Present
1. Septic Tank Systems	1. Septic Tank Systems
2. Logging	2. Logging
3. Recreation	3. Recreation
4. Grazing Animals	4. Grazing Animals

Septic Tank Systems--There are numerous individual STS on private lands in the Middle Fork sub-basin serving ranch houses and rural residences, but not as many as in the South Fork drainage. A review of computer printouts of individual existing STS in El Dorado County show that there are approximately 1,200 systems in that portion of the sub-basin. In the Placer County portion, there are an estimated 3,000 to 5,000 systems, including the community of Foresthill.

As indicated in Section III of this report, and on Figure IV-9 in the following sub-section on recreation facilities, roughly 80 percent of the Middle Fork drainage is in one of two National Forests. Unlike the South Fork sub-basin however, there are significant numbers of recreational residences using STS at only one location on Forest Services lands in the Middle Fork, the 42 residences in the Gerle Creek area. Estimates of organizational campgrounds and other facilities having STS via special permits from the Forest Service are described in subsequent paragraphs on recreation facilities.

Responsibility for controls on STS in the Middle Fork sub-basin fall under the jurisdiction of four different public agencies. On private lands in the western portion, the Environmental Management Departments of El Dorado County and Placer County provide design criteria, and installation and repair inspection in their respective areas. On Forest Service lands covering the larger eastern portion of the drainage area, the Eldorado National Forest and the Tahoe National Forest have primary responsibility for STS. Forest Service staff do coordinate with the County DEM regarding design of new systems or system repairs.

Logging--Logging is a major activity in the Middle Fork sub-basin, but precise data on locations and number of acres logged in any given year is difficult to obtain. More information is presently available for the South Fork than the Middle Fork, and the combination of the numbers of both public agencies and private companies involved, the variety of logging methods being used, and the watershed area involved make mapping of locations logged very difficult.

In the Middle Fork drainage area, significant logging has been taking place on Eldorado National Forest lands, Tahoe National Forest lands, and on private land in the eastern half of the sub-basin. The two private companies with the largest land ownership in the Middle Fork are Michigan-California Lumber and Fruit Growers, Inc. Data on acres logged in recent years was provided by the Eldorado National Forest, and clearcut acreage was provided by Michigan-California Lumber, but no information was provided by either the Tahoe National Forest or Fruit Growers. Table IV-11 lists the acres logged as provided.

Table IV-11. Available Data on Acres Logged in the Middle Fork Sub-Basin

Year	Eldorado National Forest		Michigan-California Lumber, Clearcut
	Salvage Harvest[1]	Green Harvest[2]	
1988	780	540	477
1989	3,700	470	436
1990	3,510	490	548
1991	4,060	440	*
1992	5,490	390	+

[1]Based on harvest of 5 MBF/acre in 1988-90 and 2.5 MBF/acre in 1991-92.
[2]Based on harvest of 20 MBF/acre.
*Michigan-California sawmill burned down.
+Data not available yet.

On National Forest lands, the Forest Service is primarily responsible for erosion control and control of other potential pollutant sources. The Eldorado and Tahoe National Forests use both national standards and guidelines for this purpose, as well as management practices developed for all National Forests in California, and specific policies and procedures in their own Land and Resources Management Plans (USDA draft, 1988; ENF, 1988; TNF, 1988).

On private lands, the California Department of Forestry and Fire Protection is responsible for enforcing the California Forest Practice Act. Portions of these regulations require private timber companies to submit Timber Harvest Plans for approval, for 3-year periods, for all planned significant harvesting. Many trees are harvested by either Exemptions from the THP

or Emergency Notices. Exemptions apply only to areas less than 3 acres, while emergency notices can be issued, for 60 days or less, if dead and dying trees in an area constitute more than 10 percent of the total. During operation under a THP, a private owner is strictly limited by the area and cutting methods specified, but has no set schedule for the work or any minimum area which must be harvested. Consequently, private companies often harvest less than is specified in their THP, and could cut nothing if desired.

California Forest Practice Regulations are similar to Forest Service Regulations and require the implementation of detailed BMPs. Included among these are limitations on operations in stream protection zones, on steep or unstable slopes, and during winter weather.

Recreation--While a significant number of campgrounds, picnic areas, OHV trails, and recreational residences are found in the Middle Fork sub-basin, there are far fewer than in the South Fork drainage. The Middle Fork sub-basin also does not include any ski areas, while the South Fork does.

While the facilities in the Middle Fork provided enjoyment for more than 100,000 people in 1992, they all are potential sources of pollutants in several ways. Water-contact recreation could directly cause microbiological contamination, while improper care or use of restroom facilities at any location could indirectly lead to water supply contamination. On the other hand, OHV use can produce significant erosion problems.

The locations of all significant recreational facilities in the Middle Fork drainage are shown on Figure IV-9. Details regarding the size, types of facilities, and attendance in 1991 and 1992 are listed in Table IV-12, based on data provided by the Eldorado National Forest and the Tahoe National Forest, although data on visitors at individual sites are not available from the Tahoe National Forest. Designated OHV trails can be found throughout the National Forest areas.

Table IV-12. Recreation Facilities in the Middle Fork Sub-Basin						
Recreation Facility	Units or Group Size	Toilet Type	Boat-ing	Swim	Recreation Visitor Days	
					1991	1992
Eldorado National Forest						
Big Meadows	55C	F/V	X	-	1,500	3,100
Black Oak	200G	V	X	-	1,900	3,500
Gerle Creek	50C,4P	V	X	X	20,000	19,000
Hell Hole Reservoir	10C	V	X	X	1,100	2,600
Lake Walton	8P	V	-	-	+	+
Loon Lake Area (includes parking, equestrian area, RV campground, lodge)	63C,110G	V	X	X	32,100	33,000
Middle Meadows	75G	F/V	-	-	5,300	1,000
Pleasant	10C	V	X	X	900	900
Robbs Hut (lodge)	(5 people max)	V	-	-	500	400
South Fork	17C	V	-	-	4,100	2,200
Stumpy Meadows	40C,6P	V	X	-	10,900	10,600
Upper Hell Hole	15C	V	X	X	500	500
Wentworth Springs	8C	V	-	-	2,400	2,400
Subtotals					81,200	79,200
Recreational Residences Gerle Creek	42				15,100	15,100
Special Permit						
Deer Crossing Camp	200G	F/V	X	X	2,500	2,500
Subtotal, Eldorado National Forest					98,800	96,800

Table IV-12. Recreation Facilities in the Middle Fork Sub-Basin

Recreation Facility	Units or Group Size	Toilet Type	Boat-ing	Swim	Recreation Visitor Days	
					1991	1992
Tahoe National Forest						
Ahart	12C	V	-	-	+	+
Big Tree Grove	3P	F	-	-	+	+
Coyote	125G	F/V	-	-	+	+
French Meadows	75C	F/V	-	-	+	+
Gates	125G	V	-	-	+	+
McGuire	10P	F	-	X	+	+
Poppy	12C	V	X	-	+	+
Ralston	5P	V	-	-	+	+
Robinson Flat	6C	V	-	-	+	+
Secret House	2C	V	-	-	+	+
Talbot	5C	V	-	-	+	+

Controls for pollution prevention within the National Forest lands are primarily the responsibility of the Forest Service. These controls begin with standards, policies, and guidelines set forth in each Forest's Land and Resources Management Plan. They are then carried out through procedures established in both the Forest Supervisor's office and individual Ranger District offices.

Grazing Animals--As noted earlier, it is a relatively recent discovery that *Giardia* carried by wild animals such as beavers and muskrats can cause enteric diseases in humans. Even more recent, however, is the finding that domestic grazing animals, including cows, can be carriers of *Cryptosporidium*, also pathogenic to humans. For this reason, an estimate of the number

and locations of grazing animals in the American River watershed is also included in this survey.

Both the Eldorado and Tahoe National Forests provide Grazing Allotments in the Middle Fork sub-basins which designate specific areas to be used for grazing of particular types of animals by private owners. Figure IV-10 shows the current allotment areas for both National Forests, and limitations on the numbers of animals and grazing period are listed in Table IV-13. it should be understood that the animals permitted into the allotment areas do not spread out over the entire allotment area, and may not occupy portions of the allotment areas for several years.

Contacts were also made with county agricultural personnel. Staffs of both El Dorado County and Placer County report that there is open grazing in each county, but there are no estimates of the number of head involved.

Table IV-13. Grazing Allotments on National Forest Lands in the Middle Fork Sub-Basin

Allotment Area	Maximum Number of Animals		Season of Use
	Forest Service	Private	
Eldorado National Forest			
Chipmunk (cattle)	173		05/15-10/31
Nevada Point	-	-	Vacant
Old Pino (cattle)	55	25	04/10-10/15
Rodoni (cattle)	43	30	06/22-10/15
Tahoe National Forest			
Deadwood (sheep)	600	0	06/11-07/10
Duncan Sailor (sheep)	500	0	07/11-08/15
French Meadows (cattle)	142	54	08/9-10/31
Mosquito (cattle)	200	0	06/01-09/30
Upper Greyhorse (sheep)	500	0	07/15-09/30
Volcano (sheep)	600	0	05/15-06/10

Potential for Unauthorized Activity--

The potential for unauthorized activities varies almost directly with human access to, or occupancy of, the watershed. As described in the preceding pages of this Section, and in Section III, there are no significant areas of the Middle Fork sub-basin which are strictly off limits to human access, although the Granite Chief Wilderness at the Middle Fork's headwater area does have restricted access. Development is relatively limited at present, with residential areas located only in the western quarter of the sub-basin. In addition to the permanent development and population in the sub-basin, there is some influx of tourists and campers in the summertime.

The result of the present level of development in the Middle Fork sub-basin is a moderate potential for unauthorized activity.

Anticipated Growth Within the Watershed

As indicated in Section III, land ownership in the Middle Fork sub-basin is dominated by public agencies. Together, the Eldorado National Forest, the Tahoe National Forest, the Middle Fork arm of the Auburn State Recreation Area, and BLM land occupy between 70 and 80 percent of the sub-basin, leaving 20 to 30 percent for private development. Most of the private lands are scattered across the sub-basin however, with the largest single area in the western portion of the sub-basin, and the remainder consisting mostly of individual townships within the National Forests. Therefore, future urban or suburban growth is basically limited to the relatively small western segment of the sub-basin.

Present concentrated development in the Middle Fork drainage has been limited to the community of Foresthill and areas surrounding it. Since this western segment of the sub-basin lies partially in El Dorado County and partially in Placer County, both entities provide planning for the area through their General Plans. Neither county presently has planned for significant growth in this area, so that any growth that does occur will tend to be relatively low in density and dispersed as it is now.

The relative rate of near-term residential and urban growth in this sub-basin can be expected to be slow for two reasons. First, both counties are planning for significant growth in other areas, and second and perhaps more importantly, Georgia-Pacific Corporation recently announced that it will be closing its Foresthill sawmill.

Projected Changes in Sources of Contamination

Only two significant changes are anticipated in the Middle Fork sub-basin in the next 5 to 10 years.

Human Activities--

Logging--As noted in the discussion of projected changes on the South Fork sub-basin, new timber harvest management practices to protect the habitat of threatened and endangered species are expected to be significantly different from present practices in several ways. From an overall viewpoint however, the new practices are anticipated to result in less erosion during timber harvesting.

Recreation--Both the Tahoe and Eldorado National Forests are planning to add recreational areas to provide for anticipated growth in demand. A number of specific sites in the Middle Fork sub-basin are being considered as part of this increase.

NORTH FORK AMERICAN RIVER

Natural Characteristics

Erosion--

The potential for erosion in the North Fork sub-basin is based on the combined effects of precipitation, slopes, and soil types as described in Section III. As for the other sub-basins, a four-class scale of erosion hazard is used: slight, moderate, high, and very high.

Table IV-14 summarizes the area within each erosion hazard class for the North Fork sub-basin.

Table IV-14. Erosion Hazard Class Percentages in the North Fork Sub-Basin	
Erosion Hazard Potential	Area, Percent
Very High	37
High	50
Moderate	13

Figure IV-11 illustrates the general locations of each of the erosion hazard groups of soils in the sub-basin. In the North Fork drainage only approximately 13 percent of the soils have an erosion potential of moderate or less, and these soils are found in the western portion of the sub-basin. Generally, the location of these soils coincide with the lands of the Auburn State Recreation area. While this sub-basin has the severest erosion hazard potential, it also has a general increasing gradient in erosion hazard severity, from the existence of the moderately erosive soils in the lower western area through highly erosive soils to very highly erosive soils in the central and eastern portions of the sub-basin. This gradient would be expected from the increases both in elevation and slope steepness in the central and eastern areas.

As noted previously, the existence of significant erosion potential is addressed by the U.S. Forest Service. Erosion control policies and standards are specifically included in forest service management plans prepared for the American River watershed, and detailed control designs and procedures are part of the management practices manuals and handbooks used by Forest Service personnel. The Land and Resource Management Plan for the Tahoe National Forest, for example, includes activities to control erosion throughout the sub-basin.

On private lands in the western portion of the sub-basin the Placer Resource Conservation District assists with erosion control practices.

Fires--

Major wildfires that have occurred in the North Fork American River watershed are described in Section VII. Most fires that occur are relatively small, i.e., less than 50 to 75 acres in area. In the National Forest portion of the watershed, roughly 15 to 25 wildfires occur each year.

Primary responsibility for fire management and control in the Tahoe National Forest portion of the North Fork watershed belongs to the Forest Service. On private lands, the responsibility is shared by the CDF and local fire districts in Placer County.

Wild Animals--

There are large numbers of animal species in the North Fork American River watershed which could be carriers of the *Giardia* organism. Due to the similarity in environmental conditions, the species of interest to this study and their populations, are very similar to those in the South Fork and Middle Fork watersheds. Information obtained from the staffs of the Eldorado National Forest, Tahoe National Forest, California Fish and Game Department, and trappers working for County Agricultural Commissioners Offices revealed that:

- There are no regular counts made of any animals except deer.

- Any of the wide variety of animal species which could be in the basin <u>are</u> there, including beaver, coyote, mountain lion, bear and other mammals.

- Beaver can be found in all perennial streams tributary to the North Fork American River.

- A particular herd of mule deer, known as the Blue Canyon deer herd, occupies most of the North Fork watershed. As shown in Figure IV-12, the herd tends to occupy higher elevations during the summer months, and follows relatively well-defined migration routes to a lower-elevation winter range.

- Estimates of populations of the Blue Canyon deer herd by the Department of Fish and Game indicate that the herd size has varied between 4,000 and 6,000 deer, most of which would tend to congregate near streams (CDFG, 1982). Approximately one-half of the herd occupies lands in the North Fork watershed.

Human Activities

Point Sources--

The list of potential types of point sources, and the types actually present in the North Fork sub-basin are both shown in Table IV-15. As shown there, the only significant types of point sources present include wastewater discharges, wastewater collection systems, and landfills and transfer stations.

Wastewater Discharges--Only one wastewater system in the North Fork sub-basin, the City of Colfax, is permitted to discharge treated effluent to a surface water which drains into the American River system. Other municipal wastewater systems which collect, treat, and dispose of treated effluent without discharge to a surface water are described under the subsequent topic of wastewater collection systems.

TABLE IV-15. Potential and Actual Point Sources of Contaminants in the North Fork American River Sub-Basin

Potential Point Source Types	Point Sources Actually Present
1. Wastewater discharges	1. Wastewater discharges
2. Wastewater collection systems	2. Wastewater collection systems
3. Storm runoff	
4. Landfills and transfer stations	4. Landfills and transfer stations
5. Feedlots	
6. Land spreading of sludges	

The NPDES permit for the City of Colfax limits its flow into Smuthers Ravine (see Figure IV-13) to a 30-day average dry weather flow (ADWF) of 0.13 mgd. It also limits total

coliform counts in the effluent to a median of 23 MPN/100 ml for any 30-day period. Effluent limiting concentrations are also placed on BOD, and total settleable matter.

The California CVRWQCB is responsible for wastewater dischargers in the North Fork sub-basin, as well as the rest of the American River watershed. Those responsibilities include setting policies and procedures (such as effluent limitations and monitoring requirements) as well as enforcement.

Wastewater Collection Systems--As shown on Figure IV-13, there presently are eight wastewater collection systems, or portions of collection systems in the North Fork sub-basin. The characteristics of these systems are shown in Table IV-16. All eight systems are located near I-80, and they provide wastewater service for a variety of developments including one highway rest stop, one campground, two mobile home parks, and four residential areas or communities. Two of the systems provide subsurface disposal in leachfields following treatment in septic tanks, while four systems provide surface treatment and land disposal. The remaining two systems (Placer County SMD No. 1 and Sierra Lakes CWD) are collection systems only, conveying raw wastewater to treatment and disposal sites outside the American River watershed.

Each of the above collection systems operates under specific Waste Discharge Requirements set by the Central Valley RWQCB. For the systems with treatment but no discharge, the requirements generally set raw wastewater flow limits and provide for groundwater monitoring. Enforcement of the permit conditions is also the responsibility of the CVRWQCB. The portions of the two collection systems in the North Fork sub-basin (Placer County SMD No. 1 and Sierra Lakes CWD) operate under Waste Discharge Requirements for their respective treatment plants. In the case of Sierra Lakes CWD, that plant belongs to Donner Summit PUD, located outside the American River watershed.

Storm Runoff--There are no areas with significant urban runoff in the North Fork sub-basin. While some areas do have storm sewers, most communities and developments in the North Fork drainage use ditches and intermittent streams for drainage conveyance facilities.

Table IV-16. Non-Discharging Small Community Wastewater Systems in the North Fork American River Sub-Basin		
Name	Type of Development	Wastewater Facilities
1. CA Dept. of Transportation - Gold Run Rest Stop	Highway rest stop	STS and ponds, spray
2. Heather Glen CSD	Mobile home sub-division	Pond, spray
3. NACO West - Emigrant Gap	Campground	STS
4. Shady Glen Mobile Home Park	Mobile home park	Package treatment, ponds, spray
5. Placer County Service Area No. 23 - Blue Canyon	Community	STS
6. Placer CSA No. 24 - Applegate	Community	Ponds, evaporation, percolation
7. Placer County SMD No. 1	Portion of north Auburn	Portion of collection system only
8. Sierra Lakes CWD	Subdivision	Collection only; treatment outside watershed
Notes: CSD = County Sanitation District STS = Septic tank and leachfield system CWD = County Water District		

As described for the South Fork sub-basin, stormwater discharges became part of the EPA NPDES program in 1990. None of the communities in the North Fork are large enough (>100,000 in population) at the present time to be required to obtain a municipal NPDES permit. General industrial permits are also required now for public and private facilities including wastewater treatment plants, landfills, and airports.

Landfills and Transfer Stations--There are no active landfills in the North Fork drainage area (CIWMB 1992). As shown on Figure IV-13, however, there are two closed and inactive landfills in the sub-basins (CIWMB 1991). One of these was the City of Colfax landfill which accepted leaves and clippings, as well as mixed municipal refuse. The other closed landfill,

the Clipper Creek Landfill near Applegate, accepted construction/demolition materials, some hazardous wastes, leaves and clippings, and tires. There are no transfer stations in this area, although the Dutch Flat transfer station lies just outside the watershed, in the Bear River basin (CIWMB 1992). Landfills available to residents and businesses in this sub-basin include both the Eastern Regional Landfill in the Truckee River Basin and the Western Regional Landfill, north of Roseville. Both of these are Placer County facilities and both are outside the American River watershed.

Control of solid waste in the North Fork sub-basin is the responsibility of Placer County, which is presently preparing its Integrated Waste Management Plan.

Feedlots--There are no existing feedlots in the North Fork drainage area. Small corrals can be found in agricultural and rural residential areas of Placer County, but commercial feedlots are not present.

Land Spreading of Sludges--There are no locations in the North Fork sub-basin where land spreading is used as the final disposal method for wastewater sludges. The wastewater treatment facilities in the sub-basin use sludge lagoons and/or drying beds on the treatment site, but all solids are then hauled to a landfill or other permitted solids handling facility.

Non-Point Sources--

The list of potential types of non-point sources, and the types actually present in the North Fork sub-basin are both shown in Table IV-17. As shown there, the existing types of non-point sources include all four potential types related to microbiological contamination.

Table IV-17. Potential and Actual Non-Point Sources of Contaminants in the North Fork Sub-Basin	
Potential Non-Point Source Types	Non-Point Sources Actually Present
1. Septic Tank Systems 2. Logging 3. Recreation 4. Grazing Animals	1. Septic Tank Systems 2. Logging 3. Recreation 4. Grazing Animals

Septic Tank Systems-- As in both the South Fork and Middle Fork sub-basins, there are numerous STS scattered throughout the North Fork drainage area serving individual residences. The residences involved vary from remote ranch houses to rural subdivisions. While there is one small group of 11 recreational residences on STS by special permit in the Casa Loma area near Baxter, south of I-80, in the Tahoe National Forest, the vast majority of the number of STS in the sub-basin are on private land. Roughly, somewhere between 7,000 and 12,000 systems are located in Placer County in the North Fork area. Because most of the land in this sub-basin is in the Tahoe National Forest, as shown in the subsequent description of recreation facilities, the location of STS on private lands are confined to about 25 percent of the drainage area occupying both the western portion of the sub-basin and segments of land along I-80 at the extreme northern boundary of the watershed.

Responsibility for controls of STS on private lands in the North Fork sub-basin belongs to the Placer County DEM. Primary responsibility for STS in the Tahoe National Forest is vested in the Forest Service, but Forest Service staff can consult and coordinate with Placer County regarding new system design or old system repairs.

Logging--Logging is a significant activity in the North Fork sub-basin, but precise data on locations and number of acres logged in any given year is difficult to obtain. More information is presently available for the South and Middle Forks than the North Fork and the combination of the numbers of both public agencies and private companies involved, the variety of logging methods being used, and the watershed area involved make mapping of locations logged very difficult.

In the North Fork drainage area, logging has been taking place both on Tahoe National Forest lands, and on private land in the eastern half of the sub-basin. The private company with the largest land ownership in the North Fork is Fruit Growers, Inc. Data on acres logged in recent years was not provided by either the Tahoe National Forest or Fruit Growers, Inc.

On National Forest lands, the Forest Service is primarily responsible for erosion control and control of other potential pollutant sources. The Tahoe National Forest uses both national standards and guidelines for this purpose, as well as management practices developed for all Forests in California, and specific policies and procedures in its own Land and Resources Management Plan (USDA draft, 1988; INF, 1988).

On private lands, the California Department of Forestry and Fire Protection is responsible for enforcing the California Forest Practice Act. Portions of these regulations require private timber companies to submit Timber Harvest Plans for approval, for 3-year periods, for all planned significant harvesting. Many trees are harvested by either Exemptions from the THP or Emergency Notices. Exemptions apply only to areas less than three acres, while emergency notices can be issued, for 60 days or less, if dead and dying trees in an area constitute more than 10 percent of the total. During operation under a THP, a private owner is strictly limited by the area and cutting methods specified, but has no set schedule for the work or any minimum area which must be harvested. Consequently, private companies often harvest less than is specified in their THP, and could cut nothing if desired.

California Forest Practice Regulations are similar to Forest Service regulations and require the implementation of detailed Best Management Practices. Included among these are limitations on operations in stream protection zones, on steep or unstable slopes, and during winter weather.

Recreation--The Tahoe National Forest portion of the North Fork sub-basin contains the least number of developed recreational facilities, and therefore has the lightest recreational use of National Forest lands, of any of the five sub-basins in the American River watershed.

Several factors have caused this situation including: (1) abundant facilities that can be reached by I-80 just outside the North Fork drainage, (2) the topography of the area, and (3) designation of part of the North Fork as a Wild and Scenic River. The eight campgrounds and two picnic areas in the National Forest portion of the North Fork sub-basin are shown on Figure IV-14. Details available from the Tahoe National Forest regarding these sites are listed in Table IV-18. No ski areas exist in the North Fork drainage and only a few miles of designated OHV trails have been established.

In addition to locations in the Tahoe National Forest, there are also recreational facilities with significant use levels in the Auburn State Recreation Area around Lake Clementine (see Figure IV-14). The area offers camping, day use, and a 50-berth marina on Lake Clementine. The existing campgrounds are listed in Table IV-18; they are relatively primitive at present, none having any drinking water supply for example. The estimated total 1990 day use of 500,000 people however, matches the estimate for visitors at the Marshall Gold Discovery Site in the South Fork sub-basin.

Controls on potential pollutant sources in the Auburn State Recreation Area are primarily the responsibility of the California Department of Parks and Recreation. The Auburn Boat club maintains the Lake Clementine marina however, and there presently is no pump-out station for boat holding tanks.

While these facilities provided enjoyment for many people in 1992, they also are potential sources of pollutants in several ways. Water-contact recreation could directly cause microbiological contamination, while improper care or use of restroom facilities at any location could indirectly lead to water supply contamination. On the other hand, OHV use can produce significant erosion problems.

Controls for pollution prevention within the Tahoe National Forest lands are primarily the responsibility of the Forest Service. These controls begin with standards, policies, and guidelines set forth in the Forest's Land and Resources Management Plan. They are then

- City of Roseville - Plant Intake

Constituents Included and Sampling Frequency

To meet the requirements of the SWTR, water suppliers must comply with Maximum Contaminant Level Goals (MCLGs) for *Giardia*, viruses, Legionella, HPC, and coliforms, and also meet a turbidity treatment level.

Table V-3 lists the current MCLGs, MCLs or treatment level required for each water quality constituent.

Table V-3. Drinking Water Criteria

Constituent	MCL/MCLG	Treatment Objective
Giardia	zero	3-log removal/inactivation[2]
Viruses	zero	4-log removal/inactivation[2]
Legionella	zero	
Total Coliform	absent	
Turbidity, NTU	--	0.5[1]
HPC Bacteria/ml	--[3]	<500[4]

[1]Treatment levels to be achieved in 95 percent of samples.
[2]Minimum treatment required for all surface water supplies.
[3]No numeric value set.
[4]In distribution system, if no disinfectant residual can be measured, substitute HPC analyses.

The agencies involved in the study have been collecting raw water samples for coliform and turbidity at various frequencies and for different lengths of time.

No sampling for *Giardia* or viruses has been conducted, except for a few samples collected by Arcade Water District and City of Sacramento. Arcade Water District collected samples on February 2, 1990, March 6, 1990, and March 28, 1990 to evaluate whether their wells are under surface water influence. The City collected a sample on March 16, 1992. They were

analyzed for *Giardia* and *Cryptosporidium*. The results of their monitoring data are summarized in Table V-4.

Table V-4. Raw Water Quality Excursion Frequency, Summary

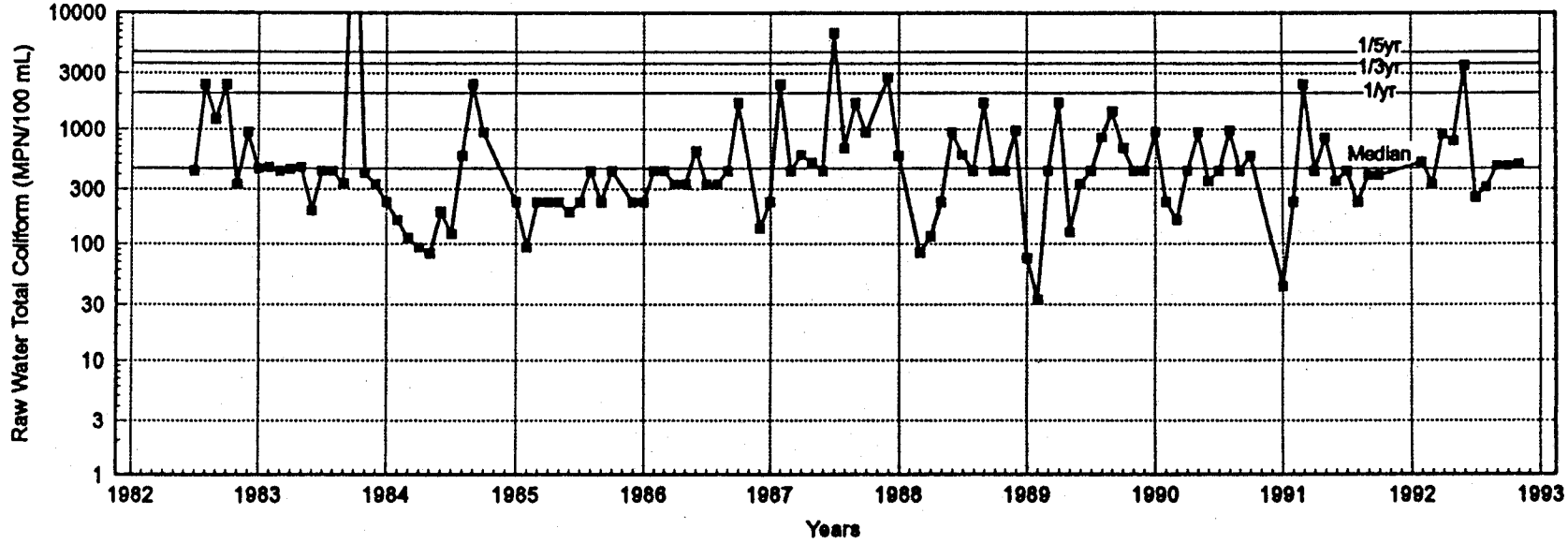
Intake	Total Coliform (MPN/100 ml)				Turbidity (NTU)			
	Median	1/yr	1/3yr	1/5yr	Median	1/yr	1/3yr	1/5yr
Fairbairn WTP	454	2054	3656	4604	3	8	11	13
San Juan Suburban	81	446	854	1107	3	10	16	19
City of Roseville					2	8	13	16
Carmichael WD					2	4	5	6
Peninsula Campground WTP					3	9	13	15
Strawberry WTP	15	126	288	400	0.22	0.30	0.33	0.35
Monte Vista WTP	33	515	1468	2231	2.07	7.69	12.69	15.5
El Dorado Hills WTP	22	303	823	1228	2.23	3.79	4.64	5.03

Review of Existing Data

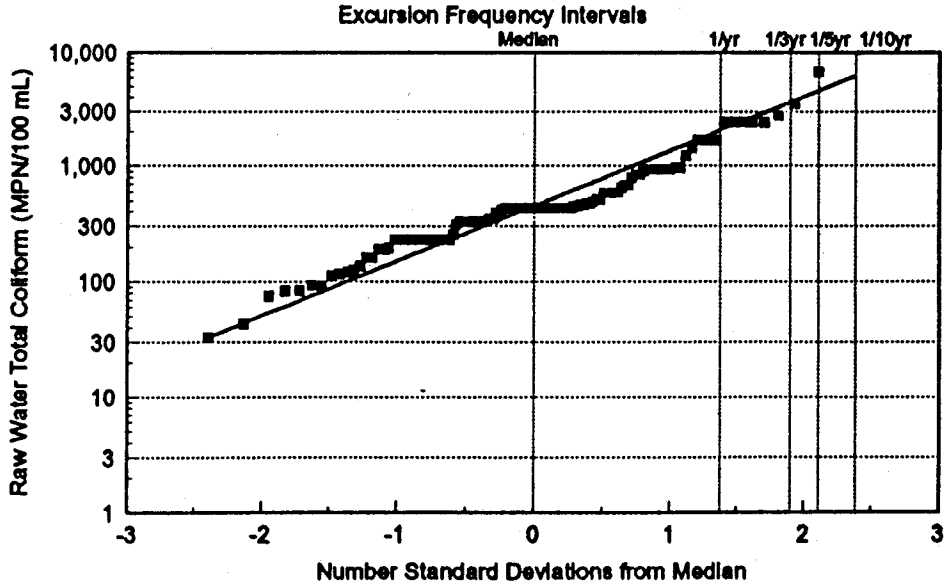
No special monitoring was conducted as part of the sanitary survey. For the purposes of this report existing records of coliform and turbidity data were evaluated.

Figures V-2 thorugh V-14 summarize the data evaluated. Turbidity data and total coliform data were plotted. For total coliform monthly medians vs. time and the frequency distribution of the monthly water total coliform counts were plotted as a log normal distribution. For turbidity the average monthly raw water turbidity was plotted vs. time and the log normal distribution of the average raw water turbidity. From these figures calculations were conducted of the median total coliform (MPN/100 ml) and the excursion frequencies of 1/year, 1/3 year and 1/5 year, similar data was generated for turbidities. Table V-4 summarizes these data.

E.A. Fairbairn Water Treatment Plant



(a) MONTHLY MEDIAN TOTAL COLIFORM COUNTS BETWEEN 1982 AND 1992



(b) FREQUENCY DISTRIBUTION OF MONTHLY MEDIAN RAW WATER TOTAL COLIFORM COUNTS

ANALYSIS RESULTS

Location:	E.A. Fairbairn Water Treatment Plant
Water Agency:	City of Sacramento

Data Record:

Parameter	Total Coliform
Record Size	114 Months
Analysis Frequency	4 - 6 per Month

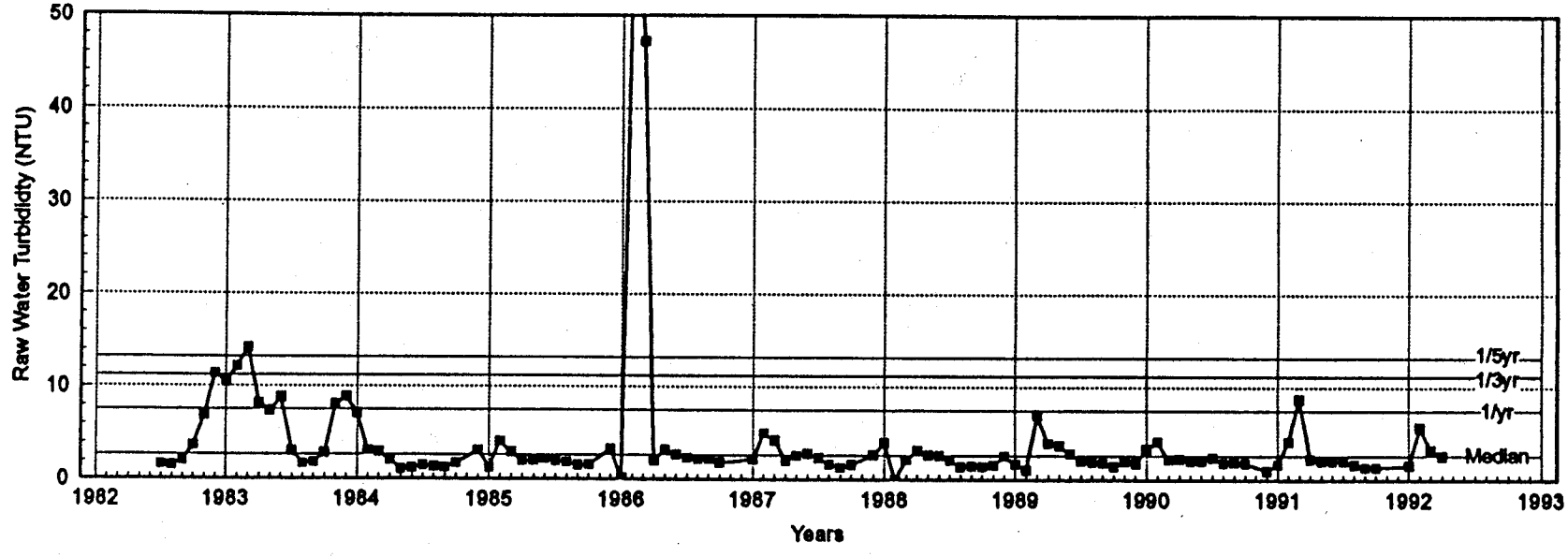
Results:

Excursion Frequency	Total Coliform (MPN/100 mL)
Median	454
1/yr	2054
1/3yr	3656
1/5yr	4604

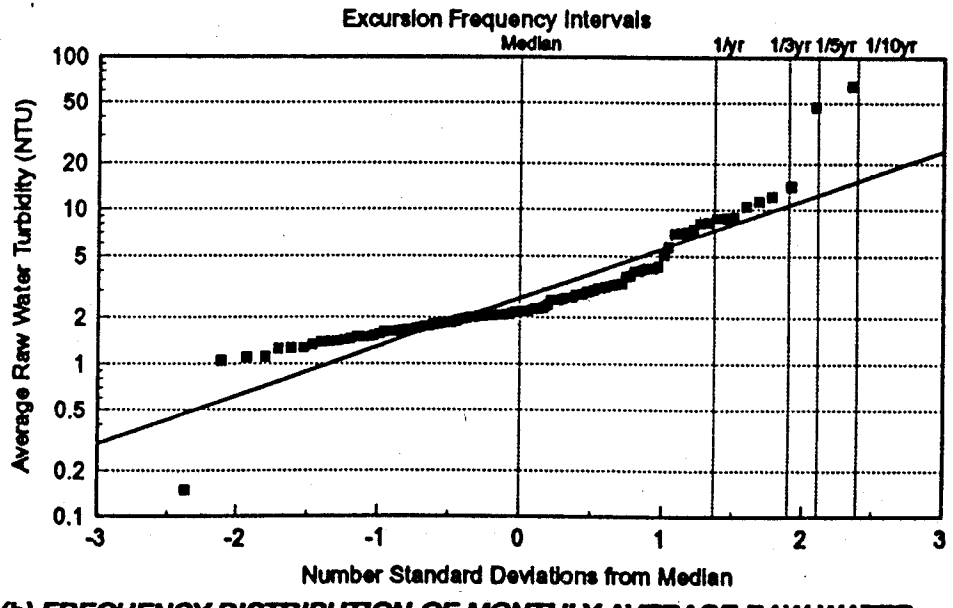
Figure V-2

HDR

E.A. Fairbairn Water Treatment Plant



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

ANALYSIS RESULTS

Location:	E.A. Fairbairn Water Treatment Plant
Water Agency:	City of Sacramento

Data Record:

Parameter	Turbidity
Record Size	109 Months
Analysis Frequency	Daily

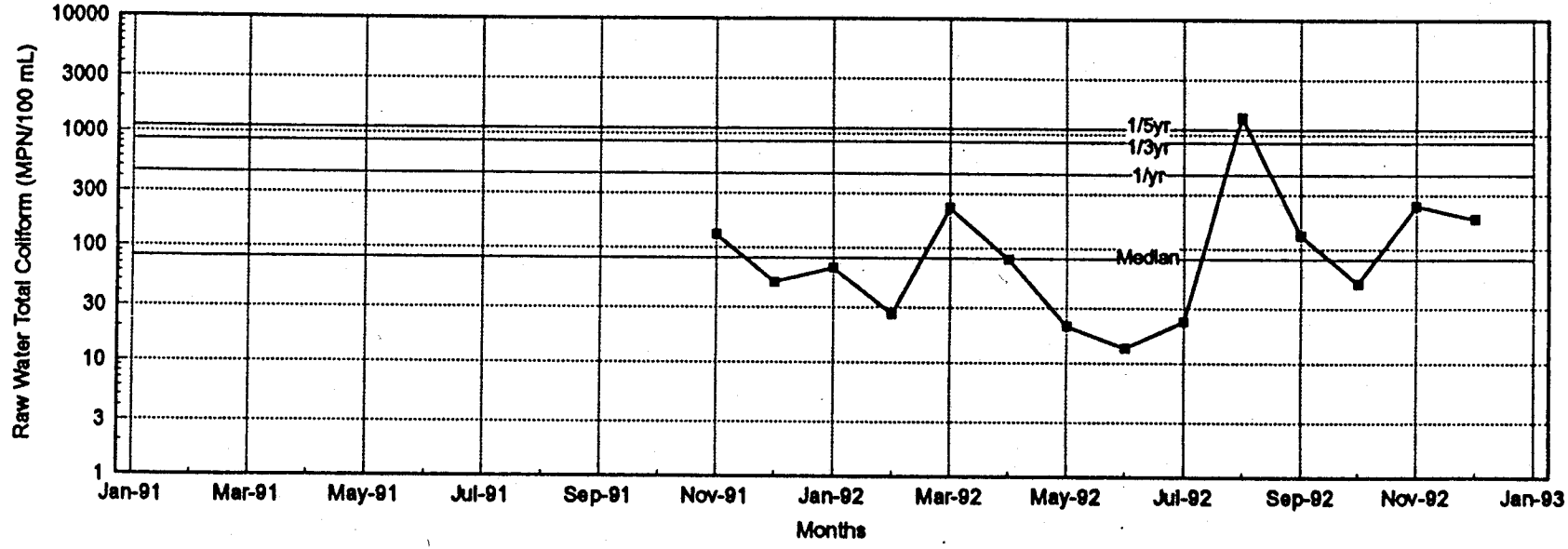
Results:

Excursion Frequency	Turbidity (NTU)
Median	3
1/yr	8
1/3yr	11
1/5yr	13

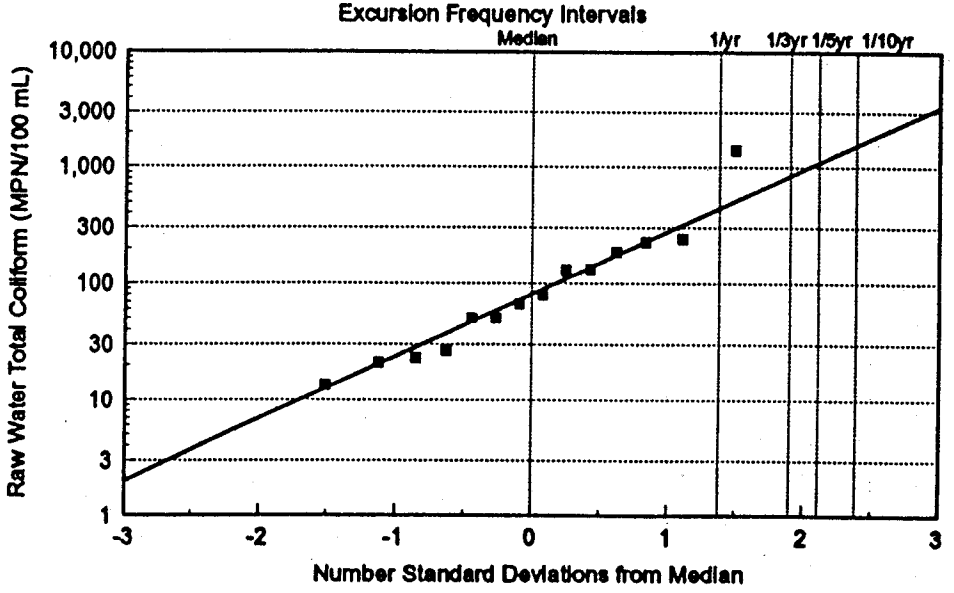
HDR

Figure V-3

San Juan Suburban



(a) MONTHLY MEDIAN TOTAL COLIFORM COUNTS BETWEEN 1982 AND 1992



(b) FREQUENCY DISTRIBUTION OF MONTHLY MEDIAN RAW WATER TOTAL COLIFORM COUNTS

ANALYSIS RESULTS

Location:	San Juan Suburban
Water Agency:	San Juan Suburban Water District

Data Record:

Parameter	Total Coliform
Record Size	14 Months
Analysis Frequency	1-3 per Month

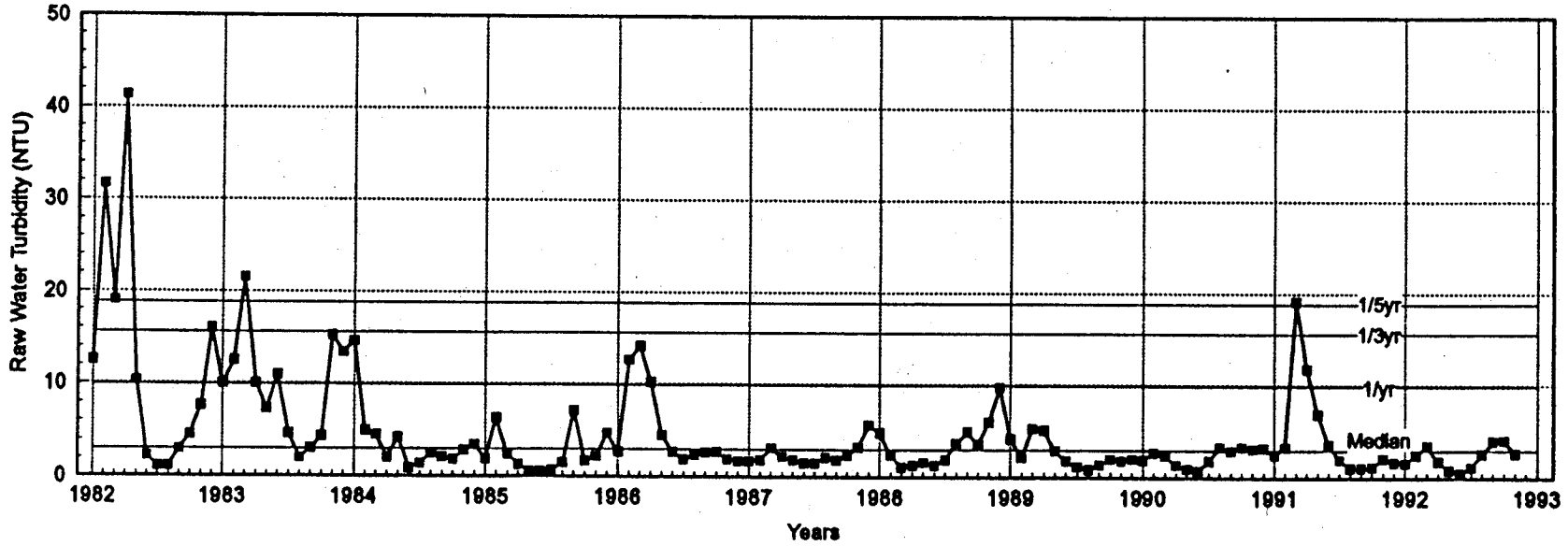
Results:

Excursion Frequency	Total Coliform (MPN/100 mL)
Median	81
1/yr	446
1/3yr	854
1/5yr	1107

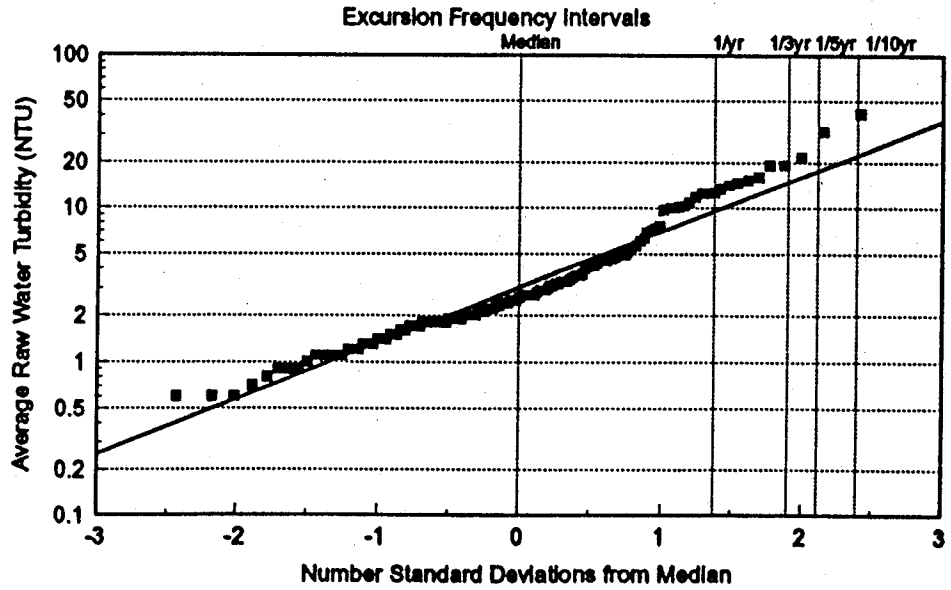
HDR

Figure V-4

San Juan Suburban



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

ANALYSIS RESULTS

Location:	San Juan Suburban
Water Agency:	San Juan Suburban Water District

Data Record:

Parameter	Turbidity
Record Size	131 Months
Analysis Frequency	Daily

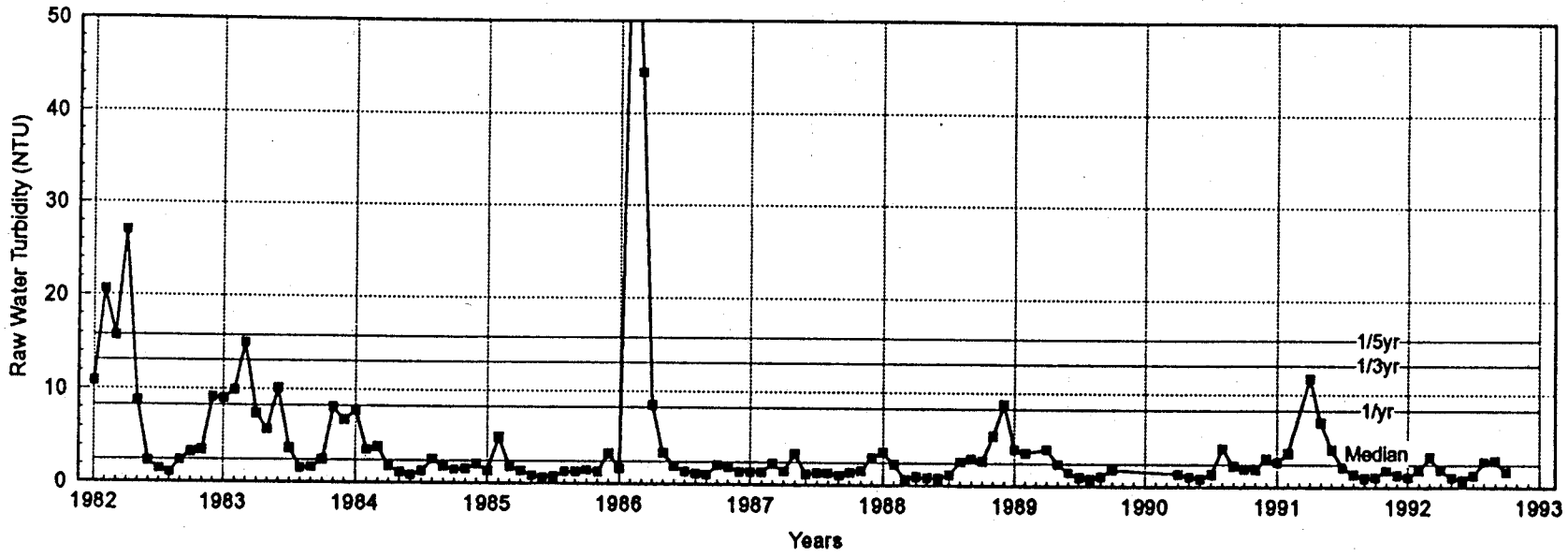
Results:

Excursion Frequency	Turbidity (NTU)
Median	3
1/yr	10
1/3yr	16
1/5yr	19

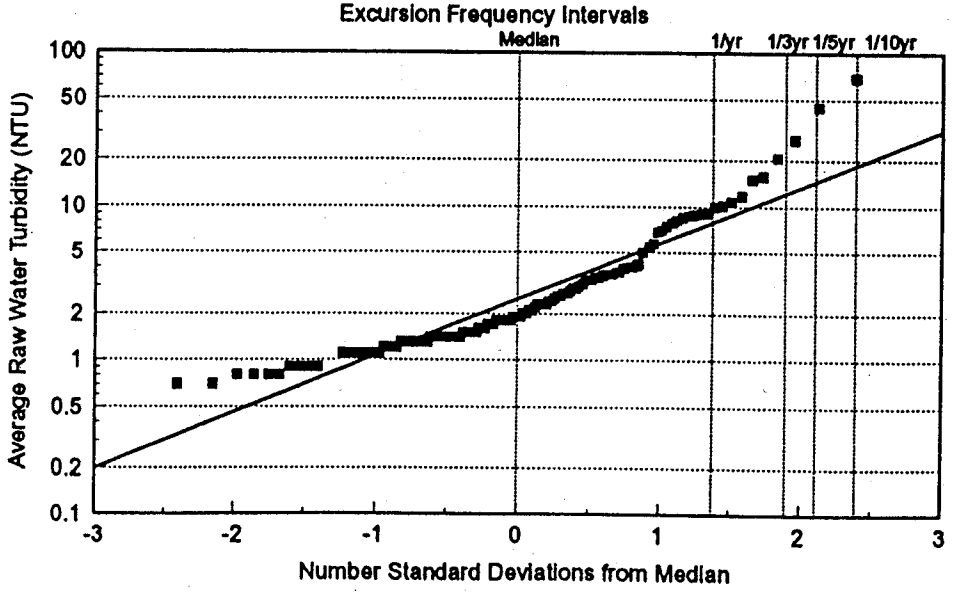
HDR

Figure V-5

City of Roseville Water Treatment Plant



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

ANALYSIS RESULTS

Location:	City of Roseville Water Treatment Plant
Water Agency:	City of Roseville

Data Record:

Parameter	Turbidity
Record Size	123 Months
Analysis Frequency	Daily

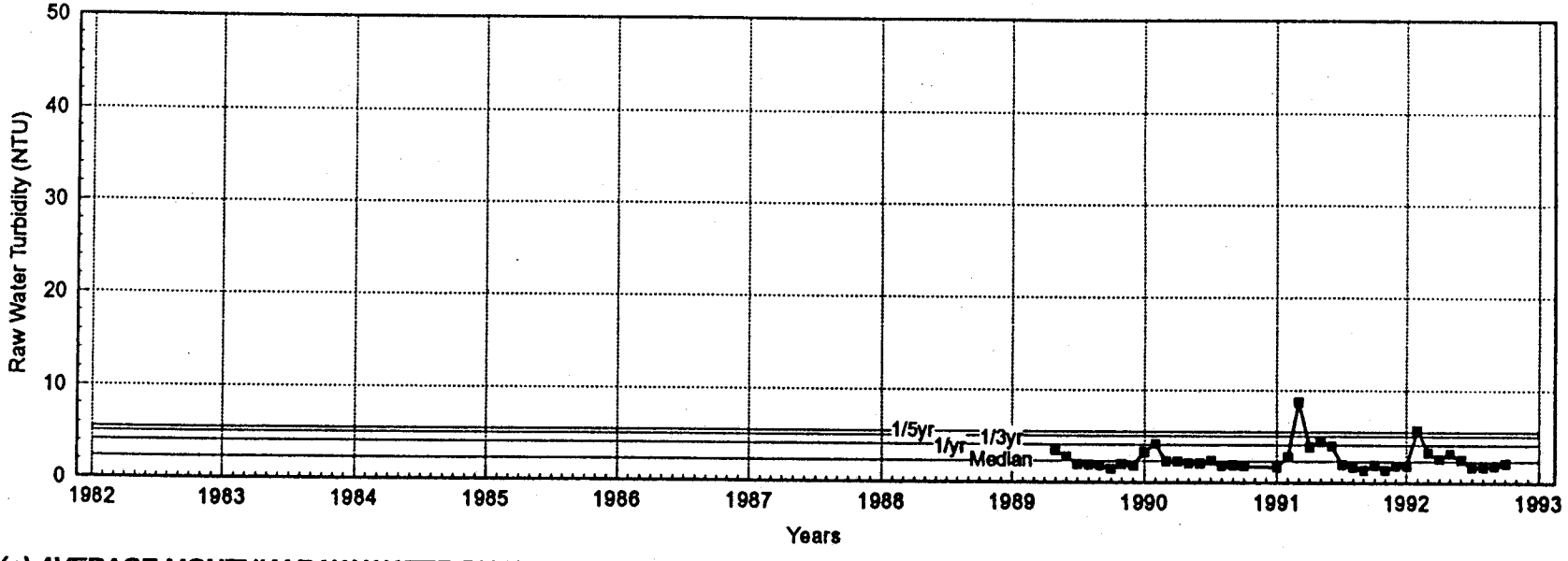
Results:

Excursion Frequency	Turbidity (NTU)
Median	2
1/yr	8
1/3yr	13
1/5yr	16

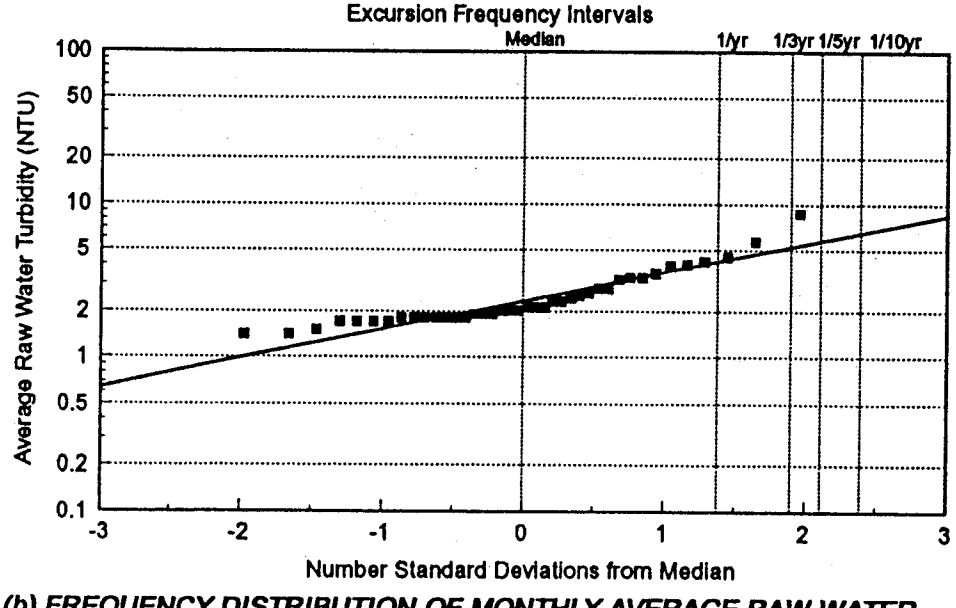
HDR

Figure V-6

Carmichael Water District



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

ANALYSIS RESULTS

Location:	Carmichael Water District Raw Water
Water Agency:	Carmichael Water District

Data Record:

Parameter	Turbidity
Record Size	40 Months
Analysis Frequency	Daily

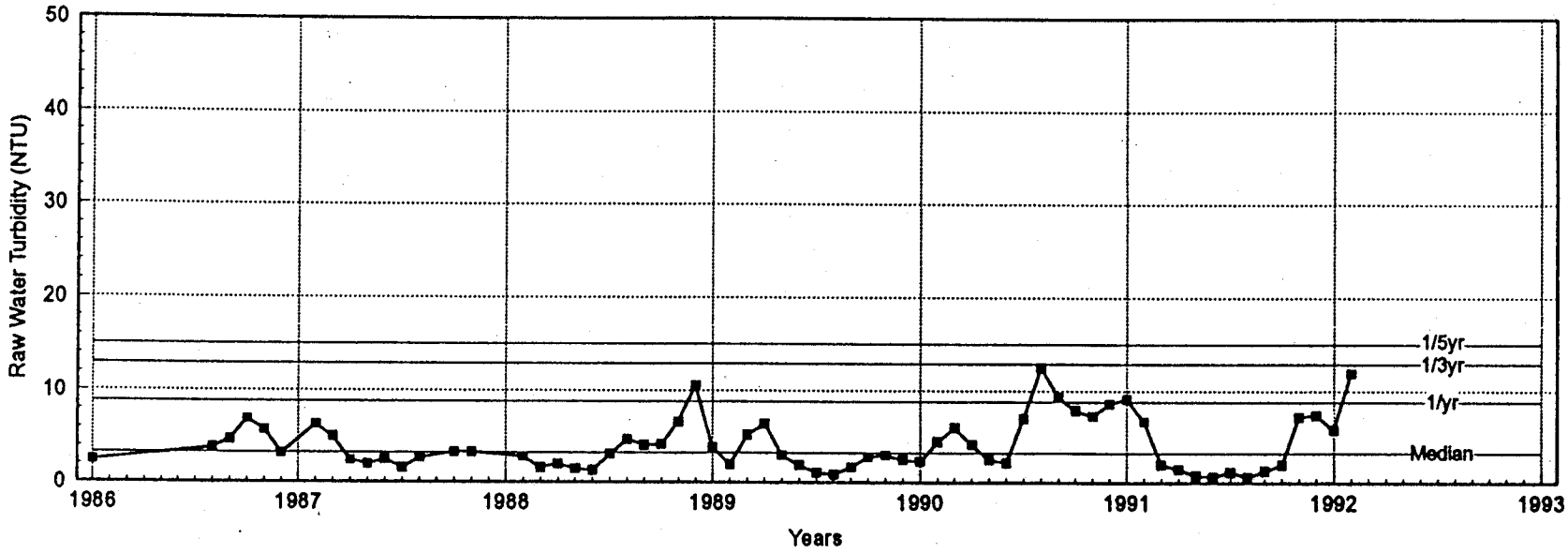
Results:

Excursion Frequency	Turbidity (NTU)
Median	2
1/yr	4
1/3yr	5
1/5yr	6

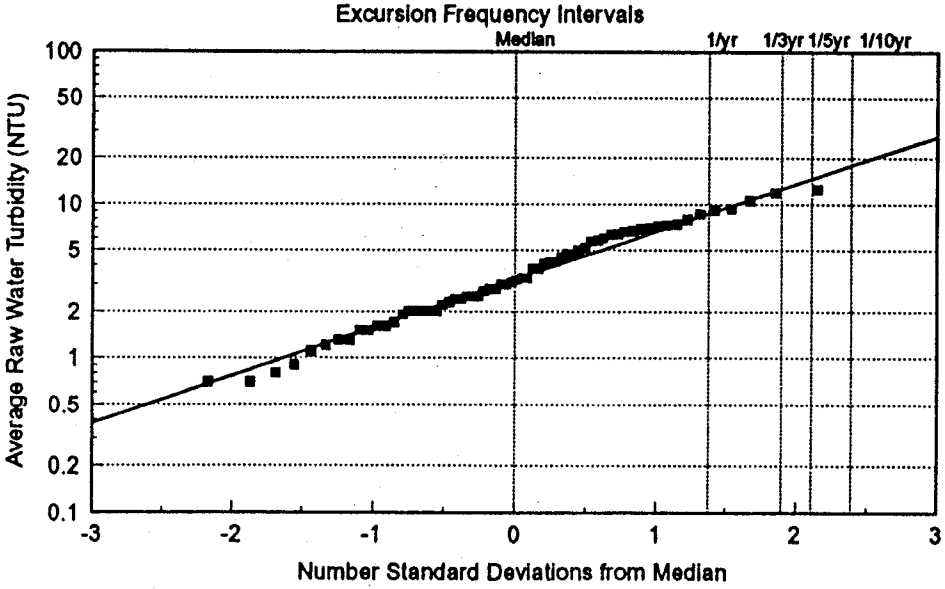
HDR

Figure V-7

Peninsula Campground Water Treatment Plant



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



ANALYSIS RESULTS

Location:	Peninsula Campground Water Treatment Plant
Water Agency:	Folsom Lake State Recreation Area

Data Record:

Parameter	Turbidity
Record Size	64 Months
Analysis Frequency	Daily

Results:

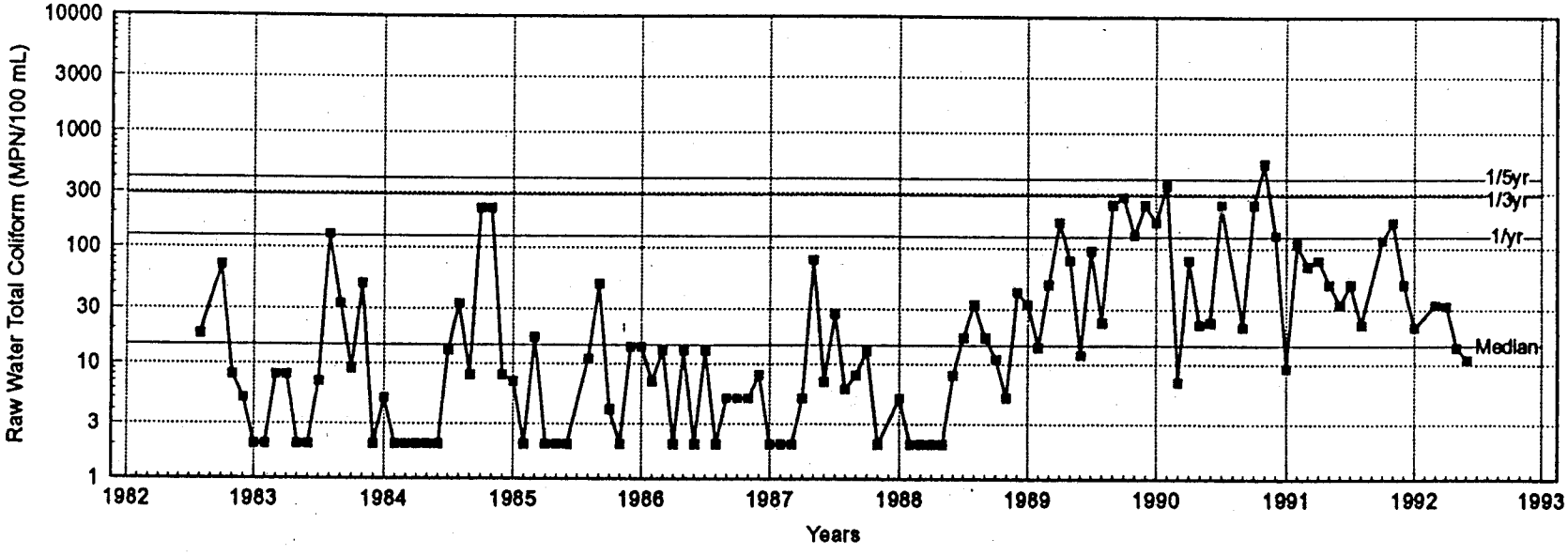
Excursion Frequency	Turbidity (NTU)
Median	3
1/yr	9
1/3yr	13
1/5yr	15

(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

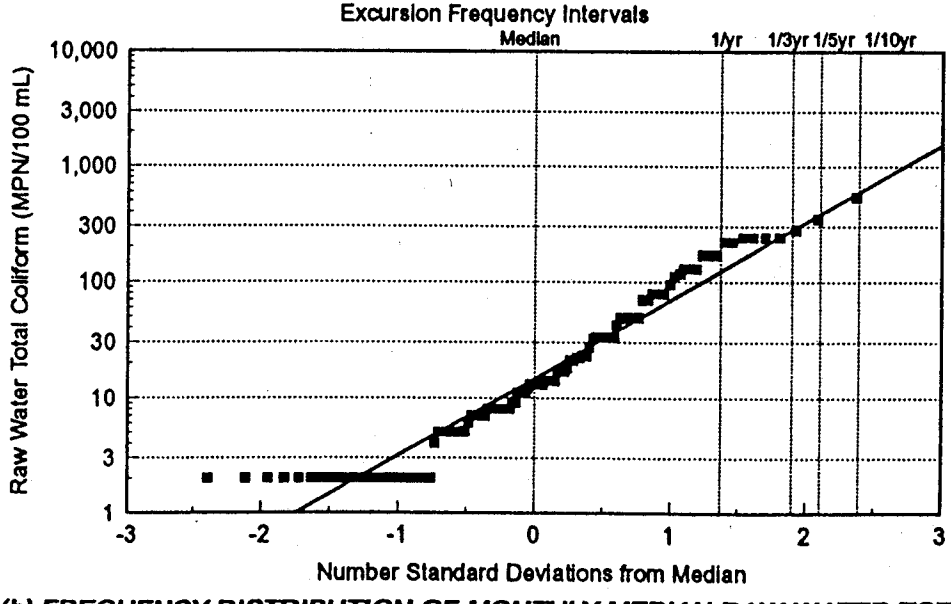
HDR

Figure V-8

Strawberry Water Treatment Plant



(a) MONTHLY MEDIAN TOTAL COLIFORM COUNTS BETWEEN 1982 AND 1992



(b) FREQUENCY DISTRIBUTION OF MONTHLY MEDIAN RAW WATER TOTAL COLIFORM COUNTS

ANALYSIS RESULTS

Location:	Strawberry Water Treatment Plant
Water Agency:	El Dorado Irrigation District

Data Record:

Parameter	Total Coliform
Record Size	113 Months
Analysis Frequency	1 per Month

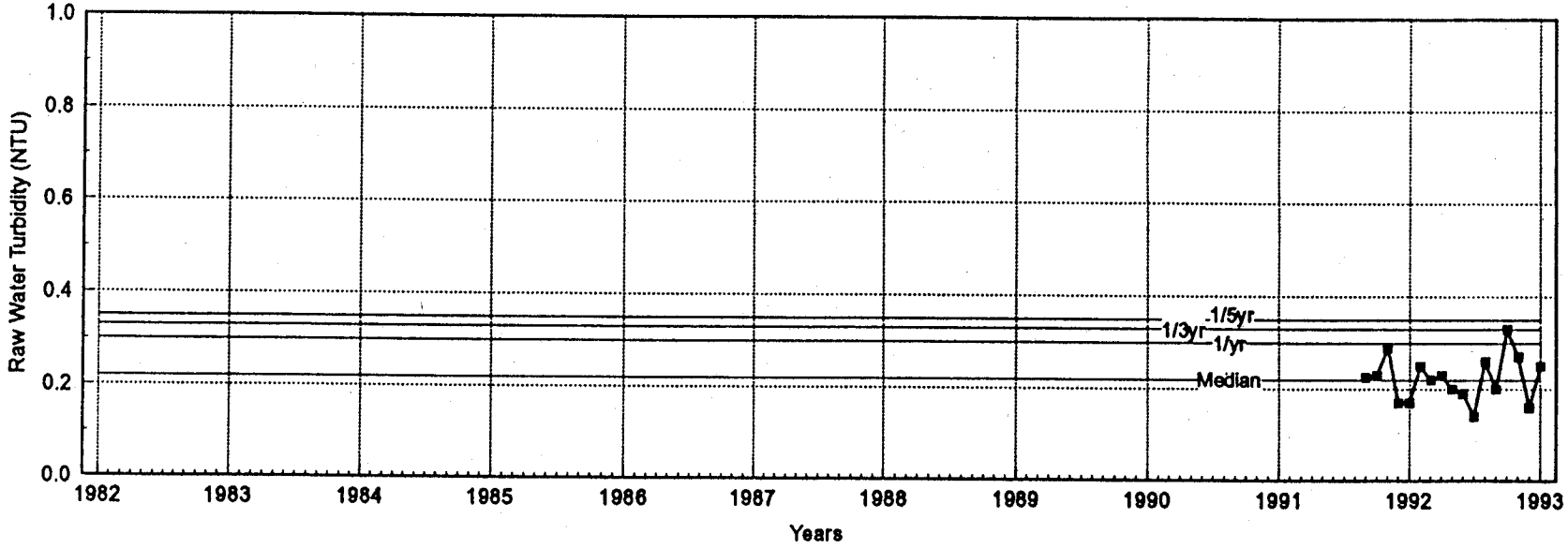
Results:

Excursion Frequency	Total Coliform (MPN/100 mL)
Median	15
1/yr	126
1/3yr	288
1/5yr	400

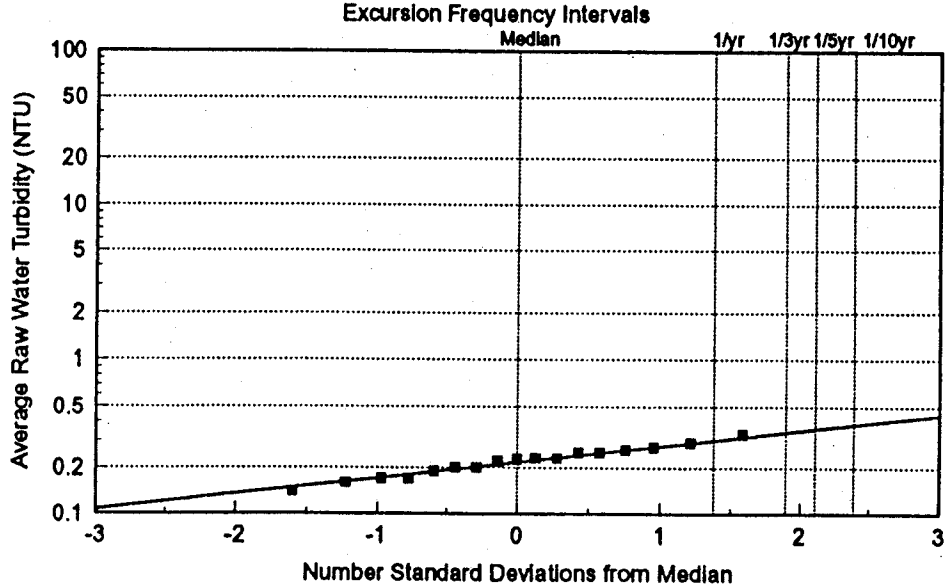
HDR

Figure V-9

Strawberry Water Treatment Plant



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



ANALYSIS RESULTS

Location:	Strawberry Water Treatment Plant
Water Agency:	El Dorado Irrigation District

Data Record:

Parameter	Turbidity
Record Size	17 Months
Analysis Frequency	Daily

Results:

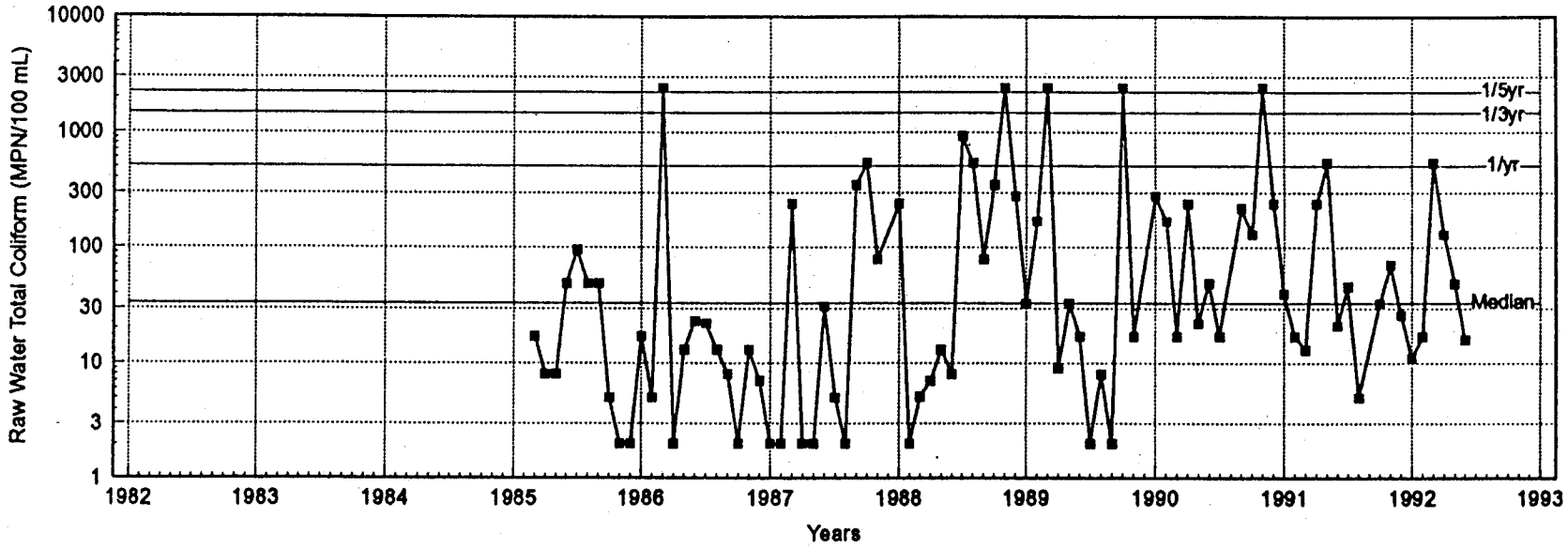
Excursion Frequency	Turbidity (NTU)
Median	0.22
1/yr	0.30
1/3yr	0.33
1/5yr	0.35

(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

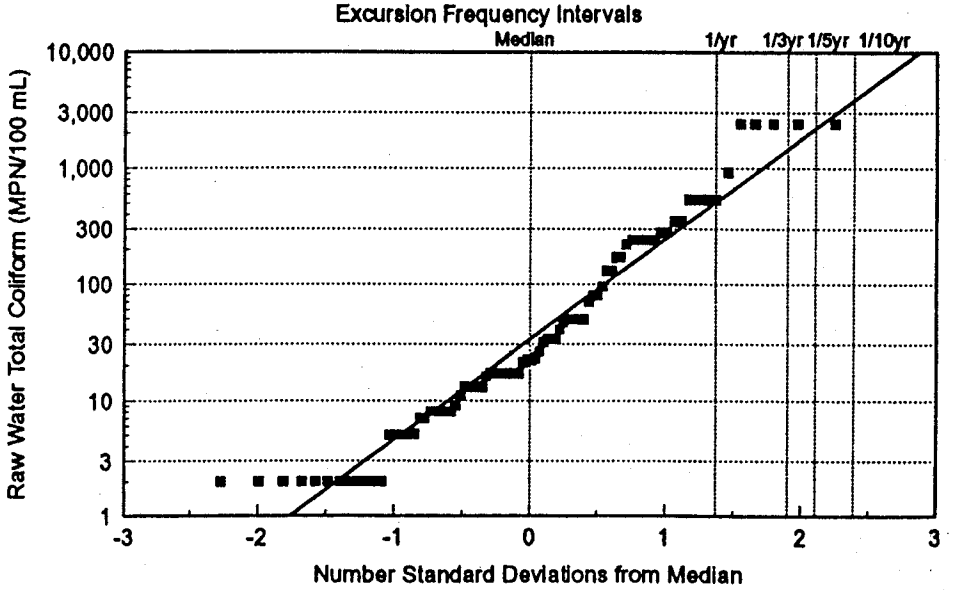
HDR

Figure V-10

Monte Vista Water Treatment Plant



(a) MONTHLY MEDIAN TOTAL COLIFORM COUNTS BETWEEN 1982 AND 1992



(b) FREQUENCY DISTRIBUTION OF MONTHLY MEDIAN RAW WATER TOTAL COLIFORM COUNTS

ANALYSIS RESULTS

Location:	Monte Vista Water Treatment Plant
Water Agency:	El Dorado Irrigation District

Data Record:

Parameter	Total Coliform
Record Size	84 Months
Analysis Frequency	1 per Month

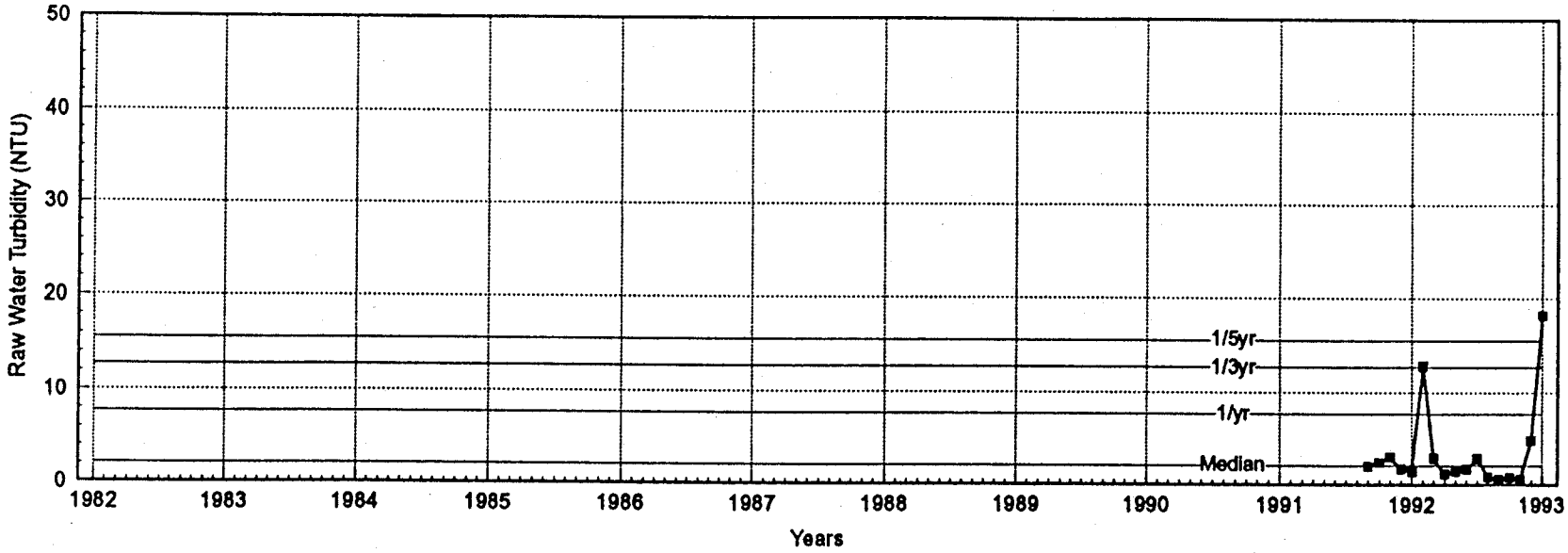
Results:

Excursion Frequency	Total Coliform (MPN/100 mL)
Median	33
1/yr	515
1/3yr	1468
1/5yr	2231

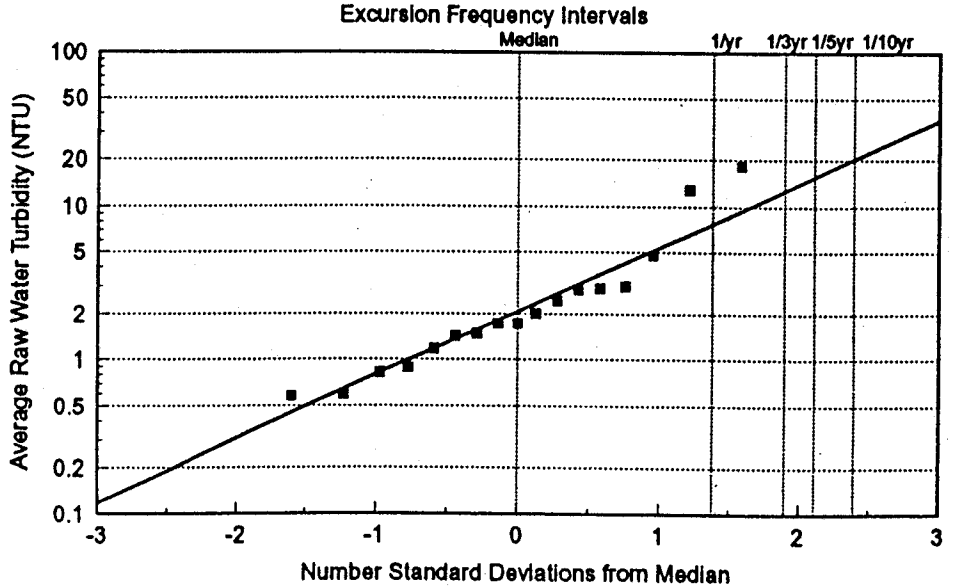
HDR

Figure V-11

Monte Vista Water Treatment Plant



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



ANALYSIS RESULTS

Location:	Monte Vista Water Treatment Plant
Water Agency:	El Dorado Irrigation District

Data Record:

Parameter	Turbidity
Record Size	17 Months
Analysis Frequency	Daily

Results:

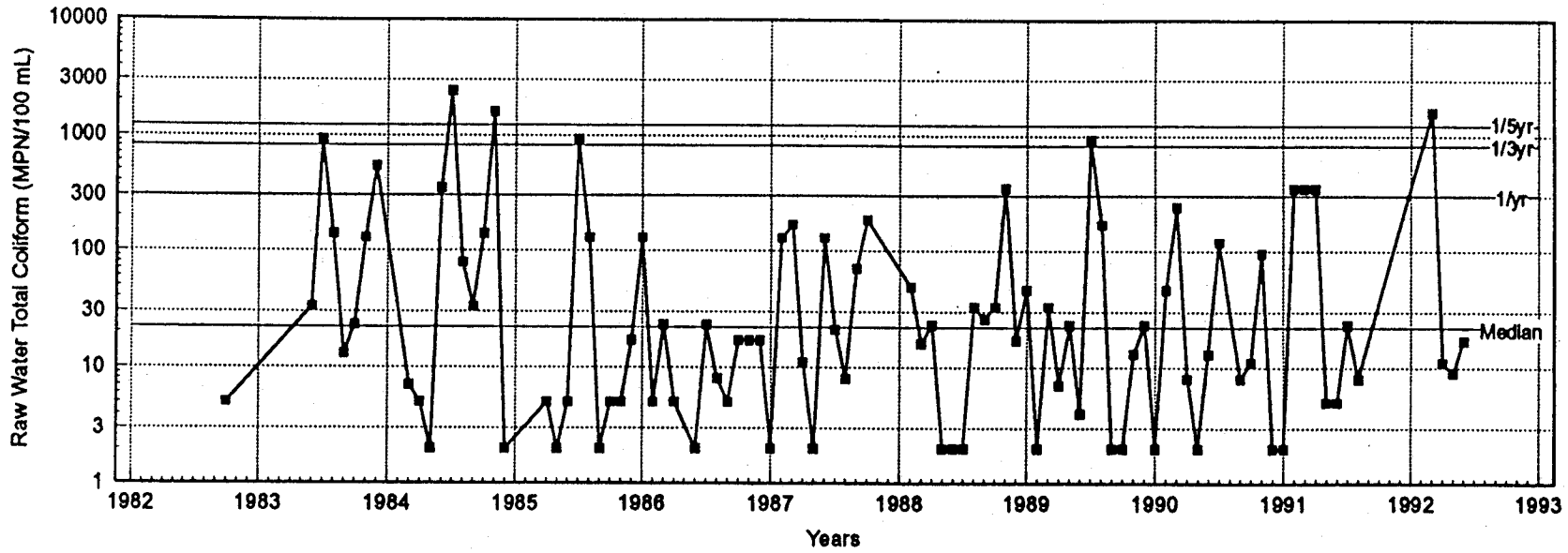
Excursion Frequency	Turbidity (NTU)
Median	2.07
1/yr	7.69
1/3yr	12.69
1/5yr	15.50

(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

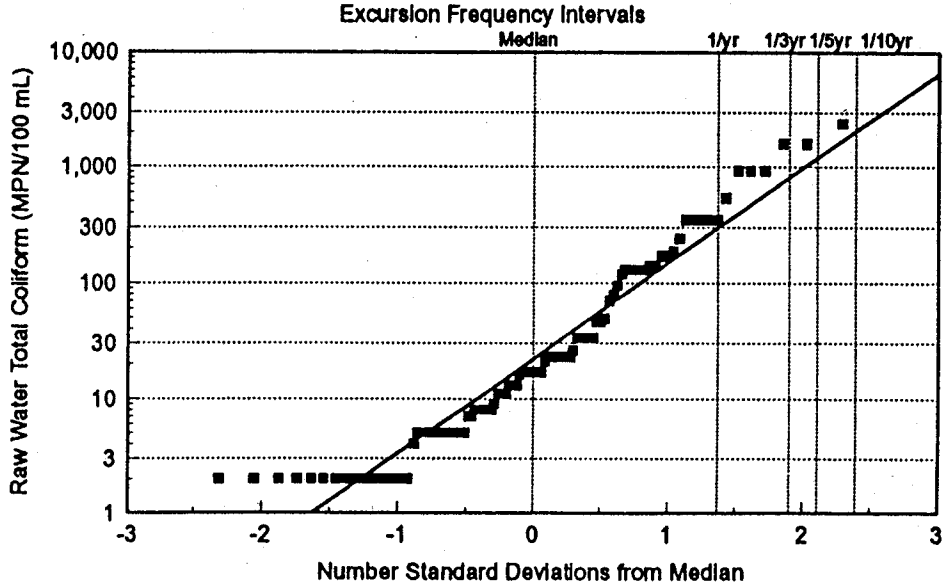
HDR

Figure V-12

El Dorado Hills Water Treatment Plant



(a) MONTHLY MEDIAN TOTAL COLIFORM COUNTS BETWEEN 1982 AND 1992



(b) FREQUENCY DISTRIBUTION OF MONTHLY MEDIAN RAW WATER TOTAL COLIFORM COUNTS

ANALYSIS RESULTS

Location:	El Dorado Hills Water Treatment Plant
Water Agency:	El Dorado Irrigation District

Data Record:

Parameter	Total Coliform
Record Size	84 Months
Analysis Frequency	1 per Month

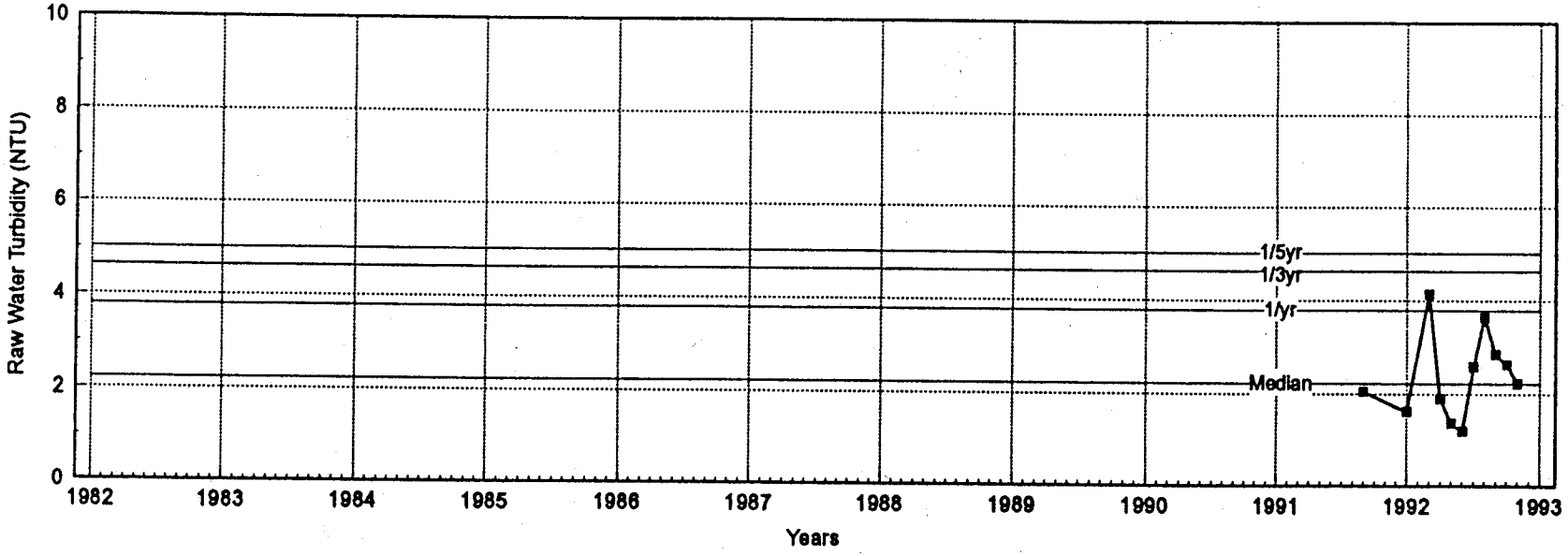
Results:

Excursion Frequency	Total Coliform (MPN/100 mL)
Median	22
1/yr	303
1/3yr	823
1/5yr	1228

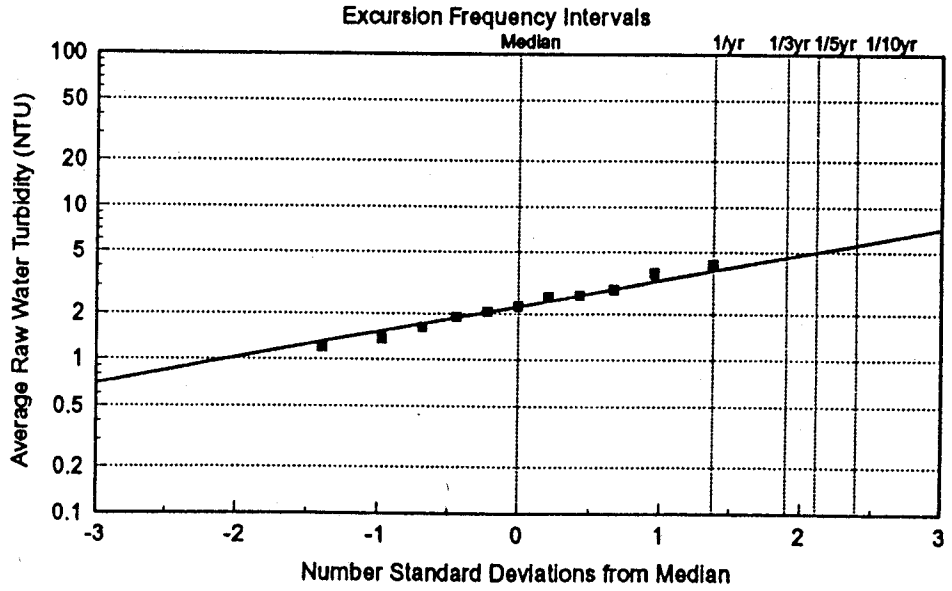
HDR

Figure V-13

El Dorado Hills Water Treatment Plant



(a) AVERAGE MONTHLY RAW WATER TURBIDITY DATA



(b) FREQUENCY DISTRIBUTION OF MONTHLY AVERAGE RAW WATER TURBIDITY

ANALYSIS RESULTS

Location:	El Dorado Hills Water Treatment Plant
Water Agency:	El Dorado Irrigation District

Data Record:

Parameter	Turbidity
Record Size	11 Months
Analysis Frequency	Daily

Results:

Excursion Frequency	Turbidity (NTU)
Median	2.23
1/yr	3.79
1/3yr	4.64
1/5yr	5.03

HDR

Figure V-14

A review of the total coliform results indicated that the median raw water total coliform counts for the five intakes evalauted were well below 1,000 MPN/100 ml. In fact, the median total coliform count stayed below 500 MPN/100 ml for the data evaluated. High counts occurred mostly during summer and spring months and are associated in summer with lower flows and increased activity on the watershed and in the streams, and in spring with runoff. Turbidity results indicated that the median turbidity at all the intakes evaluated were 3 or less turbidity units. The five year excursion did not exceed 20 NTU at any of the intakes. High turbidities occurred mostly during witner months and are associated with winter runoff.

Assessment of Contaminant Loads

Since only minimal amounts of data on *Giardia*, viruses or *Cryptosporidium* occurrence in the American River Wateshed is available, the only way to assess the contaminant concentrations in the raw water is through a literature search of studies conducted in similar watersheds.

***Giardia* lambia--**

The presence of *Giardia* lambia cysts in public water supply sources has been documented in many areas of the United States. *Giardia* has been described as one of the most common etiological agents contributing to outbreaks of waterborne gastroenteritis. Studies investigating the concentration of cysts in untreated water supplies indicate a correlation of cyst concentration with the nature and magnitude of sources of cyst contamination in the watershed. Examination of streams has shown that the frequency of cyst discovery is directly related to the intensity of human activity in these areas. In remote protected watersheds, there seems to be a correlation between cyst concentration and animal population. Unfortunately, there is no formula to correlate watershed activities to cyst concentration; additional research is needed to define this relationship.

A study conducted during 1984-1986 in streams in the Sierra Nevada can provide the best estimate as to expected cyst concentration in the American River.

Water samples were collected from 74 sites in streams in the Sierra Nevada in a study conducted by Dileanis and Riggs.[1] Two types of sample sites were selected based on the amount of recreational use in the basin. In samples collected downstream from areas with high recreational use, 44.9 percent of the samples were positive for *Giardia* cysts. In samples collected downstream of low recreational use, 17.2 percent of the samples were positive for *Giardia* cysts. The median level of cyst concentration detected in both watersheds was 2 cysts in 100 gallons or 0.5 cyst/100 L. In a study which HDR has conducted in the Tahoe Basin, samples were collected in creeks tributary to Lake Tahoe. Creeks were sampled during spring, fall and summer. The highest cyst concentrations occurred during the summer months ranging from 0 to 3.3 cyst/100 gal or an average of 1 cyst/100 gallons or 0.3 cyst/100 L.[8]

In a study conducted by Jerry E. Ongerth on three pristine rivers in the Pacific Northwest, *Giardia* cysts were found in 43 percent (94 out of a total 222) of the samples. The *Giardia* cyst concentration was in the range of 0.05 to 1.0/L. That study concluded that cysts appear to be continuously present at low concentrations even in relatively pristine rivers.[2]

A study by Joan B. Rose, Charles P. Gerba and Walter Jakubowski, Occurrence of *Cryptosporidium* and *Giardia*[12] was evaluated in 257 water samples from 17 states. *Giardia* cysts were found in 16 percent of the samples at an average concentration of 3 cysts/100 ml. In California 14 river samples and seven lake samples were tested. Only one river sample was positive (7 percent of samples). The cyst concentration in that sample was 12 cysts/100 ml, the source water was classified as pristine. There were no positive samples for *Giardia* in the lake water sampled.

These studies lead us to believe that *Giardia* cysts will be present in American River water. However, we expect the *Giardia* cysts concentration to be low. And that the allowable daily average cyst concentration (geometric mean) will not exceed 1 cyst/100 L. The few samples analyzed for Arcade Water District and the City of Sacramento were all negative for *Giardia* cyst presence.

Cryptosporidium--

In the last several years, *Cryptosporidium* has been recognized as an important microbial contaminant of water. *Cryptosporidium* is a protozoan parasite of animals and humans and a cause of acute diarrheal disease. The epidemiology and transmission of *Cryptosporidium* are similar to *Giardia*. Studies on the occurrence of *Cryptosporidium* in water suggest that it is more prevalent than *Giardia* cysts. *Cryptosporidium* is not regulated by the SWTR. The U.S. EPA is evaluating data available, and could impose additional requirements on surface water systems if it found that current requirements are not adequate to control *Cryptosporidium*.

A report by Joan Rose reports results of 107 surface water samples collected in six western states. Of the samples collected, 77 (72 percent) were positive for the presence of *Cryptosporidium* oocysts. Results of that study are included in Tables V-5 and V-6.[4]

Average cyst concentrations in waters without waste discharges were low in the California streams. The concentration was 0.04 oocyst/L. The geometric mean of oocysts concentration in lakes and streams in the western United States was 0.91 and 0.94 oocysts/L, respectively.

A study conducted by J.E. Ongerth and H.H. Stibbs reported results of sampling conducted in Washington state and California. Six rivers were sampled, and *Cryptosporidium* oocysts were found in each of the two river water samples examined. Concentrations ranged from 2 to 112 oocysts/L. In the California rivers sampled concentrations ranged from 2 to 28 oocyst/L.[3]

In another study conducted by Joan B. Rose, Charles Gerba and Water Jabukowski[12], 14 river sampels and seven lake samples were tested for *Cryptosporidium* oocysts in California. Six of the river sampels (43 percent) and seven of the lake samples (100 percent) were positive for *Cryptosporidium*, the average oocyst concentrations were 4 and 6 oocysts/100 ml, respectively. Overall *Cryptosporidium* oocysts were detected in 55 percent of surface water samples at an average concentration of 43 oocysts/100 ml.

Table V-5. *Cryptosporidium* Oocyst Concentrations in Environmental Samples[1]

State	Types of Water	Number of Samples	Number of Samples Positive	Oocyst/L Average
Arizona	Treated effluent	20	15	489
	Raw sewage	5	5	1732
	Streams[2]	9	8	18
California	Streams	3	1	0.04
Colorado	River[2]	2	2	0.12
	Treated effluent	2	2	4.0
Oregon	Streams	6	5	0.05
Texas	Reservoirs[2]	6	6	1.1
	Raw Sewage	6	4	4.1
Utah	Lakes and streams[2]	48	34	8.9
Total		107	82	

[1]Rose, J.B., J. AWWA, February 1988.
[2]Receiving sewage discharges.

Table V-6. Occurrence of *Cryptosporidium* Oocysts in Various Waters Throughout the Western United States[1]

Water Sampled	Number of Samples	Number of Samples Positive	Percent Positive	Oocyst/L[2]
Raw sewage	11	10	91	28.4
Treated sewage[3]	22	20	91	17
Reservoir, lake	32	24	75	0.91
Stream, river	58	45	77	0.94
Filtered drinking water	10	2	20	0.001
Nonfiltered drinking water	4	2	50	0.006

[1]Rose, J.B., J. AWWA, February 1988.
[2]Geometric means.
[3]Activated sludge.

Additional studies all indicate that *Cryptosporidium* may be present in source waters at higher frequency than *Giardia* cysts. Both domestic wastewater discharges and runoff containing animal wastes can contribute to the contamination.[5,13]

In the samples analyzed for Arcade Water District two samples were positive for oocyst. The oocysts concentrations in these samples were 0.43 oocysts/100 L and 0.36 oocysts/100 L.

Not enough data are currently available to predict the concentration of *Cryptosporidium* oocysts in the American River water, and at present there are no regulatory requirements as to the treatment required.

Viruses--

Studies have shown that enteric viruses can be isolated from surface water supplies. Most of these viruses enter the water through discharge of domestic wastewater. Viruses are resistant to environmental degradation and will survive in the environment for extended periods of time. The occurrence of waterborne outbreaks of viral disease, such as hepatitis A, are also well documented.[9,10]

Since infected individuals can shed large quantities of viruses, human viruses have been detected in sewage effluent and in bodies of water receiving sewage effluent. Sewage treatment processes and effluent disinfection do not completely remove or inactivate viruses.

Human enteric viruses can survive in surface waters for long periods of time. Enteric viruses include polioviruses, coxackieviruses A and B, echoviruses and Hepatitis A virus. Other viruses of concern include the gastroenteristis virus group which include the Norwalk agent, rotaviruses, and others[11].

In water, virus survival rate is impacted by temperature, sunlight, pH, heavy metals, oxidizing agents and the microbiological content of the water. Turbidity and suspended particles shield viruses and protect them from environmental damage.

Viruses are not an integral part of the human micro flora, they are infectious agents with disease-producing capabilities. Their presence is an indication of an endemic or clinical condition in the population.

The quantity of viruses released into a water body is related to the total amount of sewage treatment plant effluent and septic tank overflows into the stream and to the health of the community. It has been demonstrated that a single infectious virus unit can infect a susceptible host.

The American River receives only a very limited amount of sewage effluent. There is only one wastewater discharger of interest in the South Fork, the City of Placerville. The city is permitted to discharge up to an average of 1.6 mgd during dry weather period. The permit limits total coliform in the effluent to a maximum 30-day median value of 2.2 MPN/100 ml. To meet these requirements, the effluent is filtered and disinfected.

In the North Fork sub-basin, the city of Colfax is permitted to discharge treated effluent into Smuthers Ravine. The permit is limited to a 30-day average dry weather flow of 0.13 mgd, and limits total coliform counts to a median of 23 MPN/100 ml for a 30 day period.

Septic systems exist throughout the watershed; there is no indication of widespread septic tank failure and if properly maintained they should not be a cause of concern.

Recreational activities can also contribute to viral contamination, especially if infected individuals do not follow sound sanitary practices.

As for *Giardia* and *Cryptosporidium*, the average concentration of viruses in the American River cannot be estimated. No virus sampling has been conducted to date in the watershed. However, because of (1) dilution rate (2) overall quality of the water and (3) degree of treatment provided by the water purveyors, it can be assumed that the viruses concentration in the stream is relatively low and that the water served to the community will comply with the requirements of the SWTR.

SUMMARY

- While utilities drawing water from the American River have analyzed their source water for total coliforms and turbidity, there is only minimal data on concentrations of *Giardia* cysts and *Cryptosporidium* oocysts and no virus analyses have been conducted.

- Not enough data is available at present to draw a correlation between activities in the watershed and concentrations of microbiological contaminants other than coliforms.

- Coliform and turbidity data available indicate that treatment provided by utilizing American River water and providing a 3 log *Giardia* cysts removal/inactivation and 4-log virus removal/inactivation will satisfy the requirements of the SWTR, until additional data for *Giardia* and *Cryptosporidium* is available.

- There are no requirements for *Cryptosporidium* removal/inactivation in effect at the present time. However, EPA is evaluating available data and may change treatment requirements in the event that *Cryptosporidium* is regulated.

SECTION V - REFERENCES

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7. Surface Water Treatment Staff Guidance Manual. Office of Drinking Water, California DHS. August 1990.

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13. LeChevallier, M.W., Norton, W.D., and Lee, R.G. Occurrence of *Giardia* and *Cryptosporidium* spp. in Surface Water Supplies. Appl. and Environ. Micro., September 1991.

SECTION VI

WATERSHED MANAGEMENT AND CONTROL PROGRAM

This section of the report describes existing programs which affect or interact with federal, state and local watershed management and recommends watershed management actions to enhance the microbiological quality of the American River and prevent future degradation. Since watershed management is not an enforceable requirement for water purveyors that provide filtration, the approach taken to designing a long term program was based on consensus building. The goal was to develop best management practices which are economically feasible and within the legal authority of the water purveyors.

The key activities in the watershed related to potential surface water contamination by pathogenic microorganisms include:

- Recreation
- Septic tanks
- Wild animals
- Grazing animals
- Wastewater discharges
- Storm runoff

Descriptions of the above items are contained in Section IV. Best management practices for mining, natural disasters, and transportation corridors are described in Section VII.

EXISTING CONTROLS AND MANAGEMENT PROGRAMS

Existing Controls

Federal Agencies--

There are six principal federal agencies with important roles and responsibilities relating to surface water quality protection in California. These are the U.S. Environmental Protection agency, the U.S. Forest Service, the Soil Conservation Services (a unit of the U.S. Department of Agriculture), the U.S. Geological Survey (a unit of the Department of Interior), the U.S. Army Corps of Engineers, and the Bureau of Land Management.

U.S. Environmental Protection Agency--The Environmental Protection Agency (EPA) is the agency responsible for overseeing most of the major federal regulatory programs which protect water quality aspects of the environment and public health. The acts which spawned the regulations include: the Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Resources Conservation and Recovery Act (RCRA), Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Toxic Substances Control, and Clean Air Act (CAA).

EPA has delegated many of the specific program activities to California pursuant to requests and upon implementation of legislative requirements. This has allowed the state some flexibility to tailor the program to meet local environmental needs. EPA continues to play a major role in overseeing California's performance in carrying out the delegated national programs which use federal grants, and in supporting the state through technical expertise and research.

California has been delegated primary responsibilities for programs under the Clean Water Act, the Safe Drinking Water Act, RCRA, the Clean Air Act and FIFRA. The authorities in the Acts are generally mirrored by comparable state legislation, and the delegated programs have provided essential funding support to assist strong state programs in water pollution control, public water supply regulation, air pollution control, and solid and hazardous waste management.

Not all elements of federal programs have been delegated. Examples of program authorities still reserved by EPA include:

- Although California has primacy and maintains a more comprehensive set of state drinking water standards, EPA may develop more stringent national drinking water quality standards and enforce them until the State adopts its own equivalent or more stringent standards.

- EPA may designate "sole source" aquifers under the Safe Drinking Water Act.

- EPA may control underground injection under the Safe Drinking Water act.

- EPA shares responsibility for registration of pesticides for use under FIFRA and may supersede the State's requirements. However, the state has veto power over EPA if it wishes to set more stringent requirements.

U.S. Forest Service (U.S. Department of Agriculture)-- The U.S. Forest Service, a division of the U.S. Department of Agriculture, directs the management of the Eldorado and Tahoe National Forests which together encompass all national forest land within the watershed. Management goals and activities that could improve or affect water quality aspects of public health concerns include:

- Provide a wide range of developed and dispersed recreational opportunities, to meet projected demands using the simplest most natural designs possible, to minimize public use impacts.

- Preserve quality wilderness lands for public use and appreciation of its unique characteristics.

- Manage the wild, scenic, and recreation rivers to preserve their free flowing characteristics and protect their outstanding recreational and aesthetic values.

- Preserve the integrity of the botanical, archaeological, geological, and recreational features for which special interest areas were established.

- Maintain and enhance populations of threatened and endangered wildlife and plant species and maintain viable populations of sensitive species. Provide a diverse habitat for all species, including harvestable game fish and wildlife.

- Maintain current levels of livestock grazing and take advantage of additional forage induced by even-aged timber management.

- Sustain a long-term timber yield by practicing the most intensive forms of timber management on the most productive sites. Increase yield by application of high utilization standards and scientific silvicultural growth techniques.

- Employ integrated pest management programs to minimize losses from forest pests and aid in reforestation and timber stand improvement.

- In areas susceptible to slope instability, develop management activities to avoid initiation or acceleration of slope movement.

- Prevent degradation or groundwater quality and develop groundwater sources to meet domestic, livestock and wildlife needs.

- Conserve or improve the inherent long-term soil productivity through the incorporation of soils information into land management decisions and through soil quality monitoring.

- Protect streams, lakes, wetlands and the riparian vegetation that surrounds them. Establish a permanent Streamside Management Zone to furnish shade, ground cover and natural environmental elements, which maintain high water quality and enhance

fish and wildlife habitat. Limit cumulative impacts on watershed within the National Forests.

- Induce moderate increases in water yield by direct watershed improvement projects, meadow rehabilitation and expansion projects, and snowpack manipulation associated with timber harvest practices in true fir timber stands.

- Provide a sufficient level of fire protection and treat natural and activity fuels to assure a continuous flow of projected outputs and amenities from the Forest.

Virtually all development activity on or requiring access over or through lands under the management of the Forest Service will require one or more "Use" or Authorization Permits. Timber harvesting, mining, and grazing are single out for "Specific Use" program permits. All other uses are considered "Special Use" and are generally subject to the Rules and Regulations specified in 36 CFR Part 251.50-251.64 exclusive.

Grazing and Livestock Use--All grazing and livestock use on National Forest System Lands and on other lands under Forest Service control must be authorized by a Grazing or Livestock Uses Permit. The Code of Federal Regulations (CFR) sets the rules under which livestock operations will be conducted in order to meet the multiple-use, sustained yield, economic, and other needs and objectives for the lands involved. Allotment Management Plans prescribe the manner in, and extent to which, these operations will be carried out on a site-specific basis.

Sale and Disposal of Timber--Trees, portions of trees, and other forest products on National Forest System lands may be disposed of for administrative use by sale or without a charge, as may be most advantageous to the United States. Most of the wood products that may be disposed of by administrative use are in the form of personal fuel wood permits subject to a maximum quantity set on each National Forest.

The Forest Service will insure that each permit for timber is consistent with applicable land and resource management plans and environmental quality standards. The key factors include:

- Fire protection and suppression.
- Minimizing additional soil erosion.
- Insuring favorable conditions of water flow and quality.
- Protection of residual timber.
- Regeneration of timber.

The Code of Federal Regulations prescribes the manner in and extent to which timber sales and uses will be conducted and specifies the conditions of the sale or use and/or the cancellation of same.

Mineral Exploration and Mining and Leasing Activities--Title 36, Section 228 of the Code of Federal Regulations sets the rules and procedures through which the surface of National Forest System Land may be used in conjunction with operations authorized by the United States Mining and Mineral leasing laws, and the sale of mineral materials. Hard rock mineral leasing on National Forest System administered lands is subject to 43 CFR 3500.

The minerals authorities are grouped into three broad categories: locatable, salable, and leasable. Locatable minerals are those like gold, silver, copper, and other minerals of rate occurrence or specialized value that are available for exploration and development by mining claims under the Mining Law of 1872. Salable minerals are the common varieties of sand, gravel, stone, and cinders and other minerals of widespread occurrence, which are available under a contract sale or permit from the Forest Service,. The leasable minerals are oil and gas, geothermal steam, potash, phosphate, sodium, and similar minerals, and are available through a lease from the United States Department of the Interior. The Forest Service regulates the surface uses associated with these leases.

The procedural requirements generally provide that a Notice or Plan be filed with the Forest Service District Ranger by any person proposing to conduct operations which might cause disturbance of the surface resources. For locatable (mining claim) operations, a Notice of Intent should include enough information about the proposed activity to allow the District Ranger to identify the area involved, the nature of the proposed operations, the route of access to the area and the method of transport. If the District Ranger determines that such operations will likely cause significant disturbance of surface resources, the operator will be required to subject a more detailed Plan of Operations, which must include: the type of operations proposed and how the operations will be conducted; a description of the type and standard of the existing or proposed roads or access routes; identification of the means of transportation to be used in connection with the operations; the time period during which the activity will take place; and the measures to be taken to meet the requirements for protection of air quality, water quality, scenic values, solid wastes, fisheries and wildlife habitat, roads and for reclamation of the site.

Proponents for operations under the salable minerals laws must submit an Operating Plan to the District Ranger for prior approval. The Plan must include, as a minimum, a map and explanation of nature of the access, a description of the anticipated activity and surface disturbance, and the intended reclamation including the removal or retention of structures and facilities.

Activities on the National Forests for the exploration and development of leases from the Department of the Interior must be initiated with the Department of Interior. The Forest Supervisor will review proposed operating plans from the USDI, and shall advise the USDI of the terms and conditions required for the protection of surface resources. The Forest Supervisor will also monitor those approved operations for compliance with stipulations.

All uses of National Forest System land, improvements, and resources, except those provided for in Sections 222, 223, and 228 are designated "Special Uses," and must be authorized by an authorizing officer.

Recreational Special Uses--Recreation special use authorizations are issued to private parties, groups, other public agencies, public and private institutions, and private business that provide accommodations and services on NFS land. The kinds of recreation activities requiring permits generally fall into one of three categories:

- Private uses, such as recreation residences (in this category, permits are not required for non-commercial use or occupancy of the national forests for camping, picnicking, hiking, fishing, hunting, horse riding, boating or similar recreational activities).

- Semi public non-commercial services, such as fishing tournaments, and other group events.

- Commercial services provided for the benefit of the general public.

U.S. Geological Survey (U.S. Department of Interior)--The second federal agency with major responsibilities relating to water resources and water quality in California is the U.S. Geological Survey - Water Resources Division (USGS-WRD). The mission of the USGS-WRD, which is a non-regulatory agency, is to develop and disseminate scientific knowledge and understanding of the Nation's water resources. In cooperation with federal, state and local agencies, the USGS-WRD maintains a monitoring network for collection of river and streamflow data, and water quality information and conducts interpretive investigations of the surface and groundwater resources in the state. The USGS-WRD maintains extensive database computerized files containing the information and also publishes data reports periodically.

The USGS-WRD will provide technical support to protection programs by providing water resources and water quality data and through participation in cooperatively funded investigations. Watershed investigations include studies of the hydrogeology and water quality of the watershed surface waters and identification of sources of contamination within the watershed.

Soil Conservation Service (U.S. Department of Agriculture)--The Soil Conservation Service (SCS) has a similar role and responsibilities to that of the Geological Survey, but for soils instead of water. SCS provides technical information and advice to best management practices for agriculture, vegetation management, and soil conservation. SCS publishes county soils maps and technical reports describing the nature and erodibility of soils. The service also participates in scientific studies and offers advisory technical services to individuals, firms, organizations and interagency cooperative investigations. Investment in the service's technical input and participation should produce returns in preventing the release of potentially harmful constituents and turbidity inducing sediment loads into the raw drinking water supplies.

U.S. Army Corps of Engineers (U.S. Department of the Army)--Any person or public agency proposing to locate a structure, excavate, or discharge dredged or fill material into waters of the United States must obtain a U.S. Army Corps of Engineers' permit. Typical activities requiring permits include the construction or installation of artificial canals, artificial islands, boat ramps, breakwaters, bulkheads, dams, dikes, weirs, groins and jetties, intake pipes, levees, mooring buoys, outfall pipes, overhead power crossings, pipes and cables, piers and wharves, riprap, road fills, signs, and tunnels; or activities that result in dredging or filling, or the discharge of sand, gravel, dirt, clay, and stone.

The Federal Rivers and Harbors Act of 1899, and Section 404 of the Clean Water Act grant to the Army Corps jurisdiction over all navigable waters within the United States. Recent legislation and court decisions have expanded the legal definition of navigable waters to include marshes, swamps, and diked lands, even though they may not, in fact, be navigable.

Criteria for Evaluation--The decision whether to grant or deny a permit is based on a public interest review of the probable impacts of the proposed activity and its intended use. Benefits and detriments are balanced by considering effects on such concerns as: conservation, economics, wetlands, fish and wildlife values, flood hazards, navigation, water quality and the needs and welfare of the people. In addition, projects involving discharge or

dredge or fill material must comply with the Section 404(b)(1) guidelines prepared by the Environmental Protection Agency. The guidelines restrict discharges into aquatic areas when there are less environmentally damaging, practicable alternatives. Reasonable and practicable mitigation of unavoidable impacts will be required. A permit will be granted unless the project is found to be contrary to the public interest or fails to comply with the guidelines.

The Corps of Engineers is required by federal law to consult with state and federal wildlife agencies regarding any impacts of a project on aquatic habitats.

U.S. Bureau of Land Management (U.S. Department of Interior)--Virtually all development on or requiring access across lands under the management of the Bureau of Land Management (BLM) will require one or more "use" authorization permits issued by the BLM.

Mineral Program

A. Locatable Minerals

When locating a mining claim on any open federal lands (BLM/Forest Service) in California, notification must be provided by recording the location notice with the BLM. Surface disturbing activities require the submission of a "plan" or "notice" to BLM or Forest Service for their review and issuance of a permit (43 CFR 3802 or 3809).

B. Leasable Minerals

Coal, phosphate, sodium compounds, potash (potassium) compounds or public lands or "hardrock" minerals on acquired lands are available by lease (43 CFR 3400 and 3500).

C. Salable Minerals

Sand, gravel, fill, decorative stone, construction aggregate are issued for fair market value under contract from BLM (43 CFR 3600) except that municipalities may receive such materials free of charge.

Oil and Gas and geothermal leases are also available through BLM.

Forestry Program

A. Timber Resources

A contract is required for removal of timber and other vegetation resources for commercial or domestic use. Timber includes sawtimber, fuelwood, poles, posts, and any standing trees, down trees and logs capable of being measured in board feet. Other vegetative resources include Christmas trees, cones, boughs, manzanita, moss, and many other unspecified products all of which are salable.

B. Road Construction and/or Hauling

New road construction or commercial hauling of private timber across BLM land requires a right-of-way grant from BLM.

Lands and Programs

Uses and projects requiring right-of-way grants or temporary use permits include access roads, utility lines, communication sites, or any other uses that involve the placement of either temporary or permanent improvements upon BLM lands. In addition, any activity that involves physical disturbance to the land or vegetation requires a permit, e.g., brush removal or test hold drilling. Other long-term occupancy or use of BLM land may also be authorized by a lease. Applications must be filed with the local BLM office. The use of BLM lands for grazing of any livestock requires a grazing lease.

State Agencies: General Responsibilities--

There are a variety of state agencies with interests and responsibilities relating to surface water resources and groundwater and activities could affect their quality or availability.

California Environmental Protection Agency; State Water Resources Control Board and Central Valley Regional Water Quality Control Board--The Owner or operator of any facility that is currently discharging or will be discharging waste into any surface waters of the state must obtain waste discharge requirements. These requirements serve as a federal National Pollutant Discharge Elimination System (NPDES) Permit from the Regional Water Quality Control Board (Regional Board) in the project area.

Waste Discharge Requirements

The Owner or operator of any facility or activity which discharges or will discharge waste that may affect groundwater quality or from which waste may be discharged in a diffused manner (e.g., erosion from soil disturbance) must first obtain waste discharge requirements from the Central Valley Regional Water Quality Control Board (Regional Board).

The Regional Boards issue NPDES permits and adopts waste discharge requirements to protect the waters of the state for all designated beneficial uses in the watershed. The State Water Resources Control Board (SWRCB) and Regional Boards seek to attain the highest possible water quality in the state. Examples of activities that may require an NPDES permit include:

- Feedlots for cattle, swine, sheep, goats, horses, turkeys, chickens, and ducks.
- Sewage treatment plants.
- Stormwater runoff discharges (municipal, industrial, and construction).
- Dredge spoils discharges.
- Mining activities.
- Groundwater discharge operations.

Examples of the types of wastes that may require waste discharge requirements are:

- Drainage from agricultural operations.
- Drainage from waste materials in landfills.
- Flow or seepage containing debris or eroded earth from logging operations.
- Drainage from inoperative and abandoned mines.
- Waste from construction or dredging operations.
- Food production and processing wastes.
- Waste from manufacturing and refining operations.
- Municipal and industrial wastes, if percolation or injection to groundwater are the disposal methods.

The discharge of waste into a municipal sewer system is not usually subject to waste discharge requirements. However, the United States Environmental Protection Agency (EPA), the State Board, the Regional Boards, and the local wastewater management agency may require some industries to pretreat hazardous wastes prior to discharge to the municipal sewer system. The local wastewater management agency will notify the industry of the requirements. Waste disposal by injection well may also be subject to a Federal Underground Injection Control Program permit issued by the EPA.

The Regional Board evaluates the "Report of Waste Discharge" to determine whether the proposed discharge is consistent with the Regional Board's adopted water quality standards, the Areawide Waste Treatment management Plan ("208"), and the Water Quality Control Plan (Basic Plan) for the area in which the proposed activity is located, and "Chapter 15" regulations, if applicable.

When adopting waste discharge requirements, the Regional Board sets pollutant limits (effluent limitations) on each discharge as a condition of approval. Monitoring the compliance with the limitations ensures that the discharge will not harm beneficial uses, such as public water supplies, agricultural and industrial water use, wildlife habitats, or any water-related activity.

Stormwater Permits

Discharges composed entirely of industrial stormwater runoff may be eligible for coverage under a General Industrial Stormwater Permit issued by the State Water Board rather than an individual permit issued by the appropriate Regional Water Board. Eligible activities include:

- Facilities subject to stormwater effluent guidelines (40 CFR subchapter N).
- Manufacturing facilities.
- Mining facilities.
- Hazardous waste treatment, storage, or disposal facilities.
- Landfills, land application sites, and open dumps that receive industrial waste.
- Recycling facilities such as metal scrap yards, battery reclaimers, salvage yards, automobile yards.
- Transportation facilities.
- Sewage treatment plants.
- Certain facilities if materials are exposed to stormwater.

The State Water Board has also developed a General Construction Activity Stormwater Permit for stormwater runoff associated with any construction activity including clearing, grading, excavation reconstruction, and dredge and fill activities that result in the disturbance of at least five acres of total area.

Underground Tanks

The underground tank law established state regulations requiring permits to be issued by the Regional Water Quality Control Board to underground tank owners.

A developer-applicant will need this permit if they own, operate, or intend to construct an underground storage tank containing a hazardous substance.

All new underground storage tanks must provide primary and secondary containment for the hazardous substances stored. The primary container must be product-tight under all circumstances (i.e., impervious to the substance contained in it).

Secondary containment must be constructed to prevent structural weakening as a result of contact with any released hazardous substances, and also shall be capable of storing the hazardous substances for the maximum anticipated period of time necessary for the recovery of any released hazardous substance. An access casing is required in the secondary container for installation of the monitoring system to detect unauthorized releases and provide a conduit for removal of the hazardous substance.

Existing Underground Storage Tank Monitoring

Statewide standards have been established for monitoring underground storage tanks that store hazardous substances to protect water quality. The objective of the monitoring program is to detect any unauthorized release from any portion of the underground storage tank system at the earliest possible opportunity.

In the event monitoring indicates an apparent unauthorized release has occurred, the actions to be taken will be governed by the provisions of Chapter 16 of Division 3, Title 23, California Code of Regulations, which regulates underground tanks.

Release Reporting Requirements

Specific procedures are required for reporting unauthorized releases. All unauthorized releases must be reported by underground storage tank owners or operators to local agencies.

Repair and Upgrade Requirements

A non-pressurized underground motor vehicle fuel storage tank may be repaired once by the operator. The tank owner must demonstrate to the local agency that all of the problems have been identified and that the proposed repair will correct them. A test or inspection must be performed to determine if the underground storage tank is structurally sound. Repairs are required to be performed, using accepted engineering practices, with materials that are compatible with the underground storage tank and with the hazardous substance(s) being stored. All repaired tanks must be retrofitted with cathodic protection and overspill prevention. Following the repair, the underground storage tank owner must demonstrate that the repair was successful and that the underground storage tank will meet the applicable containment.

Certain specific actions and evaluations must be completed by the underground storage tank owner when the underground storage tank is either temporarily or permanently taken out of service. Temporary closure allows an underground storage tank to be taken out of service for up to one year without implementing permanent closure. Leaking underground storage tanks must be repaired or permanently closed.

California Environmental Protection Agency, Department of Pesticide Regulation--

Restricted Materials Permits

Any property owner or operator who wishes to use a pesticide designated as a "Restricted Material" on a specific crop or site must first obtain a permit from the county agricultural commissioner (GAC). A list of restricted materials is found in Title 3, California Code of Regulations, Section 6400. Restricted materials are those pesticides which the Director finds to be a potential hazard to public health, pesticide applicators, field workers, domestic animals, crops, or to wildlife and the environment in general. The GAC enforces pesticide laws and regulations at the local level. Each GAC, prior to issuing a permit to possess or use

a restricted material, shall determine if a significant adverse environmental impact may result from the use of the pesticide.

There are two types of permits an applicant may obtain. The first is an agricultural permit which is to be used for agricultural purposes such as the production of food, feed and fiber, golf courses, parks, cemeteries, or right-of-ways. The second type of permit is for non-agricultural uses which include industrial and institutional uses.

Department of Fish and Game--

Lake/Streambed Alteration Agreement

Any person, governmental agency, or public utility proposing any activity that will divert or obstruct the natural flow or change the bed, channel or bank of any river, stream, or lake, or proposing to use any material from a streambed, must first notify the Department of such proposed activity. Based on the information submitted by the applicant and a possible field inspection, the Department will negotiate a Lake/Streambed Alteration Agreement with the applicant designed to protect and conserve the fish and wildlife resources of the waterway.

The notification requirement applies to any work undertaken within the 100-year flood plain of a body of water or its tributaries including intermittent streams. As a general rule, however, it applies to any work undertaken within the annual high-water mark of a stream, or lake which contains, or once contained, fish and wildlife, or supports, or once supported, riparian vegetation.

The Department of Fish and Game bases its evaluation of a Notification of a proposed lake/ streambed alteration on the anticipated impact of the proposed project on fish and wildlife resources. Consequently, the Department will write the Lake/Streambed Alteration Agreement with terms and conditions designed to protect and/or compensate for these resources.

Standard and Special Suction Dredging Permits

Anyone proposing to use suction or vacuum dredging equipment with an intake diameter of 8 inches or less in any river, stream, or lake designated as open for dredging must obtain a standard suction dredging permit from the Department of Fish and Game.

The state and regional offices of the Department of Fish and Game regulate the use of suction and vacuum dredging equipment to maintain a stable environment for fish life and wildlife resources in California's waters. The State also has jurisdiction over waters flowing across federal land.

The Department of Fish and Game will not issue a suction dredging permit if the proposed dredging activity will harm fish. In addition, the Department will not issue a permit for dredging in any national forest or in any national, state, county, or municipal park if the agency in control of the forest or park has prohibited dredging in its jurisdiction.

In addition to the county restrictions, the following river reach restrictions also apply:

AMERICAN RIVER (SACRAMENTO COUNTY). From the mouth upstream to Nimbus Dam is Zone A.[1]

AMERICAN RIVER, NORTH FORK (EL DORADO AND PLACER COUNTIES). From Folsom Reservoir to 1,000 feet upstream from the Colfax Iowa Hill Bridge is Zone F. From

[1]Zone A waters are closed to all dredging activities.

1,000 feet upstream from Colfax Iowa Hill Bridge to Health springs (T16N, R14E, S26) is Zone A. Recreational dredging is allowed in Auburn State Recreation Area on an interim management basis.

AMERICAN RIVER, MIDDLE FORK (EL DORADO AND PLACER COUNTIES). From its junction with the North Fork and the American River upstream to the confluence with the Rubicon River is Zone F.[2] Recreational dredging is allowed in Auburn State Recreation Area on an interim management basis.

AMERICAN RIVER, NORTH FORK OF THE MIDDLE FORK (PLACER COUNTIES). From its junction with the Middle Fork of the American River upstream to the bridge on the Michigan Bluff (Deadwood) Last Change Trail (T15N R12E S32) is Zone F.

AMERICAN RIVER, SOUTH FORK (EL DORADO COUNTY). From Folsom Reservoir upstream to the Highway 50 crossing at Riverton is Zone F.

AMERICAN RIVER SOUTH FORK TRIBUTARIES (EL DORADO COUNTY). All tributaries to the South Fork of the American River from Folsom Reservoir upstream to Chili Bar Bridge (T11N R103 S35) are Zone F, except Weber Creek above Highway 50 crossing which is Zone C.[3]

Anyone proposing to use suction or vacuum dredge equipment with an intake diameter over 8 inches in any lake, stream, or river in the state must obtain a special suction dredging permit from the Department of Fish and Game. In addition, anyone proposing to use suction or vacuum dredge equipment of any size in the area designated as closed by the Department must also obtain a special suction dredging permit. The Department maintains a list of open and closed waters. The State has jurisdiction over waters flowing across federal

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[2]Zone F waters are open to dredging throughout the year.

[3]Zone C waters are open to dredging from June 1 through October 15.

land. The five regional Fish and Game offices regulate the use of suction and vacuum dredge equipment to maintain a stable environment for fish and wildlife resources in California's waters.

California Department of Forestry and Fire Protection Timber Harvesting Plans--
Timber owners or operators who propose to cut and remove solid-wood forest products of designated live commercial forest trees from non-federal timber lands must first submit a timber harvesting plan to the Department of Forestry and Fire Protection for approval. Timber owners include persons who own timber, or timber rights on lands owned by another party. Solid-wood forest products include sawlogs, veneer logs, poles, pilings, timbers, posts, tanbark, chips, fuelwood, split products, root-crown burls, and pulplogs. Timberland is non-federally owned land capable of bearing designated commercial forest tree species. Designated commercial forest tree species vary between regions. Timber operators or owners should contact regional offices of the Department of Forestry and Fire Protection in the area of the proposed timber operations to determine what lands are timberlands.

The Department of Forestry and Fire Protection approves timber harvesting plans to assure that timber operators carry out their activities in keeping with the goal of maximum, sustained timber production while considering maintenance of recreation, watershed, wildlife, range, forage, and fisheries.

Timberland Conversion Permit

Any person who owns timberlands which are to be devoted to uses other than the growing of timber, or who applies for immediate rezoning from Timberland Production Zone (TPZ) whether timber operations are involved or not, must obtain a Timberland Conversion Permit from the Director of Forestry and Fire Protection. Examples of activities requiring a timberland conversion permit include development of a ski area or other development of recreational facilities, the construction of a housing development, changing timberland to grazing land, or applying for immediate rezoning from TPZ.

The Director of Forestry and Fire Protection evaluates applications for timberland conversion permits to assure that the proposed timberland conversion meets the requirements of the Forest Practice Act, related Board of Forestry regulations, and provisions, rules, and regulations requiring stocking for continued forest production, or to enable a county to finalize approval of immediate rezoning from TPZ.

Owners proposing a conversion of a timber stand of less than three acres within a single ownership to other uses need not obtain a timberland conversion permit if the conversion conforms to the local general plan and zoning ordinances. Timber owners may not use this exemption more than once for a parcel in a single ownership. Public agencies proposing to convert timberland to construct rights-of-way across public property and landowners granting easements for, or constructing and maintaining utility transmission lines need not obtain a timberland conversion permit.

Additionally, a landowner who has satisfied all local CEQA requirements for a subdivision development is exempt from a Timberland Conversion Permit.

Department of Health Services Environmental Health Division--

Medical Waste Treatment Facility Permits

Any person who provides offsite treatment of medical waste as defined by the Medical Waste Management Act (Health and Safety Code Division 20, Chapter 6.1) must obtain a permit to operate from the Department of Health Services (DHS).

Any person that is a large quantity generator providing onsite treatment of their own medical waste is required to obtain a permit pursuant to that same section of the California Code of Regulations (CCR).

Any person who operates a transfer station for the management of medical waste as described in the Medical Waste Management Act (MWMA) and CCR must obtain a permit

to operate from DHS. Medical waste is defined as being composed of bio-hazardous waste or sharps waste generated or produced as a result of:

- Diagnosis, treatment, or immunization of human beings or animals.
- Any research pertaining thereto.
- The production or testing of biologicals.

Types of facilities that require medical waste facility permits are:

Treatment-Onsite treatment facilities (greater than 200 pounds per month) or offsite treatment facilities which perform any treatment processes such as:

- Incineration.
- Steam sterilization.
- Other alternative medical waste treatment methods which are approved by DHS.

Transfer station-This is an offsite location where medical waste is loaded, unloaded, or stored during the normal course of transportation of the medical waste. Transfer station does not include common storage facilities, large quantity generators which are used for the purpose of consolidation, or onsite treatment facilities.

Persons desiring to transport medical waste must file an application for registration with the California Environmental Protection Agency's Department of Toxic Substances Control.

BEST MANAGEMENT PRACTICES

Land-use and structural controls implemented by water utilities and other agencies with jurisdiction in the watershed comprise the building blocks of a watershed protection program. This section reviews and describes some of the more commonly used protection measures, or best management practices (BMPs) with potential applicability in the American River watershed. Because surface water supplies can be affected by a broad range of lan

uses, the description of protection measures has been divided into several categories: (1) general watershed protection measures common to a variety of land uses, (2) agricultural best management practices, (3) forestry best management practices, (4) urban nonstructural controls, and (5) urban structural controls. Material for this section was drawn largely from a recent report by the American Water Works Association Research Foundation entitled "Effective Watershed Management for Surface Water Supplies," 1991. Finally, the section concludes with a matrix of measures that appear feasible to adopt in the American River watershed.

Structural controls are specific capital improvements designed to filter, detain, or reroute contaminants carried in surface runoff. Nonstructural controls utilize land-use planning, land-use regulations, and land ownership tools to eliminate or minimize sources of contamination in a watershed.

General Watershed Protection Measures

Buffer Zone Protection--

The most sensitive portions of water supply watersheds are those areas immediately adjacent to streams and reservoirs. Development activity within and adjacent to watercourses can degrade water quality by increasing the availability and transport of pollutants. Retention of vegetated, undisturbed buffers along watercourses is one of the most effective practices used to protect water supplies.

Buffer zones are commonly created in two ways: (1) the utility, municipality, or other cooperating jurisdictions acquires the buffer area, or (2) development or other land management activity within the buffer zone is restricted.

Monitoring and experience have shown that even small, intermittent, and ephemeral streams have a significant effect on downstream water quality. In addition, poorly treated stormwater discharges often bypass, or "short-circuit," vegetative buffers, particularly when runoff is

routed directly to receiving waters through storm sewers, culverts, and other confined drainage courses.

Reservoir Use Restrictions--

Reservoir-use restrictions can be considered part of a watershed protection program because policies for recreational use of public water supplies are frequently connected with land-use controls in the rest of the watershed. With the exception of water supplies drawn from multipurpose impoundments managed by agencies such as the Corps of Engineers and Bureau of Reclamation, reservoir-use restrictions are one of the few control measures usually within the jurisdiction of water utilities.

Cause-and-effect relationships between recreational use and water quality contamination in surface water sources are difficult to establish because of the difficulty in maintaining an adequate sampling control. Without conclusive monitoring studies of recreational impacts, it is recommended that water utilities continue to impose restrictions on recreational use of public water supplies to minimize the risk of biological contamination and hazardous spills.

Land Acquisition--

The most effective way to guarantee protection of surface water supplies is the utility or jurisdictions to acquire most or all of the land in the watershed. Although public agencies can often apply their power of eminent domain to condemn private property, purchase of large tracts is no longer feasible in most instances because of political opposition and the high capital costs of land.

Land acquisition is often used as a last resort when regulatory or voluntary controls are not available or are considered ineffective.

Sign Posting--

Signs have been widely used by water utilities and their cooperative jurisdictions as a notification tool for protecting water supplies. Their most common use is for posting

watershed property against trespass. Signs can be posted along legal property boundaries, physical drainage boundaries, or along travel routes such as roads and trails.

Signs are also helpful for communicating special regulations for watershed lands that are open to the public but subject to restrictions. They can be used to alert the public or road maintenance crews about special regulations that pertain to a watershed or simply carry a general message about the need to protect water supplies. In regions where extensive use of road salt is a water quality concern, signs can be used to alert state and municipal road crews that alternative deicing methods should be employed. Pesticide spraying restrictions along state highway right-of-ways also can be indicated with "spray" "no-spray" zoning signs.

Written Agreements--

Written agreements with public and private landowners in the watershed can provide formal, legal bases for specific watershed controls that are not otherwise provided through existing land-use regulations or land ownership. EPA has placed an increased emphasis on written agreements by explicitly including them among the criteria in the Surface Water Treatment Rule for determining whether public surface water systems may be allowed to remain unfiltered. The final rule states that in order for an unfiltered system to avoid the requirements for mandatory filtration, it "must demonstrate through ownership or written agreements with landowners in the watershed, or a combination of both, that it controls all human activities which may have an adverse effect on the microbiological quality of the source water" (EPA 1989a).

Plan Review--

For lands outside the direct control of water utilities, one of the most effective ways to protect water supplies is for the utility to participate in the process of reviewing land-use activities that could potentially degrade water quality. This is accomplished by reviewing permits, plans, designs, or other documents that are required by regulations and policies. In watersheds threatened by urban development, plan review could involve review of plans and permits for activities such as residential development, structural BMPs, water and sewer service, and septic system construction.

Watershed Inspection Programs--

An important component of any effective watershed protection program is field inspection. Frequent, routine inspections of the watershed are needed to identify sources of contamination and determine the effectiveness of control measures. Ideally, watershed inspection should be coupled with a sampling program in order to document water quality impacts and help quantify the effectiveness of structural and nonstructural controls.

Legal Action--

When local governments have exhausted the police powers available under existing regulations, an option for protecting water supplies is to pursue legal action. Threats to water quality can be addressed either through administrative actions or court suits. Administrative actions involve protests or similar actions taken through government channels when existing regulations are not properly enforced or do not provide sufficient protection. Court suits are used if a government agency, landowner, or other party continues to ignore regulations or when land-use actions endanger public water supplies. Although legal actions are not always successful, they can increase public scrutiny and help to focus attention on the need to protect water supplies.

Public Education and Participation--

Public education and community involvement programs may play a valuable role in a watershed protection program. Citizens and property owners need to understand the objectives of the watershed protection program, the benefits to the community and to themselves, and ways in which they can participate. Public awareness affects the acceptability of mandatory controls, the effectiveness of voluntary measures, and the level of support provided by elected officials. A public education campaign can improve the feasibility of a plan and is often critical for successful implementation of an effective watershed protection program.

Agricultural Best Management Practices

Agricultural nonpoint sources of pollution include both irrigated and nonirrigated crop production, pasture land, feedlots, and animal-waste management areas. Surface water supplies that drain from agricultural areas may be degraded by erosive tillage practices, alteration of riparian areas, fertilizer and pesticides, or poor waste management practices. The approach taken by the federal Water Pollution Control Act (PL 92-500) and amending legislation called for source management, rather than collection and treatment of pollutants, as the preferred method for controlling agricultural nonpoint pollution. Agricultural best management practices have been developed to address this need and include a variety of structural and nonstructural methods designed to protect soil and water resources.

Conservation Tillage--

Conservation tillage systems are farming practices that retain crop residues (stalks, stems, and roots) on the surface of cultivated croplands after harvest. They protect the soil surface from erosion, helping to maintain good soil structure, reduce soils compaction, and improve soil properties such as aeration and infiltration.

Contour Farming--

Where feasible, contour farming is a method of tillage, planting, and cultivation on the contour that can reduce sheet and rill erosion. The practice is most applicable on land with a 2 percent to 8 percent slope, where its effectiveness for controlling phosphorus and sediment export is rated as fair and good, respectively (USEPA 1987b). Contour stripcropping is similar to contour farming but differs in that strips of close-growing vegetation (such as meadow grasses) are planted between strips of production row crops. The sediment-trapping characteristics of contour stripcropping allow it to be used on slopes approaching 15 percent. On steeper slopes, its effectiveness is similar to or slightly better than that of contour farming (USEPA 1987b). Both methods must be practiced each year to maintain their effectiveness.

Terraces--

Terraces may be used on long slopes of up to 12 percent. They may consist of small earth embankments, channels, or a combination of ridges and channels constructed on the contour. The ridge of the terrace is designed to guide surface water to a controlled outlet. The outlet may be either a grassed waterway or an underground drain that carries water to a ditch or creek. Terraces reduce slope length by breaking the slope into near-horizontal slopes and are used to reduce sheet and rill erosion and prevent development of gullies. Terraces are used where contouring, contour strip cropping, or conservation tillage along cannot provide sufficient soil protection.

Grassed Waterways--

A grassed waterway is a natural or artificially constructed broad, shallow drainage channel that is planted with erosion-resistant grasses. Waterways can be designed to handle both large and small drainage areas where concentrated flows are a problem. The depth and width requirements of a waterway are a function of slope and size of the drainage area. Grasses waterways are a fairly inexpensive solution to concentrated flow problems on agricultural croplands. They are effective in reducing ephemeral gully erosion and can result in 60 to 80 percent reduction of sediment exports (EPA 1987a). Their primary disadvantage to farmers is that they take cropland out of production by dedicating it to grass. In some cases, gully erosion that occurs at the outlet of grassed waterways may result in a high annual maintenance cost. In these instances, grade stabilization structures may be used to stabilize the outlet.

Conservation Structures--

Agricultural soil conservation structures include a variety of nonvegetative techniques used to control erosion and sedimentation. Two of the most common types of conservation structures are sediment control basins and grade stabilization structures. Sediment control basins are useful to control sediment loss due to surface runoff by acting as a settling basin for sediment. They are generally most effective in small drainage areas. In larger drainage areas, the size of the dam and pipe required for the facility may make it uneconomical for farmers and cost-sharing agencies.

Grade stabilization structures are used to control gully development by armoring and modifying the longitudinal slope of drainageways. One example is a block chute, which employs rectangular blocks laid over a bed of fine rock and geotextile fabric. The advantages of block chutes are that they tend to be less expensive than other conservation structures and can be used in situations in which there is a large amount of overfall (distance from the top of the structure to the flow line of the ditch or creek). The primary limitations of block chutes are that they require considerable amounts of hand labor to construct.

Grazing Practices--

The objective of range and pasture management is to prevent overgrazing because of large and excessive concentrations of grazing populations. Management practices include irrigation to promote regrowth, rotating animals between pastures, spreading mineral and feed supplements, and allowing animals to graze only when a particular plant food is growing rapidly (EPA 1988b).

Animal-Waste Management--

Animal-waste management facilities such as manure bunkers and lagoons are BMP facilities where animal wastes are temporarily held until they can be utilized more efficiently or until they can be safely disposed of. Wastes can be stored in earthen ponds or holding facilities. Confined animal feeding operations such as dairies and feedlots can be a major source of bacteria, pathogenic organisms, and nutrient loading in downstream water supplies. In cases where waste storage facilities are not used, farmers usually are required to distribute manure on adjacent fields daily. During the dormant season, there is less opportunity for the biological processing of animal wastes. Facilities such as lagoons or manure bunkers allow farmers to store wastes until field conditions are more suitable for land application. They also can lessen dependence on chemical fertilizers for crop production.

Silviculture Best Management Practices

Surface water supplies located in forested watersheds are widely considered to produce the best raw water quality. Poor silviculture practices in such areas can produce a variety of

nonpoint water quality problems, including increases in sediment, turbidity, nutrients, temperature, natural organics (e.g. tannin and lignin), and dissolved oxygen. Controlling nonpoint source pollution from timber harvesting and other forest management activities is an essential part of a protection program for watersheds that include commercial forest land.

In addition to identifying the need for controlling nonpoint source pollution from agricultural activities, the federal Water Pollution Control Act Amendments of 1972 (PL92-500) specifically identified silvicultural activities as potential sources of nonpoint pollution. The act required California to develop methods to control pollutants emanating from such sources. As with agricultural lands, EPA has adopted the concept of BMPs to control potential nonpoint pollution from forested lands. EPA did not provide specific procedures for accomplishing these objectives in the 1972 act or the Clean Water Act of 1977 (PL 95-217). However, federal land management agencies such as the U.S. Forest Service developed documents that describe silvicultural BMPs, and California also has passed forest practices acts, in part, to fulfill the state's requirements for establishing programs for the control of nonpoint source pollution from silvicultural activities. The state must specify the relationship between water quality standards and BMPs and has pursued written agreements to establish that federal agency requirements for silvicultural BMPs will enable compliance with water quality objectives..

Control strategies or BMPs used to prevent or minimize adverse impacts from forest management activity include buffer strips; design and construction of haul roads, skid trails, and landings; postdisturbance erosion control; seasonal operating restrictions; and slash disposal. Protection of vegetated buffer strips is a control measure common to nearly all land uses discussed earlier. Evaluation of the effectiveness of individual BMPs is often difficult because logging operations typically involve the use of several BMPs applied jointly. However, the disproportionate erosional impacts produced by roads and skid trails indicate that BMPs for these features should receive close attention in the planning, implementation, and monitoring phases of forestry operations.

Design and Construction of Haul Roads, Skid Trails, and Landings--

The transportation network on commercial forest land consists of haul roads, skid trails, and landings. Related BMP guidelines normally call for avoiding disturbance to sensitive areas such as unstable terrain and riparian areas and for minimizing their total areal coverage or percentage within the basin. When possible, roads should use nongeometric horizontal and vertical alignments and conform as closely as possible to natural ground contours. For ground-based logging systems that require skid trails, the recommended BMP is to predesignate their locations within the logging unit and restrict machinery from operating outside the approved routes.

Postdisturbance Erosion Control--

Erosion can be controlled from previously disturbed surfaces by the application of various natural or artificial ground coverings. Materials include straw/asphalt, wood chips, straw, erosion mats and hydromulch. A comparison of erosion reduction by the five different methods reviewed by Burroughs and King (1989) showed that straw applied with an asphalt tackifier generally provided the greatest reduction in surface erosion. With the exception of hydromulch, comparable reductions in erosion were obtained with application rates sufficient to obtain at least 90 percent coverage of exposed areas. Seeding alone has done little to control surface erosion until germination and growth of new plants, and then only if the seed has not been washed from the slope.

Erosion control for skid trails, landings, and temporary haul roads also may involve removal of culverts and construction of earth berms, or "water bars," to prevent runoff from creating rill and gully erosion.

Seasonal Operating Restrictions--

Seasonal operating restrictions can involve prohibitions on logging during certain calendar periods or weather conditions. Logging operations are normally suspended during the winter season to avoid soil erosion and long-term damage to the soils. Seasonal restrictions may also be established for extremely dry periods to reduce wildfire ignition potential.

Slash Disposal--

Most forest management programs involve procedures for reducing the amounts of nonsalable woody residue, or slash, that remain on the harvest units following log removal operations. Slash is disposed of through mechanical piling or burning, or both, to improve the efficiency of reforestation efforts and reduce the amount of combustible woody material. BMPs for management of woody debris in riparian areas differ regionally and should be tailored to the situation. In some cases, the presence of large woody debris has helped prevent channel scour and streambank erosion in steep gradient streams (Swanson et al., 1976; Swanson and Lienkaemper, 1978; Bilby and Likens, 1980). Few studies however, offer guidance on how to distinguish stable versus unstable debris accumulations in stream channels or assess the risk of damaging downstream drainage structures such as bridges and culverts.

Nonstructural Controls for Urban Development

Watershed protection programs for urbanizing watersheds involve decisions on how to employ nonstructural versus structural BMPs. For areas in which current development densities are sufficiently low to preclude the need for structural urban stormwater BMPs, the most reliable way to assure long-term protection of water quality is to restrict future development by means of land-use controls. From a risk standpoint, there is more certainty that nondegradation water quality goals will be achieved if the emphasis is on controlling the sources of contamination rather than on removing contaminants after they enter watercourses.

Density Restrictions--

Density restrictions are the most common type of land-use controls used to protect watersheds from urban development. Emphasis on low-density residential land use is particularly common in unsewered rural areas, where minimum lot sizes are often established to insure sufficient land areas for on-site septic systems. Zoning legislation allows local governments to regulate development densities by setting restrictions on lot size. Local jurisdictions usually adopt density restrictions for a variety of reasons, only one of which may

relate to protection of water supplies. Example objectives include preserving agricultural land to protect open space for wildlife habitat or aesthetic reasons, and to control expansion of public facilities and services such as schools, fire protection, roads, wastewater collection and treatment systems, and water service systems. Density restrictions may be defined for the entire watershed or for "critical areas" of the watershed (lands within a specified distance of watercourse) or on the basis of the sewage disposal system capacity.

The most common strategy for establishing lot-size restrictions is to require larger lot sizes for areas located near streams and reservoirs. In some cases reductions of the maximum development density have been used to protect public water supplies.

Cluster Development--

For some watersheds that face urban development pressure, a viable option is cluster or planned unit development. Under a cluster development scenario, impervious areas such as structures and parking facilities are concentrated in one portion of the tract in exchange for open-space requirements in the remaining portion. The advantages of clustering are twofold: It can achieve average densities comparable to large-lot zoning while concentrating disturbance and impervious surfaces to less-sensitive portions of the watershed; and its lower infrastructure costs make it more feasible to finance the cost of sanitary sewers and stormwater management systems. Cluster development can be planned together with protection requirements for special areas such as buffer zones, wetlands, and groundwater recharge zones.

Impervious Surface Limits--

Impervious areas such as buildings, roads, parking lots, and other paved areas can increase peak storm flows and may be major sources of contaminants in urban watersheds. In forested watersheds with commercial timber harvesting activity, increases in peak flows and soil erosion can occur if roads, skid trails, and other compacted areas comprise a significant percentage of the basin (Harr 1976). As a result, land managers have advocated limiting the percentage of lots or other planning units that can be paved or otherwise disturbed.

Prohibited Land Uses--

Certain land uses inherently present high risks for contamination for water supplies. Landfills may contain a variety of hazardous materials that can pose a serious threat to surface water and groundwater supplies. Industrial developments may involve point source discharges and storage, production, or processing of hazardous chemicals that increase the chance of toxic spills in water supplies. Commercial and high-density residential development can convert a significant percentage of the basin to impervious areas, which increase peak flows and provide a major source of pollutants in stormwater runoff. For an unfiltered source, land uses such as grazing and dispersed recreation can increase the risk of pathogenic organisms entering the water supply.

The most effective way to protect water supplies is to explicitly prohibit high-risk land uses that could occur in the watershed in the absence of regulatory controls. This approach differs from other control strategies that simply regulate the density of specific land uses.

Septic Tank Restrictions--

On-site septic systems are the most common type of sewage disposal method used in rural watersheds. If septic systems are poorly sited, constructed, or maintained, they can pose significant threats to the water quality of both surface and groundwater supplies. Generally, conventional septic systems should not be allowed in areas where soil type, subsurface conditions, groundwater conditions, or proximity to surface water could cause contamination of water supplies. Minimum requirements for the design, installation, operation, and maintenance of septic tanks and other on-site sewage disposal systems are established by state and local public health codes. Although water utilities rarely have enforcement authority over septic systems, they should coordinate closely with local jurisdictions to ensure proper enforcement of septic system regulations in public water supply watersheds.

Municipal and county health departments normally have responsibility for administering septic system regulations. In unsewered rural areas, lot-size restrictions are often established on the basis of the minimum area necessary to support septic systems. A minimum lot size of at least one acre is usually required by local health departments for construction of

conventional septic systems. However, it is not uncommon to require a minimum lot size of 2 to 5 acres for development with on-site septic systems. Where site conditions are not favorable for conventional septic tanks, state and local regulations may permit alternative designs such as low-pressure pipe systems and mound systems. Water utilities can reduce the risk of contamination from septic systems by coordinating closely with local jurisdictions on review of, and approval for, proposed systems and by monitoring existing systems.

Interim Policies and Regulations--

Interim regulations, also known as moratoriums, can be used to temporarily prevent urban development or other potentially damaging land uses until long-term policies, plans, or regulations can be adopted. Interim controls for urban watersheds temporarily restrict development through denial of building permits, rezoning requests, water and sewer connections, septic system permits, or other permits, until long-range planning studies are completed and permanent controls are adopted. Interim regulations can apply to a particular jurisdiction to the entire watershed, or to critical portions of the watershed.

Subdivision Regulations--

Subdivision regulations control how land is subdivided and developed into buildable sites. These regulations play an important role in a watershed protection program for urbanizing areas by stipulating design, engineering, and construction standards in order for plats to be approved and buildable lots to be sold and developed.

Subdivision regulations, together with zoning, are the most commonly used local control for new land developments. Subdivision regulations also may be used to enforce zoning ordinance requirements for development controls such as minimum lot size, impervious surface limits, and lot-size configurations. They can also assure adequate management of stormwater by specifying requirements for peak flow and volume control, drainage systems, and stormwater treatment. Subdivision regulations and review procedures may also provide a means for ensuring the proper design and installation of wastewater systems (on-site septic systems, community systems, or municipal sewers); adequate erosion and sediment control

during construction; and protection of undisturbed land such as buffers, conservation easements, and open-space land.

Transfer of Development Rights--

During the early 1980s, transfer of development rights appeared to be a promising land-use control option. With this approach water districts would act as brokers by purchasing development rights on privately owned parcels where water quality could be threatened if residential units were constructed. Development rights would then be transferred to less sensitive parcels such as upland watershed zones or properties located outside the basin.

Street Sweeping--

Pollutant concentrations in urban runoff are a function of two factors--the amount or availability of contaminants that accumulate on impervious surfaces, and the runoff processes that mobilize and transport material into receiving waters. Because streets and parking areas constitute a significant percentage of the impervious area in highly urbanized areas, an objective of street sweeping programs has been to reduce the amount of sediment and bound contaminants that accumulate on paved surfaces. The pollutant removal efficiency of conventional street sweepers depends on the size range of contaminated particles. Once thought to be a highly effective technique for improving urban runoff quality, street sweeping is now regarded as having low effectiveness for removing fine sediment in comparison to well-maintained catch basins. Street sweeping is considered to be effective for removing pollutants associated with larger material such as trash and debris.

Structural Controls

Structural stormwater controls or structural BMPs are capital improvements designed to filter, detain, or reroute contaminants carried in surface runoff. They include wet retention ponds, dry detention ponds, infiltration controls, and diversion systems. In contrast to land-use controls, the site-specific nature of structural controls provides greater opportunities for measuring effectiveness. Useful references for the planning and design of structural BMPs include Schueler (1987), Northern Virginia Planning District Commission (NVPDC) (1987),