Rector Creek Reservoir Watershed Sanitary Survey 2009 Update

Rector Creek Watershed, Reservoir, Water Treatment Facility, and Silverado Trail (base of photo)

July 10, 2009

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Prepared For
Veterans Home of California and Rector Reservoir Surface Water Treatment Facility
California Department of Health Services Drinking Water Division

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WATERSHED SANITARY SURVEY CHECKLIST

System Information:

System Name: Veterans Home of California

System No.: 2810008

Survey Due Date: 2009

Preparer Information:

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Date Prepared: July 10, 2009

Watershed Survey Description:

Name of Watershed: Rector Creek

Total Watershed Size in acres: 10.86 square miles or 6852.65 acres

Location: Central Napa County on the east side of the Napa Valley.

Name(s) of water treatment plants using the watershed as a source:
Veterans Home of California, Rector Treatment Plant

Watershed Sanitary Survey Checklist - Veterans Home of California

Potential Contaminant	Potential to Impact Water Quality	Source and Comments
Wastewater:		
Treatment plant effluent discharges	Low	No discharges from wineries.
Storage, transport, treatment, disposal to land.	Low	Winery irrigation systems. No Reported Problems.
Residential septic systems	Low	Low density development. Some reports of system failures.
Commercial/industrial septic systems	Low	No reported problems with wineries.
Reclaimed Water	Low	Atlas Peak Winery irrigation system No reported problems.
Urban Areas	None	Not on watershed.
Agricultural Crop Land Use	High	High rate of Vineyard development
Pesticide/Herbicide Use	High	Wide variety of chemicals applied Varying human and wildlife toxicity Frequent use by multiple vineyards Difficult to monitor in raw water Inability to treat in finished water
Grazing animals	Low	Likely present but not observed
Concentrated Animal Facilities	None	Not in watershed.
Wild Animal Populations	Low	Probably not in #s significant to be a risk.
Mines:		
Active	None	Not on watershed.
Inactive	None	Not on watershed.
Disposal Facilities:		
Solid Waste	None	Not on watershed.
Hazardous Waste	None	Not on watershed.
Logging	None	Not on watershed.

Watershed Sanitary Survey Checklist - Veterans Home of California (continued)

Potential Contaminant Source	Potential to Impact Water Quality	Comments
Recreation:		
Reservoir Body Contact	Low	Prohibited but occasional unauthorized swimming likely happens.
Reservoir Non-Body Contact	Low	Prohibited. Access by Vets Home only.
Watershed Activities	Low	Hunting & Fishing.
Unauthorized Activity:		
Transient camps	Low	Probably not in #s significant to be a risk.
Illegal Dumping	Low	Limited access to area except for property owners.
Underground storage tank leaks	None	No reported leaks.
Traffic Accidents/Spills:		
Transportation Corridors	Low	Private roads. Limited access. There are deliveries to Atlas Peak.
History of accidents/spills	Low	No incidents reported.
Geological Hazards:		
Landslides	Moderate	Just 10% of watershed is classified with a moderate potential for landslide or other erosion in natural conditions. Developed areas join in the moderate classification.
Earthquakes	Low	Sufficient distance from active faults.
Erosion and Sedimentation	High	Many upslope roads and road stream crossings redirect runoff and subject native soils and fill soils to fluvial erosion. Any bare soils subject to increased surface erosion. Expansion of vineyards replacing native chaparral with introduced grapes reduce vegetative cover on disturbed “manufactured” soils. soils make their way quickly downslope along steep canyons and headwater streams which fill reservoir.
Fires	High	Fire creates ash and increases erosion. A severe fire in 1981 burned the entire watershed. Fire is a natural watershed process that has been suppressed.

Watershed Sanitary Survey Checklist - Veterans Home of California (continued)

Other Issues on the Watershed	Comments	
Groundwater Discharges:		
Natural Discharge	Low	Springs & Wells.
Gas, oil, geothermal wells	None	Not on watershed.
Seawater Intrusion	None	Not on watershed.
General Water Conditions:		
Reduction in available water quantity.	Low	Rector reservoir fills nearly every year. Water is adequate to meet present demand. Municipal water diversion should be re-evaluated in order to maintain minimum bypass flows as per water rights permit.
Construction of water diversion or reservoir projects		No proposed projects known at this time.
Relocation of intakes		Not significant. Veterans Home has the capability to take water at different reservoir depths.
Growth:		
Population/General Urban Area Increase	Moderate	Rural Residential growth is projected.
Land Use Changes		Vineyard expansion is expected to continue.
Industrial Use Increase		Winery expansion is likely.
Incoming Water Quality:		
Raw Water Quality	Moderate	Suspect dissolved, or degraded forms of pesticides from vineyard applications
		Potential increase in suspended sediment from vineyard development. Further research needed.
		Possible increased algae and turbidity with more vineyard development.
Difficulty meeting drinking water standards		None anticipated

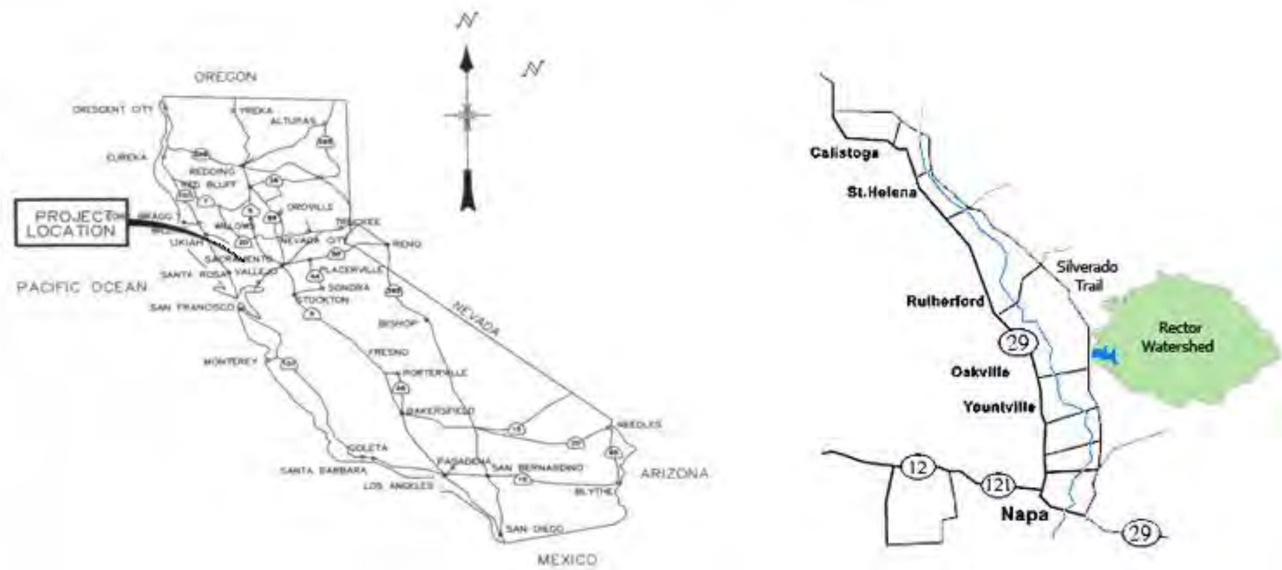
Abbreviations

APW	Atlas Peak Winery
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
CCR	California Code of Regulations
CDF	California Department of Forestry – Recently reorganized as CalFire
CDFG	California Department of Fish and Game
CDPH	Department of Public Health, Field Operations Branch, Santa Rosa District Office
DEPARTMENT	Department of Public Health, Field Operations Branch, Santa Rosa District Office
District	Department of Public health, Field Operations Branch, Santa Rosa Office
DMG	Division of Mines and Geology
DO	Dissolved Oxygen
DPHSS	Department of Public Health (above) Sanitary Survey dated 1/1/96
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
MCL	Maximum Contaminant Level
mg/L	milligrams per Liter (equivalent to parts per million)
ml	milliliter
MPN	Most probable number
MSL	Mean Sea Level
NCDEM	Napa County Department of Environmental Management
NCFD	Napa County Fire Department
NCFWCD	Napa County Flood Control and Water Conservation District
NCPD	Napa County Planning Department
NCRCD	Napa County Resource Conservation District
NCSSC	Napa County Soil Survey of California
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
pCi/L	picocuries per Liter
PGMESC	Preliminary Geologic Map of Eastern Sonoma County and Western Napa County, California
ppm	parts per million
Regional Board	California Regional Water Quality Control Board, San Francisco Bay Region
RWQCB	California Regional Water Quality Control Board, San Francisco Bay Region
NRCS	U.S. Department of Agriculture Natural Resource Conservation Service
SWFDTR	California Surface Water Filtration and Disinfection Treatment Regulations
SWTR	Federal Surface Water Treatment Rule
USDIGSM	U.S. Department of the Interior Geological Survey Map
YVH	Yountville Veterans Home

1. INTRODUCTION

The Yountville Veteran‟s Home (YVH) is in Napa County in the small town of Yountville, between the City of Napa and St. Helena (Figure 1). Veterans Home acquires their water from Rector Creek and Reservoir, a tributary to the Napa River on the east side of Napa Valley. This Watershed Sanitary Survey is being updated from 2003 to identify potential contaminants in the watershed.

Figure 1. Location maps



Sanitary Survey Requirements

California Surface Water Treatment Regulations adopted by the California Department of Public Health (CDPH) require public water systems to complete a watershed sanitary survey every five years to evaluate conditions that may affect compliance with State of California Drinking Water Standards. A Sanitary Survey is a review of a public water system for the purpose of evaluating the adequacy of water sources, facilities, equipment, operations and maintenance that together collect, treat, and distribute drinking water (California Regulations Relating to Drinking Water CH 15, Art. 1 §64401.40. 2007). The survey includes geographical, biological, and hydrological descriptions of the relevant watershed, a summary of source water quality monitoring data, a description of activities and sources of potential contamination, significant changes that have occurred since the last survey (2003) that might affect the quality of the source water, a description of watershed control and management practices, and an evaluation of the system's ability to meet requirements of the Surface Water Treatment Rule and California Regulations for Drinking Water (CH 17, Art 7. 1 §64665. 2007).

This Watershed Sanitary Survey has its study area in the Rector Creek Watershed in Napa County. The Rector Creek Watershed fills Rector Reservoir to become the source of surface water for the Yountville Veteran‟s Home and the town of Yountville.

This 2009 version is the third Watershed Sanitary Survey for Rector Creek Watershed. A watershed sanitary survey provides documentation of existing and potential contaminant sources within a watershed supplying a surface water source. With this information, the water purveyor can adopt or modify watershed management practices to improve source water quality protection. Monitoring procedures can be implemented that are designed to alert water system personnel to water quality problems. Additional treatment processes may be identified that treat expected contaminants identified in the Watershed Sanitary Survey and Source Water Assessment. A Watershed Sanitary Survey helps the water purveyor to anticipate changes in water quality and to adjust treatment processes accordingly.

The 2003 Sanitary Survey was conducted by Ridge to River as well. Much of this material is still valid and has been incorporated into this 2009 update.

Objectives of this Watershed Sanitary Survey

Purpose of the Watershed Sanitary Survey

The primary purpose of the Watershed Sanitary Survey is to provide the Yountville Veteran‟s Home with information about potential contaminant sources and pollution control strategies. This information will enable the YVH to protect its water supplies before, during and after water treatment.

Objectives

1. Satisfy Surface Water Treatment Rules for Watershed Sanitary Survey.
2. Provide an ongoing base of information to the YVH. This allows the YVH to take appropriate action when practices within the watershed have the potential to impact the quality of drinking water resources.
3. Compare present information to past sanitary surveys to determine whether contaminant sources are increasing, decreasing, or remaining stable.

Study Approach, Organization, and Acknowledgements

Study Approach

Ridge to River‟s approach to the Watershed Sanitary Survey included the following methods:

- 2003 Watershed Sanitary Survey of Rector Reservoir as a foundation for this Update
- Review, revision, and additions to the 2003 Watershed Sanitary Survey bringing it up to date
- Analysis of air photos, maps, diagrams, plans, reports, and files
- Discussions with Patrick Gilleran, Russell Van Voorhis, David Kernohan, and Mark Nicander, pertinent individuals involved in operations and management of the water system
- Communications with Guy Schott and Wendy Jo Krull of California Department of Public Health Drinking Water Services
- Communication with Brian Bordona of Napa County Department of Planning and conservation
- Contacts with individuals and personnel of various land management and regulatory agencies, especially the offices of Napa County
- Field review of the watershed to revise and/or validate the checklist of potential contaminant sources:
    a) Ridge to River staff accompanied Veterans Home water treatment plant operators Russell Van Voorhis and Winniefredo Cruz in a boat for a tour around the tributary inlets to the lake
    b) Ridge to River staff explored roads in the central watershed
    c) Ridge to River mapped Assessor Parcel Numbers and landowners in the watershed
    d) Ridge to River commissioned a plane, pilot, and photographer for overflight and photos at about 1000 feet of elevation over private watershed areas otherwise unaccessible to us.

e) Drinking Water Source Assessment was conducted by exploring areas of the watershed where legal access was afforded in attempt to examine contaminant sources and suggest methods to minimize pollution of the Rector Creek source water

- Identification and evaluation of pollutants present in raw water quality test results
- Consultation with two California Registered Professional Geologists

This 2009 Watershed Sanitary Survey Update was developed by Ridge to River staff for Yountville Veteran‟s Home. Our report was prepared by Anna Birkas, Watershed Scientist, Teri Jo Barber, Registered Professional Hydrologist, Karen Youngblood in mapping, and Geological consultation with Elias Steinbuck and Harold Wollenberg, both Registered in the State of California in the practice of the geological sciences. We are sincerely grateful for the excellent support, observations, and insight we were provided from Marc Nicander, Pat Gilleran, David Kernohan, and especially Russell Van Voorhis from Veterans Home. Guy Schott and Wendy Jo Krull of California Department of Public Health supplied important documentation and historical information about the water supply system. The quality of our report is owed in part to the excellent service we were provided.

Report Organization

The report is organized in accordance with the outline provided in the American Water Works Association (AWWA) Watershed Sanitary Survey Guidance Manual. See the Table of Contents at the beginning for a complete directory of the report contents.

Rector Reservoir

2. WATERSHED AND WATER SUPPLY SYSTEM

Rector Creek Watershed

Rector Creek‟s watershed drainage area encompasses approximately 10.86 square miles, the equivalent of 6852.65 acres. Average annual precipitation is 32.5 inches at the Oakville gauging station on the Napa River about 4 miles from the Yountville Reservoir, with data measured since 1909 (Western Regional Climate Center, Station # 046351, Oakville 1 W). Because Rector Watershed is higher in elevation, annual precipitation was estimated to be 36" on average. The dam and reservoir are located approximately 2.5 miles northeast from the Town of Yountville on Silverado Trail in Napa County. Rector Creek crosses Silverado Trail approximately 500 feet downstream of the spillway. Vehicle access to the reservoir and the water treatment facility can be made from the gate at 7300 Silverado Trail.

Rector reservoir has three main tributaries termed the North Fork, Rector Creek Mainstem, and Lorette Creek. The watershed boundary extends easterly 4.7 miles to Atlas Peak. Rector Watershed lies adjacent to the Lake Hennessey watershed to the north. Rector Reservoir and its tributaries comprise the Veterans Home‟s water source. The Lake Hennessey reservoir acts functionally as a back-up supply for Veterans Home customers in times of outage, available from the City of Napa.

The Rector Creek Watershed is steeply mountainous around the reservoir. Steep bedrock gorges at stream inlets give way to a relatively flat mesa in the upper elevations of the watershed (Figures 2, 3, 4). Vegetation is dominated by chaparral, dense stands of hardwoods, and grasslands. From the dam and throughout the reservoir area, the upper mesa cannot be observed do to the steep terrain around the reservoir, and likewise, the lower gorge and reservoir cannot be observed from most of the flat mesa at the top. The upper mesa has been in a developmental phase since the early 1990‟s.

Figure 2: Rector Creek Watershed Topography from USGS contours with roads, streams, watershed boundary

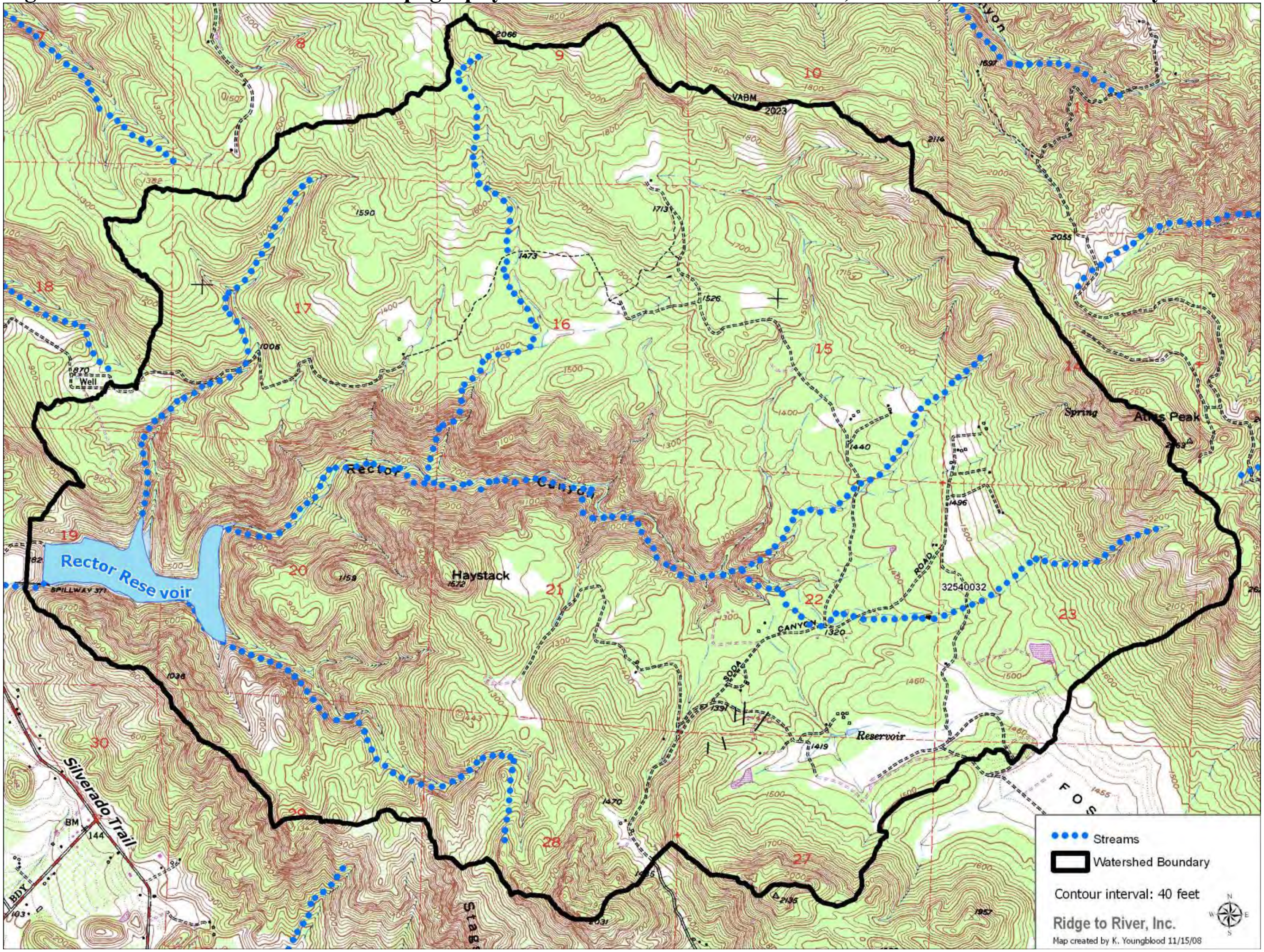


Figure 3. Rector Creek Watershed Aerial Photo 1993

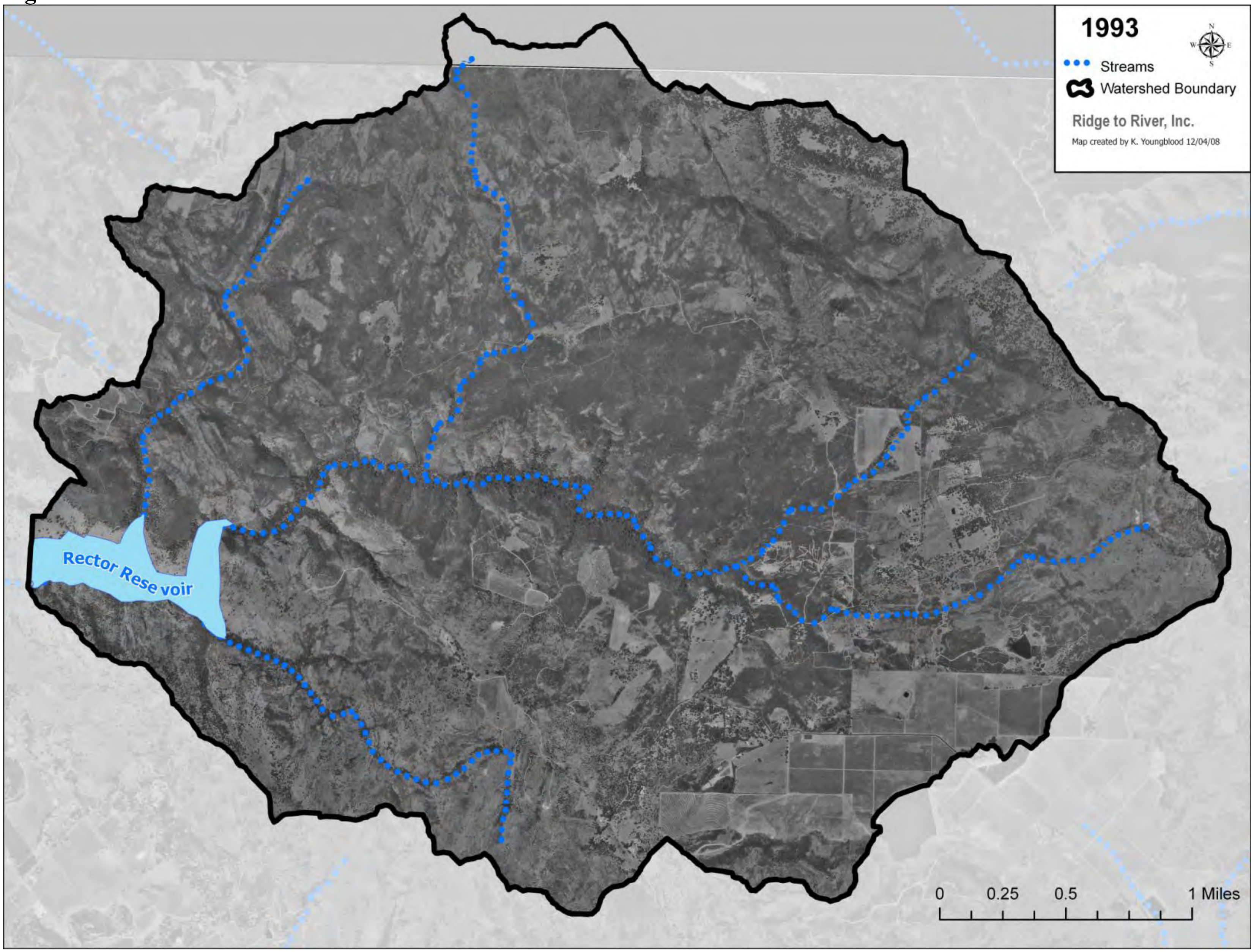
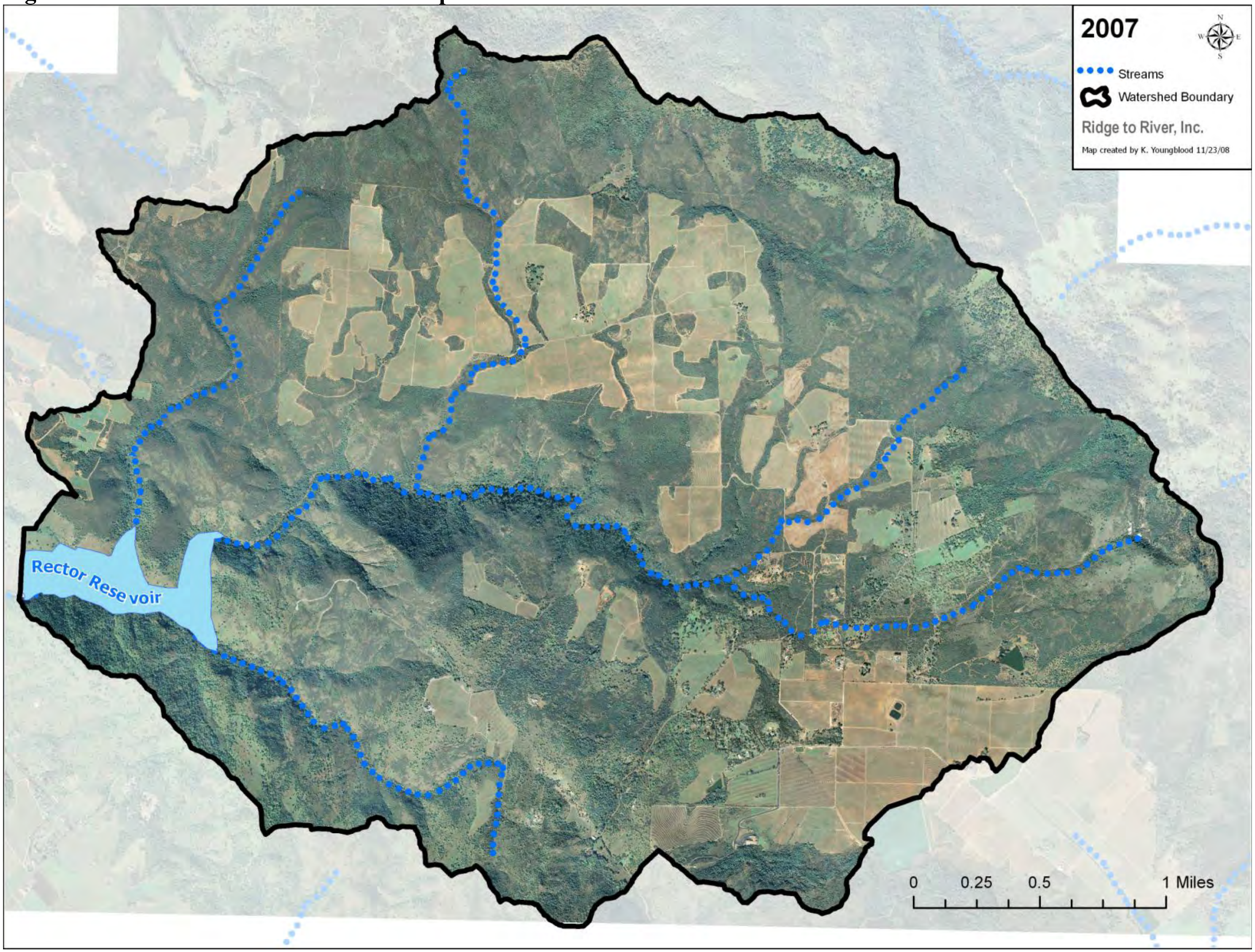


Figure 4. Rector Creek Watershed Aerial photo 2007



Land Use

When combined with Lake Hennessey‟s watershed area to the north (which does allow some recreation), extensive connected wildlands offer open space values and wildlife habitat with extensive home ranges providing a relief to the human and agricultural developments across the Napa Valley. However as these aerial photos suggest, agricultural development in the watershed has increased significantly since 1993.

The Rector Watershed is zoned "Ag-Watershed" for Agriculture and Watershed in the Napa County General Plan. The land within the watershed is termed "open space", where agriculture is allowed alongside watershed as a dominant permitted land use. The sub-dominant land use is rural residential, with homes located on Soda Canyon Road and on small private roads accessed from Silverado Trail. No official constraints exist as to development on Open Space lands, but rather the term "open space" is used to convey that some land in the watershed has not yet been developed. Presently, the upward limit of development that could protect this watershed from 100% agricultural development (excepting the rugged topography of the inner watershed and the steep terrain of the surrounding hills) is a limit of land clearing imposed by Napa County such that all parcels must retain 60% of their tree cover and 40% of understory/chaparral and environmental impact analysis. All new development within the Rector Watershed requires environmental scrutiny, often resulting in an Environmental Impact Report/Statement – a scientific document prepared at the landowner‟s expense to identify potential environmental degradation, minimize it, and ultimately defend a development‟s plan. If findings suggest that there would be any net increase in sediment production, Napa County Department of Planning and Conservation would reject the project to protect the Yountville Veteran‟s Home water supply (Brian Bordona – 2008, personal communication).

<u>Veterans Home Property</u>

The Rector Reservoir Watershed boundary encompasses 10.86 square miles, the equivalent of 6852.65 acres. The State of California owns approximately 1,900 acres managed by the Veterans Home (Andy Ellicock, 2003), of which 1,070 acres lie within the watershed boundary and the remaining acreage just outside it (Rector Watershed Sanitary Survey, 1996). These 1070 acres comprise the reservoir itself and a buffer zone around it, basically the lowermost 15% of the Rector Reservoir Watershed drainage area. Recreational uses such as swimming, boating, hunting, fishing, and camping are prohibited in the watershed but may occur illicitly to some extent.

<u>Private Properties</u>

The remaining watershed lands - 85% of the watershed area - are privately owned. Most of the area is undeveloped. While Napa County describes these lands as open space, in reality they are only open until they are developed. The private parcels are either undeveloped or have been converted to vineyards, homesteads, or wineries. There are one or more dams upstream of the Rector Reservoir that are used to support the agriculture (mostly vineyards) and rural residential land uses (YVH, 2003).

Vineyard Agriculture and Wineries

Agriculture use is predominately limited to viticulture with 23 active vineyards, three wineries, and one application for a winery to date. Most of these were developed in Mainstem Rector Creek between 1993 and 2003. In the last five years the eastern headwaters of the Mainstem experienced the most vineyard development (Figures 3 & 4 show development during this time period). Atlas Peak Winery and Stagecoach wineries are the largest in the watershed, with approximately 500 acres in grape production each (although part of Atlas peak winery is in the Milliken Watershed). The Atlas Peak Vineyard is located in the southeast area of the watershed, while Stagecoach is located in the northwest (contact information in Table 1).

Table 1. Vineyard Information for Rector Watershed (Napa Agricultural Commissioner, 2008)

Permitee/Company	Vineyard Name	Contact	Address	
Antinori California	Antinori California	Glenn Salva	3149 Soda Canyon Road, Napa, CA 94558	(707)265-8866
Atlas Peak	Atlas Peak Vineyards	Tony Fernandez	P.O. Box 5660, Napa, CA 95481	(707)224-5424
Dave Pirio Vineyard Mgmt.	Martin Vineyards	David Pirio	P.O. Box 2340, Yountville, CA 94599	(707)944-1462
Dave Pirio Vineyard Mgmt.	Taylor Vineyards	David Pirio	P.O. Box 2340, Yountville, CA 94600	(707)944-1462
Dave Pirio Vineyard Mgmt.	Chappellet Vineyards	David Pirio	P.O. Box 2340, Yountville, CA 94601	(707)944-1462
Enterprise Vineyards	Oakville Ranch	Philip Coturi	P.O. Box 233, Vineberg, CA 95487	707-996-6513
Gaskin Vineyards	Gaskin Vineyards	George Gaskin	3188 Soda Canyon Road, Napa, CA 94558	(707)259-1914
Krupp Vineyards	Stagecoach Vineyards	Jan Krupp	3265 Soda Canyon Road, Napa, CA 94558	(707)259-1198
Krupp Vineyards	Krupp Vineyards	Jan Krupp	3266 Soda Canyon Road, Napa, CA 94558	(707)259-1198
Madrigal Vineyard Mgmt	Levine Vineyards	Jess Madrigal	P.O. Box 937, Calistoga, CA 94515	(707)942-6577
Nord Coast Vineyard Service	Artesa Foss Valley	Jon Kanagy	1326 Hillview Lake, Napa, CA 94558	(707)226-8774
Renteria Vineyard Mgmt.	R. Mondavi	Oscar Renteria	1106 Clark Street, Napa, CA 94559	(707)255-0786
Renteria Vineyard Mgmt.	Atlas Peak-Rombauer	Oscar Renteria	1107 Clark Street, Napa, CA 94559	(707)255-0786
Rios Farming Company	Soda Canyon Ranch	Manuel Rios	1131 Walnut Drive, St. Helena, CA 94559	707-965-2587
Silverado Farming Company	Rivera Vineyard	Pete Richmond	2310 Laurel Street Suite 5, Napa, CA 94558	(707)251-9081
Silverado Farming Company	Probst Vineyard	Pete Richmond	2311 Laurel Street Suite 5, Napa, CA 94558	(707)251-9081
Trinchero Family Estates	Haystack Peak	Todd Berg	P.O Box 248, St. Helena, CA 94574	(530)476-3228
Victorias vineyard Inc.	Schneider Vineyards	Victor Fuentes	P.O. Box 2572, Yountville, CA 94599	(707)337-6993
VY Borny Vineyard Mgmt	Gloria Vineyard	James Decker	P.O Box 367, Rutherford, CA 94573	(707)944-9135

Yountville Equip. Company	Baker Mansfield	Doug Hill	P.O. Box2288, Yountville, CA 94599	(707)255-0214
Yountville Equip. Company	Briarstone	Doug Hill	P.O. Box2288, Yountville, CA 94600	(707)255-0214
Yountville Equip. Company	Lupa-Pell	Doug Hill	P.O. Box2288, Yountville, CA 94601	(707)255-0214
Yountville Equip. Company	Johnson	Doug Hill	P.O. Box2288, Yountville, CA 94602	(707)255-0214

Rural Residences

There are presently 39 residential dwellings in the watershed (*NCEM, 2003*). The nearest town is Yountville - which is approximately 2.5 miles southwest and downstream from the dam and so the Yountville area is outside the watershed boundary and outside the area of interest.

Topography and Natural Setting

The Rector Reservoir Watershed rises to elevations over 2,663 feet above mean sea level (MSL) on the slopes of Atlas Peak Mountain. Rector Creek begins at its headwaters approximately 2.2 miles east of Rector Reservoir on the east side of Haystack Mountain dropping from a elevation of 1,300 feet to 400 feet above MSL along Rector Canyon. There are several tributaries to the creek, including the three most pronounced, the North Fork, Mainstem Rector Creek, and Lorette Creek. The watershed is mainly mountainous with flat terrain limited to the central upper „mesa" region where vineyard agriculture is mainly conducted as the dominant land management practice in the watershed.

Slopes range from 2 to 75 percent with over half of the watershed within 50 to 75 percent slope range. The hazards of erosion are slight to high (*NCSSC, 2003*). The steeper slopes are subject to landsliding. The previous operator, Mark Nicander, indicated that slide actively erodes mainly rubble sized colluvium into the lake every year or so (Rector Sanitary Survey, 2003).

Climate

Napa County, similar to much of California, has a Mediterranean climate characterized by rainy winters and dry summers. The Pacific Ocean at San Pablo Bay, at the mouth of the Napa River, provides a source of cool moist air which makes its way partially up the Napa mainstem to buffer the otherwise hot summer air. Air temperatures range from 17 °F to 109 °F. The average annual precipitation in the Rector watershed ranges from 26 to 36 inches, and approximately 85 percent of that falls as rain between November and March (*NCSSC, NCFWCD, 2003*).

Geology

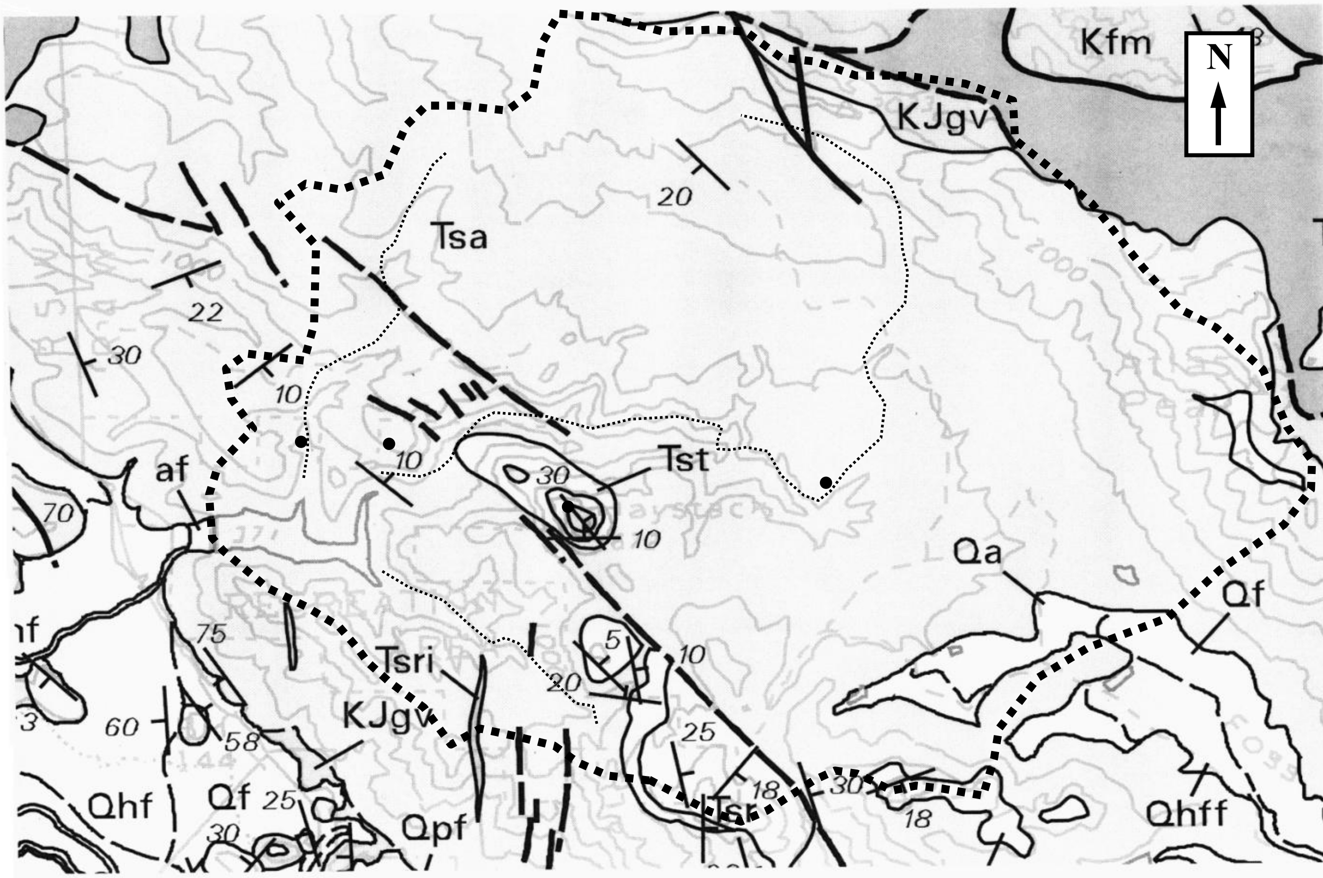
Figure 5 offers the results of a review of the most recent geologic maps of the Rector Creek watershed from one complete set of recent stereoscopic aerial photographs from 2002 along with a review of available pertinent literature (Steinbuck, 2008). Geologic features can be obscured by dense vegetation and other factors and therefore older features may exist that were not identified. The information presented herein is informational only and shall not be used to substitute for the geologic and geotechnical site investigations required under Chapters 7.5 and 7.8 of Division 2 of the Public Resources Code. The following excerpt was quoted directly from Steinbuck, 2008 (Professional Geologist #7538) so as not to misinterpret.

Geologic Setting
The lithology in the watershed is characterized by Pliocene Sonoma Volcanics (Graymer and others, 2007; Wagner and Bortugno, 1982). Sonoma Volcanics consist of a series of mixed volcanic rock types including andesite to basalt lava flows, pumiceous and welded ash-flow tuffs, and tuff breccias. Graymer and others (2007) depict several discontinuous fault traces within the basin. However, these faults are not active faults per the Alquist-Priolo Fault Zoning Act that defines active faults as those that have ruptured in the past 11,000 years. No “active” faults are mapped in the Rector Creek watershed (Bryant and Hart, 2007).

Landslides
Landslides observed within the Rector Creek watershed consist of rapid moving shallow seated debris slides and flows and are typically found on steep streamside slopes adjacent to Rector Creek and its larger tributaries. Observed landslides were generally less than 0.25 acres in aerial extent and were identified on the historic set of aerial photographs by their readily identifiable (accordingly relatively recent) bare failure scars. The most common natural triggering mechanisms for landslides are intense or long duration rainfall, undercutting of the toe of the hillside by stream bank erosion, and earthquake-induced ground shaking (Wieczorek, 1996). Human associated activities that can contribute to slope failure include excavation (a change of the mass balance of the hillslope), and alteration of the local hydrology (concentrating road run-off, or increasing soil moisture from vegetation removal). Landslides have been a continuing process vital to the development of the regional geomorphology (Benda et al., 2003), however earth materials delivered to stream systems can adversely impact water quality by causing rapid increases in turbidity levels after initial slope failure, and chronic increases in turbidity levels as disturbed soils are exposed to subsequent rainfall events prior to revegetation.

Vineyards
Based on a review of the aerial photos, several vineyards were identified in the basin, predominately located on low gradient ridge-top slopes. No obvious evidence of point source erosion resulting in sediment delivery to a watercourse was observed on the aerial photos. However, it is possible that chronic erosion and sediment delivery to the stream system may exist in the watershed, particularly as a result of concentrated run-off from the vineyards.

Storage Tanks
Aboveground storage tanks (AST) are likely to exist in the watershed for fuel storage associated with the ongoing maintenance of the vineyards. The ASTs typically store diesel fuel, a hydrocarbon derived from the petroleum industry that contains known carcinogenic compounds. Fuel storage tanks have the potential to contaminate soil and possibly groundwater from a one time spill event, or chronic leakage (ongoing drip).



LEGEND

<u>**Surficial Deposits (Holocene – Late Pleistocene)**</u>

Qa	**Alluvium**
Qf	**Alluvial fan deposits**

<u>**Sonoma Volcanics (Pliocene)**</u>

Tsa	**Andesite to basalt lava flows**
Tst	**Pumiceous ash-flow tuff**
Tsr	**Rhyolite flows**
Tsri	**Rhyolite plugs**

<u>**Great Valley Sequence (Late Cretaceous – Late Jurassic)**</u>

KJgv	**Sandstone, shale, and conglomerate**

Watershed Boundary

Main Watercourse

Fault contact

Contact
Depositional or intrusive contact

35 **Strike and Dip**

Small Landslide
too small to depict at map scale

Mod. from: Graymer and others, 2007. Geologic Map and Map Database of Eastern Sonoma and Western Napa Counties, California. USGS Scientific Investigations Map 2956, contour interval 200 feet, original map scale 1:100,000.

Figure 5	**Regional Geology and Landslide Map** **Rector Creek, Napa County, CA**	Prepared For: Ridge to River	Scale ~ 1:50,000
		Prepared By: Elias J. Steinbuck, PG	Date: 12/05/08

Soils

The soils found in the Rector Reservoir Watershed are listed below. These soil types are keyed to numbered polygons in Figure 6. The rocky Hambright complex, 50 to 75 percent slopes: makes up the majority of the Rector Watershed. This soil is approximately 25% gravel, 20% sand, 25% silt, and 30% clay (as sited in EIR. Ellen Wentworth 1995; USDA NRCS 1978; PPI Engineering, 1996).

The hazard of erosion in Rector Watershed ranges from slight to high. Soils within the steeper portions of the watershed areas are unstable due to weathering and steep slopes beyond the angle of repose prone to erosion, landslides, and slumping. The dominant Hambright soil complex has both low infiltration and slight to moderate erosion hazard. This low potential for erosion is likely partially due to their buffering with course rock fragments on their surface (Poesen, et al. 1994; Cerda, 2001; Descroix et al., 2001; Ballanay and Grismer, 2005). Other than minor concentrations of serpentine some watershed soils, we know of no other soil mineral deposit that could pose a hazard to the water quality in Rector Reservoir. Mining has not been active in the present or past in this watershed (*NCPD*).

Figure 6. Soils Map of Rector Creek Watershed (Obtained from Napa County database. USDA, 1978)

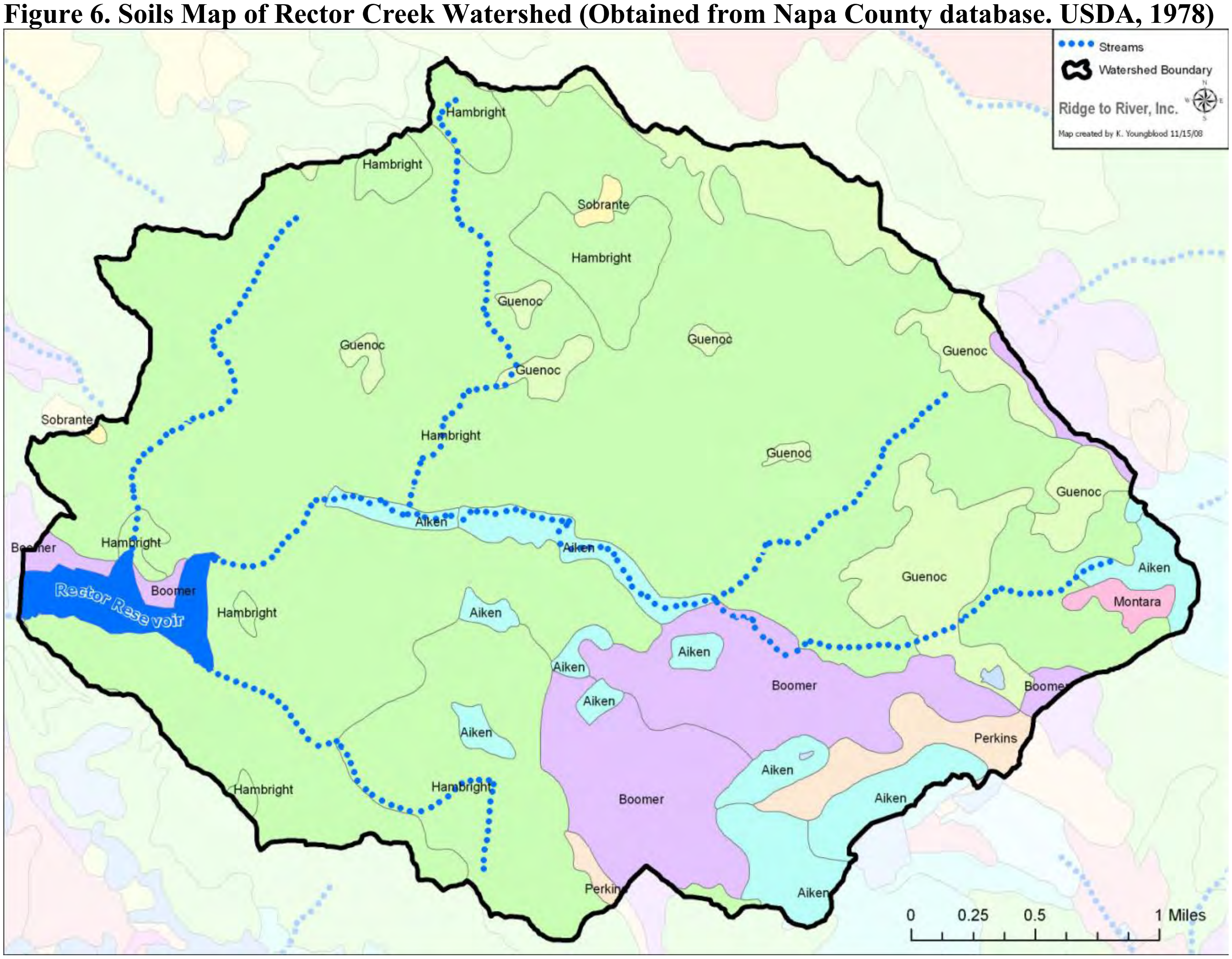


Table 2. Soil Type Keys for Soils Mapped in Rector Reservoir Watershed, in Figure 6

Map Symbol	Mapping Unit
100	**Aiken loam, 2 to 15 percent slopes:** Found at an elevation of 300-2,500 feet. Formed from basic volcanic rock, reddish and of medium acidity. Supports natural vegetation including Ponderosa Pine, Redwood, Oaks, and annual grasses. In a representative profile the surface layer is reddish brown, medium acid and slightly acid loam 8 inches thick. The subsoil is medium acid, reddish brown clay loam and medium acid, yellowish red clay 36 inches thick. Hard basic igneous rock is at a depth of 44 inches. Water capacity is 6.5to 11 inches with run-off rapid at slopes above 30 percent.
101	**Aiken loam, 15 to 30 percent slopes:** See above.
102	**Aiken loam, 30 to 50 percent slopes:** See above
104	**Bale clay loam, 0 to 2 percent slopes:** Bale is found among alluvial fans, floodplains and low terraces. Elevation is 100-300 feet. The soil is formed in alluvium derived from rhyolite and basic igneous rock. Natural vegetation is oak, poison oak, blackberry and willows. The soil color is dark gray and it is slightly acidic. In a representative profile the surface layer is dark gray, slightly acid loam 6 inches thick. The subsoil is 18 inches thick. The upper 11 inches is grayish brown, slightly acid loam, and the lower 7 inches is brown, slightly acid loam. Between depths of 24 and 60 inches or more are stratified layers of gray and pale brown slightly acid loam, gravelly sandy loam, and sandy loam. Water permeability is moderate and pooling occurs during rainfall. Water capacity is 6-9 inches.
105	**Bale clay loam, 2 to 5 percent slopes:** See above
108	**Boomer gravelly loam, 15 to 30 percent slopes:** Well-drained soils on uplands found at elevations of 500-2,500 feet. Formed with mixed igneous rock. Vegetation includes, Douglas Fir, Ponderosa Pine, Madrone, Manzanita, and poison oak. The soil has a layer of up to 2 inches of duff and is brown in color with medium acidity. Soil permeability is moderately low and water capacity is 6-10 inches.
109	**Boomer gravelly loam, 30 to 50 percent slopes:** See above.
110	**Boomer-Forward-Felta complex, 5 to 30 percent slopes** : See above. This soil is a complex mixture of 40 percent Boomer soils, 35 percent Forward soils, and 20 percent Felta soils. Runoff is medium.
111	**Boomer-Forward-Felta complex, 30 to 50 percent slopes:** See Above listing.
114	**Bressa-Dibble complex, 30 to 50 percent slopes:** Well-drained soils on uplands. Elevation is 400-2,000 feet, formed from sandstone and shale. Vegetation includes grasses and scattered oak. In a representative profile the surface layer is pale brown, slightly acid silt loam 10 inches thick. The subsoil is light yellowish brown and yellowish brown, slightly acid and medium acid silty clay loam 23 inches thick. Weathered, soft sandstone is at a depth of 33 inches. Water capacity is 4-6 inches and permeability is moderately slow.
115	**Bressa-Dibble complex, 50 to 75 percent slopes:** See above listing.
116	**Clear Lake clay, drained:** This series consists of poorly drained soil on old alluvial fans and in basins. They are formed from alluvium and sedimentary rock at an elevation of 30-200 feet. In a representative profile the surface layer is very dark gray, slightly acid to mildly alkaline clay 46 inches thick. The

underlying material is light olive brown, moderately alkaline clay to a depth of 69 inches or more. Water capacity is 8-10 inches. Natural vegetation includes annual grasses and scattered oak. Permeability is slow.

117 **Clear Lake clay, overwashed:**
See above. There is a gray overwash of above with sandy loam 20-40 inches thick.

118 **Cole silt loam, 0 to 2 percent slopes:**
The Cole series consists of somewhat poorly drained soils on alluvial fans and flood plains. Elevation is 100 to 300 feet. These soils formed in alluvium weathered from sandstone, shale, and basic rock. The plant cover is oak and native grasses. The surface layer is grayish brown, slightly acid silt loam about 8 inches thick. The available water capacity is 10 to 12 inches.

128 **Diablo clay, 15 to 30 percent slopes:**
The Diablo series consists of well –drained soils on uplands. Elevation is 50 to 1,500 feet. These soils formed in material weathered from sandstone and shale. The plant cover is mostly annual grasses and scattered oaks. In a representative profile the surface layer is dark gray and very dark gray, acid clay 25 inches thick. Weathered sandstone and shale are at a depth of 60 inches. Permeability is slow. Available water capacity is 6 to 10 inches.

136 **Felton gravelly loam, 30 to 50 percent slopes:**
The Felton series consists of well –drained soils on uplands. Elevation is 300 to 2,000 feet. These soils formed in material weathered from sandstone and shale. The plant cover is douglas fir, ponderosa pine, manzanita, and fern and grasses and redwoods in moist draws. In a representative profile the surface layer is dark grayish brown, neutral gravely loam 6 inches thick. The subsoil is about 27 inches thick. Weathered shale is at a depth of 33 inches. Permeability is moderately slow. The effective rooting depth is 30 to 40 inches. Available water capacity is 5 to 8 inches.

139 **Forward gravelly loam, 9 to 30 percent slopes:**
The Forward series consists of well-drained soils on uplands. Elevation is 400 to 3,500 feet. These soils formed in material weathered from rhyolite. The plant cover is Douglas fir, madrone, scrub oak, and bay trees. In a representative profile the surface layer is light gray, slightly acid gravelly loam 4 inches thick. Permeability is moderately rapid. Available water capacity is 2 to 4.5 inches.

141 **Forward-Kidd complex, 50 to 75 percent slopes:**
See above description and; a soil complex that consists of very steep soils on uplands. These soils are so intermingled that it was not practical to separate them at the scale used in mapping. Commonly, the Forward soils are on toe slopes and the Kidd soils on side slopes.

143 **Guenoc-Rock outcrop complex, 5 to 30 percent slopes:**
The Guenoc series consists of well- drained soils on uplands. Elevation is 700 to 3,000 feet. These soils formed in material weathered from basic igneous rock. The vegetation is mostly annual grasses, scattered oaks, and some brush in shallower areas. In a representative profile the surface layer is dark reddish brown and reddish brown, neutral loam 12 inches thick. The subsoil is dark red, neutral clay loam 18 inches thick. Fractured, shattered basalt is at a depth of 30 inches. Permeability is moderately slow. Available water capacity is 4.5 to 7 inches.

144 **Guenoc-Rock outcrop complex, 30 to 75 percent slopes:** See above listing.

151 **Hambright-Rock outcrop complex, 2 to 30 percent slopes:**
The Hambright series consists of well-drained soils on uplands. Elevation is 400 to 2,500 feet. These soils formed in material weathered from basic volcanic rock. The vegetation is annual grasses and forbs and oaks on gentler slopes. Most of the areas are brushy and rocky. In a representative profile the surface layer is dark grayish brown and brown, medium acid very stony loam and about 6 inches thick. The subsoil is dark brown, medium acid very stony loam about 6 inches thick. Fractured basic igneous bedrock is at a depth of 12 inches. Permeability is moderate. Available water capacity is 1 to 2 inches.

152 **Hambright-Rock outcrop complex, 30 to 75 percent slopes:** See above listing.

154 **Henneke gravelly loam, 30 to 75 percent:**
The Henneke series consists of excessively drained soils on uplands. Elevation is 500 to 4,000 feet. These soils formed in material weathered from serpentine. The vegetation is scattered oak, digger pine, scrub oak, manzanita, muskbrush, toyon, MacNabb cypress, and a few annual grasses. In a representative profile the surface layer is reddish brown, neutral gravelly loam 7 inches thick. The subsoil is reddish brown, mildly alkaline very gravelly clay loam 8 inches thick. Fractured, greenish blue serpentine is at a depth of 15 inches.
Permeability is moderately slow. Available water capacity is I to 3 inches.

157 **Lodo-Maymen-Felton association, 30 to 75 percent slopes:**
Lodo consists of somewhat excessively drained soils on uplands. Elevation is 400 to 2,500 feet. These soils formed in material weathered from sandstone and shale. The vegetation is chamise, manzanita, and scrub oak and small trees in protected areas. The surface layer is brown, neutral loam 4 inches thick. The subsoil is brown, neutral heavy loam 3 inches thick. Fractured sandstone is at a depth of 7 inches. Permeability is moderate. The available water capacity is 1 to 3.5 inches

160 **Los Gatos loam, 50 to 75 percent slopes:**
The Los Gatos series consists of well-drained soils on uplands. Elevation is 400 to 2,500 feet. These soils formed in material weathered from sandstone. The vegetation is mainly brush and a few scattered oaks and small areas of grass. In a representative profile the surface layer is yellowish brown and brown, neutral loam 16 inches thick. The subsoil is brown, slightly acid loam and clay loam 20 inches thick. Massive sandstone is at a depth of 36 inches. Permeability is moderately slow. Available water capacity is 3 to 8 inches.

163 **Maymen-Millsholm-Lodo association, 30 to 75 percent slopes:**
This association consists of steep and very steep soils on hills mainly in the northern part of Napa County bordering Yolo County and extending southward to Lake Berryessa. The Maymen soils in this association are in convex areas on north-facing slopes of mainly 30 to 75 percent. The Millsholm soils are in convex areas on south-facing slopes of mainly 50 to 60 percent near ridge peaks. The Lodo soils are in convex areas on south-facing slopes of mainly 30 to 75 percent.

166 **Montara clay loam, 5 to 30 percent slopes:**
The Montara series consists of well-drained soils on uplands. Elevation is 500 to 1,500 feet. These soils formed in material weathered from serpentine. The vegetation consists mainly of annual grasses and a few grey (digger) pine. In a representative profile the surface layer is grayish brown and dark grayish brown mildly alkaline clay loam underlain at a depth of 12 inches by serpentine. Permeability is moderately slow. Available water capacity is 2 to 2.5 inches.

168 **Perkins gravelly loam, 2 to 5 percent slopes:**
The Perkins series consists of well-drained soils on terraces. Elevation is 150 to 1,500 feet. These soils formed from alluvium derived from igneous rock. The vegetation consists of oak woodlands and grasses in natural state and orchards and vineyards where the soils are cultivated. In a representative profile the surface layer is brown, slightly acid gravelly loam 19 inches thick. The subsoil is reddish brown, slightly acid gravelly clay loam 38 inches thick. The substratum is brown slightly acid gravelly loam to a depth of 60 inches. Permeability is slow. Available water capacity is 7.5 to 8.5 inches.

169 **Perkins gravelly loam, 5 to 9 percent slopes:** See above listing.

174 **Riverwash:**
Miscellaneous areas that are in active stream channels, on floodplains, and adjacent to drainageways. Slope is 0 to 5 percent. Elevation is 200 to 1,500 feet. The areas are inundated during periods of waterflow and are subject to constant deposition and removal of material. Vegetation consists of occasional willows, water grasses, and some brush. Riverwash consists of erratically stratified layers of water-deposited sand, gravel, stones, and cobbles. Layers of sandy loam and silt loam are deposited for short periods but are subject to intermittent scouring and removal. Thickness of the strata ranges from 2 to 30 inches. Reaction is neutral or mildly alkaline. The organic matter content varies among strata but is commonly low.

175 **Rock outcrop:**
Consisting of ridges of igneous bedrock and of outcrops of sandstone and shale in the Blue Ridge area bordering Yolo County. The areas are more than 90 percent Rock outcrop and less than 10 percent areas of soil material less than 6 inches deep. The vegetation consists of small shrubs and a few stunted trees in cracks between lichen-covered rocks. Runoff is very rapid.

176* **Rock outcrop-hambright complex, 50 to 75 percent slopes:**
See above listing. This complex is about 60 percent Rock outcrop, 30 percent Hambright soils, and 10 percent Guenoc and Kidd soils. Rock outcrop is in areas 1 to 5 acres in size. It consists of basic igneous boulders, stones, and outcrops. Runoff is very rapid. The hazard of erosion is high.

177 **Rock outcrop-Kidd complex, 50 to 75 percent slopes:**
This complex consists of areas of Rock outcrop and soils on south-facing slopes. Elevation is 1,000 to 3,000 feet. The areas of Rock outcrop and soils are so intermingled that it was not practical to map them separately at the scale used in mapping. The soils formed in material weathered from basic igneous rock and rhyolite. This complex is about 70 percent Rock outcrop, 25 percent Kidd soils, and 5 percent Hambright, Boomer, and Forward soils. Rock outcrop areas are 1 to 5 acres in size. It consists of basic igneous boulders and massive rhyolitic escarpments, stones, and outcrops. Runoff is rapid. The hazard of erosion is very high.

178 **Sobrante loam, 5 to 30 percent slopes:**
The Sobrante series consists of well-drained soils on uplands. Elevation is 400 to 2,000 feet. These soils formed in material weathered from sandstone. The vegetation is mostly annual grasses, scattered oaks, and a few digger pine. In a profile, the surface layer is brown, slightly acid loam 6 inches thick. The subsoil is reddish yellow, light brown, and pink, medium acid clay loam 24 inches thick. Massive sandstone is at a depth of 30 inches. Permeability is moderate. Available water capacity is 4 to 6 inches.

179 **Sobrante loam, 0 to 50 percent slopes:**
See above listing. Runoff is rapid. The hazard of erosion is moderate to high.

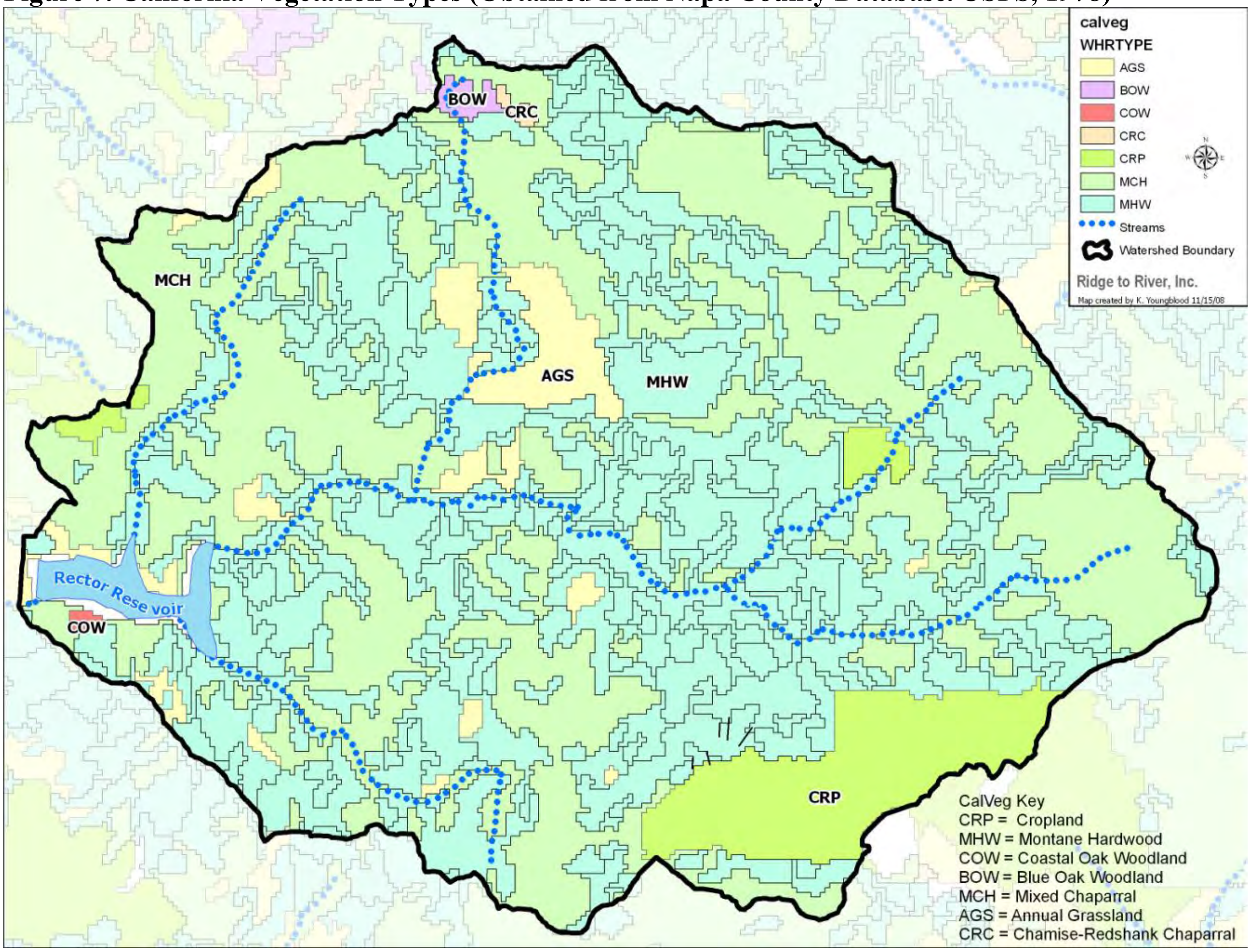
181 **Yolo loam, 0 to 2 percent slopes:**
The Yolo series consists of well -drained soils on alluvial fans. Elevation ranges from near sea level to 500 feet. These soils formed from recent alluvium. The vegetation consists mostly of vineyards and small areas of pasture and prune orchards. In a representative profile the surface layer is dark grayish brown, neutral loam and silt loam 24 inches thick. The underlying material is dark grayish brown and brown, neutral silt loam to a depth of 60 inches or more. Permeability is moderate. Available water capacity is 10 to 12 inches.

182 **Yolo loam, 2 to 5 percent slopes:** See above listing.

Vegetation

Soil type, soil moisture conditions, percent organic matter, solar aspect, slope, and climate are primary interacting factors supporting native plant communities in watershed areas still exhibiting natural conditions. Figure 7 mapped plant communities in the watershed in 1978 before the vineyard boom. Only a small area was mapped in 1978 as cropland. Since that time much more area in the upper mesa has been converted to cropland as is visible when comparing watershed air photos from 1993 and 2007 (figures 3 and 4) and in the 2002 air photo. The most common vegetation types in Rector Watershed were chaparral, manzanita, ceanothus, chamise, musk brush, chaparral pea, yerba santa, birch leaf mahogony - a variety of grasses and legumes, herbaceous plants, hardwood trees, and shrubs. Woodlands include small Live Oak, Blue Oak, California Bay Laurel, Buckeye. This group of hardwoods as well as assorted mixed conifers thrive in riparian corridors where moisture is more abundant. Leaf fall and litter from native plants exceeds generally exceed that of cropland vegetation. The photos that follow contrast vineyard cropland and roads that have displaced native chapparal, grasslands and woodlands.

Figure 7. California Vegetation Types (Obtained from Napa County Database. USFS, 1978)



Wildlife

Wildlife in the watershed area is diverse and scattered. Wildlife habitat is considered poor to fair in open land and good in the woodland areas (*NCSSC, 2003*). Wildlife habitat types are blue oak woodland, blue oak grassland, and interior chaparral. Habitats near the reservoir intake are riparian with cottonwood, and cattails (*CDFG, 2003*).

Observed wildlife in the area include black tailed deer, bobcats, mountain lions, gray fox, opossums, skunks, coyotes, jack rabbits, squirrels, wild turkeys, quails, wood ducks, golden eagles and wintering bald eagles, red shoulder hawks, red tailed hawks, kestrel, and osprey. Beavers were a part of the watershed at one time but were hunted out. Milliken Reservoir watershed reportedly supports beavers and it is possible that some could have migrated back into Rector Watershed (*CDFG, 2003*). Rector Reservoir contains a residual population of trout, roughfish, and steelhead (Skinner, 1962).

Hydrology

Average annual precipitation was estimated at 36 inches per year for Rector Creek Watershed. Continuous rainfall measurements have been recorded at Veterans Home in Yountville (1914 to present), Napa State Hospital in Napa (1917 to present), Conn Dam north of Yountville (1947-1998) and Milliken Dam southeast of Yountville (1965-1996).

Rector Creek Watershed is the primary water source for the Reservoir. Besides the North Fork, Lorette, and Mainstem, Rector Creek has several smaller seasonal tributaries.

In 1990, an inflow weir was installed just upstream of Rector Creek outlet. Flows were measured from May 1990 to February 1991 until the drought ended. The concrete piers from the weir are still there and can barely be seen emerging from the cobble (Mark Nicander, personal communication, 2008). Flow measurements ranged from 450 to 1,700 gpm, the equivalent of 1 – 4 CFS (*YVH*).

Inflow to the reservoir is the sum of streamflow from the mainstem Rector Creek, the North and South forks, and the smaller seasonal tributaries, as well as hillslope runoff and direct precipitation on the surface of the lake. Annual effective inflows estimated by DWR from 1964 to 1978 ranged from 2000-29000 acre-feet per year when precipitation ranged from 13-53 inches per year. This correlation can be used to estimate inflow into the reservoir by inputting annual precipitation into the following equation (DWR, 2000): The equation is presented graphically with a correlation R^2 = 98% for the regression equation that generates the curve graphic (Figure 8).

$$y=3.1572\ X^{2.2977}$$ where y=inflow (acre-feet) and x=annual precipitation (inches)

This equation allows one to calculate the reservoir inflow based on the precipitation experienced in a year, or even in individual storm pulses. Average annual precipitation is 36 inches as measured at Veterans Home. Using the equation or curve this comes to about 11878 AF/year. A dry year with 26 inches of rain would yield about 5625 acre-feet of inflow into Rector Reservoir. The graphic curve provided on Figure 10 enables the estimation without cranking the calculation by cross referencing perpendicularly up from “annual precipitation” (x-axis) until you meet the curve, then crossing horizontally from the curve to “annual reservoir inflow” (y-axis). Using this more simple method on the 26 inches of rain in a very dry year, the estimate comes to about 5300 acre-feet of inflow to the reservoir.

Direct experience indicates the reservoir fills up almost every year and spills over during the winter (Marc Nicander and Russell Van Voorhis personal communication). When full, the volume of water behind the dam at the present (post-1989) spillway crest elevation of 381.5 feet is 4535 acre-feet. Thus even in dry years when precipitation is less than 26 inches, the reservoir is expected to fill. Rector Reservoir‟s capacity, safe yields, and water right permit conditions are discussed later in Chapter 2, under Water Supply Sources.

Upstream Water Diversions

A 950 acre-foot earthen dam reservoir at Atlas Peak Winery stores some 49 acre-feet of water each year. This reservoir is filled by runoff during the rainy season and is used as irrigation water for the vineyards during the summer (*APW*). The Veterans Home has primary water rights to the water. Therefore, if Rector Reservoir capacity is below normal during the summer, the Atlas Peak Winery can be required to release their water storage to the Rector Reservoir (*YVH*).

Drainage pipes under vineyard and road ditches represent small water diversions. Additional diversions are likely present including small rural spring diversions with or without permitted water rights.

Wetlands

Wetlands are common ecological features found in most watersheds. Because of the status of wetlands as areas rich in biological diversity, additional botanical research is often required when planning to develop property if it contains a wetland. For this reason, people often keep information about their wetlands to themselves. At least one wetland is mentioned in an EIR regarding vineyard expansion. Several man-made wetland features were observed during the 2003 field reconnaissance in the form of small ponds formed from damming small streams in their headwaters. These wetlands, although maintained somewhat artificially, are colonized by aquatic plants and animals and become habitat features on the landscape that are protected from development by environmental regulations. There are likely to be many wetlands throughout the watershed.

Water Supply System

History

The Veterans Home of California is a facility of the State of California, Department of Veterans Affairs. It was established in the late 1800's and has served as a residential facility and hospital for veterans since that time. Throughout its existence, the Veterans Home has operated its own water supply system.

The Department of Public Health (DPH) has regulated the water system through the years, but it was not until 1982 that the Veterans Home applied for a domestic water supply permit. The system's existing water supply permit, No. 02-91-016, was first issued by DPH on August 9, 1991, and was amended on December 28, 1994. Considerable challenges existed in treating for turbidity and in backwashing filtration apparatus while maintaining a constant flow of finished water to customers without a finished water supply tank. Therefore a new water treatment system targeting these problems was developed and went online April 15, 2000 at a cost of roughly $5 million. A new permit was applied for in 2001 and was issued by DPH in 2002 for the new water treatment facilities.

On 7/17/02, SPH Associates (Consulting Engineers) performed a First Year Operation review of the new Rector Water Treatment Plant. The review was specified to examine results of water quality comparing performance standards to actual operating conditions, an assessment of problems experienced during the first year of operations, and a list of corrective actions needed. Water quality generated by the new plant was consistently well within DPH standards. The most serious operating problem proved to be a disrupted portion of support gravel, sand, and coal in Filter #2 of the Roberts filters. A portion of the sand and other media were found in the clearwell, and were finally cleaned in 2005 (Russell Van Voorhis – 2008, personal communication). Repairs were made to the wall plate and more sand was added to the filter to replace what was lost in the disrupted area. Generator problems were solved by adjusting sensitivity to the voltage drop sensor in the automatic switch. One of the $KMnO_4$ feed pumps failed repeatedly as a result of a residual PVC glue ball which seized a ball valve in a shut position. This was solved by replacing the ball valve.

Service Connections

The system has twelve service connections. These include: The State of California‟s Veterans Home, The California Department of Fish and Game‟s Region 3 Headquarters building and fish production hatchery, the Napa State Hospital for mental health (not currently using water from this source), the Town of Yountville, Paraduxx Winery, the Napa County Corporation Yard, the City of Napa (only used by Napa as an emergency source), and a few private residences.

The Veterans Home system wholesales water to the Town of Yountville on a regular basis. The Veterans home has twelve potable service connections in all. Approximately half of the water produced is sold to the town of Yountville. There are two raw water service connections, one for Fish and Game and one of Cal-Fire training grounds. The Napa State hospital has the right to receive water from the Veteran‟s Home, but has not exercised this right in years (Van Voorhis, personal Communication, 2009). The Population of Yountville, including the Veteran‟s home is approximately 3190. The population of the Veteran‟s Home includes 1038 veterans and 1000 staff persons (2009 email, David Kernohan).

During the 16 years between 1988 and 2002 the Veterans Home produced an annual average of 301 million gallons in years the plant operated. During the years between 2003 and 2008 the annual average production was 322 million gallons, a 7% increase over 6 years time.

In the last decade, the population of Yountville and the number of service connections has shown a continued increase (Table 3).

Table 3. Population, Service Connections, and Water Usage at Veterans Home (Rector Inspection Report, DPH 2008)

Year	Pop-ulation	Equiv. Number of Conn.	Total Water Demand (MG)			Average Daily Usage (gpdc)		
			Annual	Max. Month	Max. Day	Annual	Max Month	Max Day
1998	1,150	348	189.9	45.5	2.0	1,495	4,218	5,747
1999	1,150	348	181.4	27.4	1.8	1,428	2,540	5,172
2000	2,500	758	331.6	46.5	1.77	1,199	1,979	2,335
2001	2,500	758	311.0	44.1	1.89	1,124	1,877	2,493
2002	2,500	758	318.9	46.9	1.91	1,153	1,996	2,520
2003								
2004								
2005	2,500	758	540.3	77.52	1.75	1,953	3,299	2,309
2006			362.5	42.53	2.28			
2007	3,290	997	378.1	44.0	1.73	1,039	1,424	1,735

Cross-Connection Control Program

The Veterans Home has an in-house cross-connection specialist that tracks and tests all devices annually. Dan Lopez is the cross connection control program coordinator. The Veterans Home has a map with the location of each backflow device. A log is kept for each backflow devise that includes location, tag number, size, manufacture, line pressure, test date, and testing criteria. The cross-connection survey is ongoing (Russell Van Voorhis – 2008, personal communication).

Water Sources

<u>Rector Reservoir</u>

Rector Reservoir is the primary source of water for the Veterans Home water system. The reservoir is located along the eastern side of the Napa Valley at the base of the Howell Mountain foothills near Silverado Trail, about 4 miles northeast of the Veterans Home. The reservoir was created by the construction of Rector Dam in 1945. The dam is an earthen structure approximately 152 feet high and 800 feet long. The lake had an original capacity of 4400 acre-feet. The capacity was increased in 1985 to approximately 4535 acre-feet (AF) by raising the spillway height by about two feet to its present elevation of 372.5 feet. The lake usually overflows over the spillway each year (Figures 8, 9, 10).

Figure 8. Bathymetric Map (Elevation Contour) of Rector Reservoir

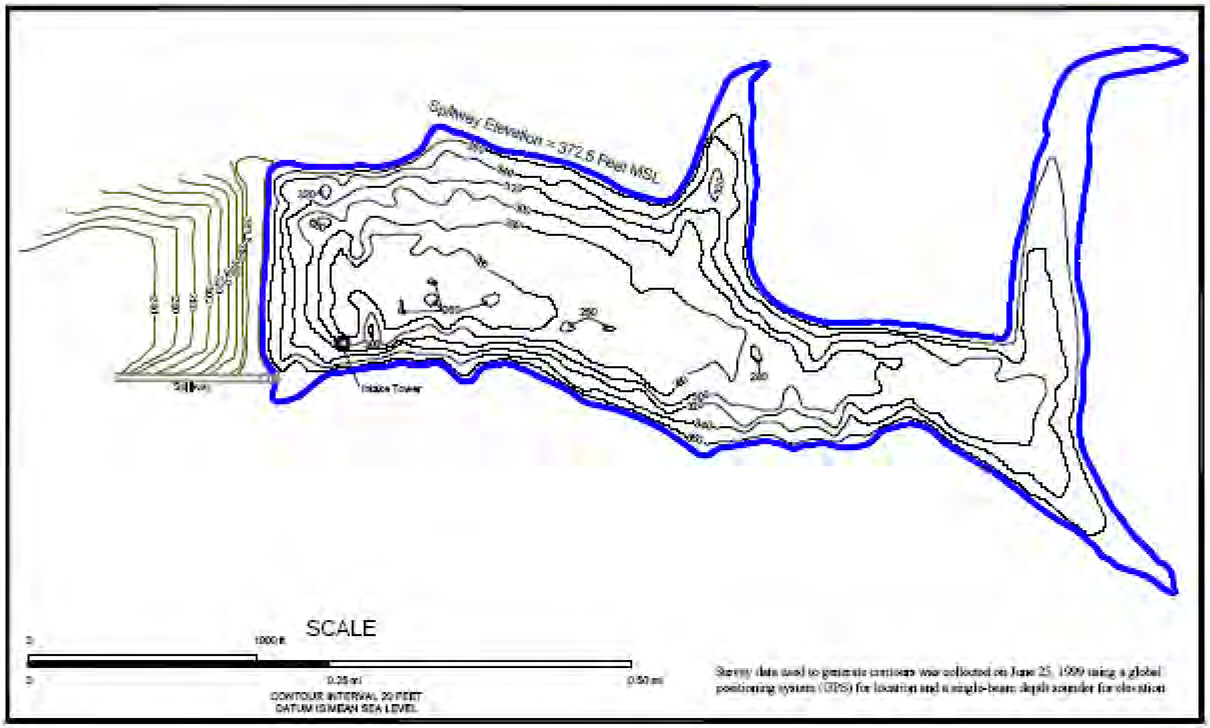
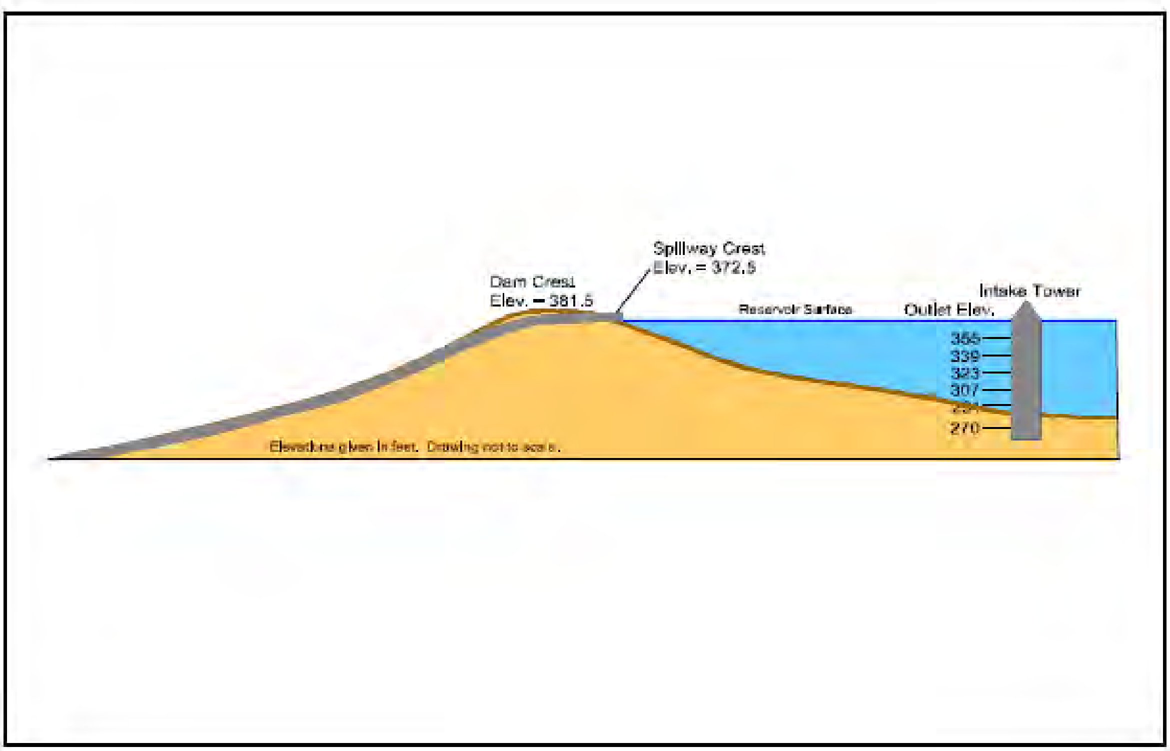


Figure 9. Rector Dam Profile (Courtesy Guy Schott, CDPH 2009)



As of 1970, Rector Creek"s water diversion is licensed by the State Water Resources Control Board Division of Water Rights to California Department of Veterans Affairs as follows based on priority of rights established May 7, 1942 (DWR, 1970): "the amount of water to which this right is entitled and hereby confirmed is limited to the amount actually beneficially used for the stated purposes and shall not exceed:

- 5.55 cfs by direct diversion January 1 – December 31 of each year
- 1767 afa by storage to be collected from October 1 of each year to May 31 of the succeeding year
- The total amount of water to be taken from the source (direct diversion plus collection to storage) shall not exceed 3518 afa from October 1 to September 30.
- The maximum amount that can be taken from the reservoir storage is 1767 af per year, not including direct diversion.
- The maximum amount that may be held in storage in Rector Reservoir shall not exceed 4400 af.

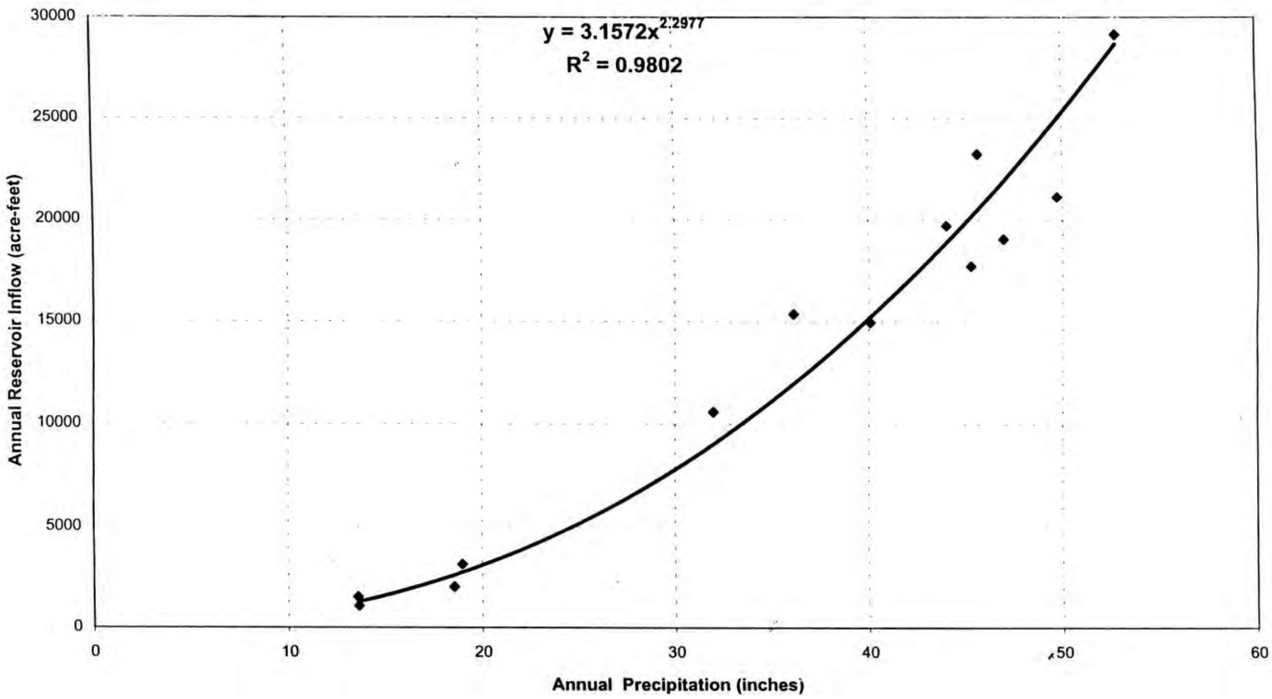
According to the Department of Water Resources study, the original maximum reservoir capacity when full to the spillway was estimated to be 4,780 AF. The 2001 volume estimate of 4535 AF represents a diminished capacity of 245 AF, even after including additional storage volume after the spillway was raised, due to sedimentation since the dam was built. The rate of sedimentation was 5% of volume in 54 years, due to watershed erosion, sediment transport, and deposition of sediments into the reservoir. Geologist Martin Trso estimated that the sedimentation rate has increased since 2000 (Stagecoach EIR, 2006). The drain to the reservoir is at 255 feet of elevation (Russell Van Voorhis – 2008, personal communication). The YVH hired divers to film the reservoir bottom to show the condition of sedimentation. These videos show that the drain is covered with silt, however the top of the trash rack over the drain valve was visible. The Division of Safety of Dams wants the drain of the reservoir to be exercised. This has not been done in several years, and there are potential problems associated with exercising this equipment and releasing water and sediment. The drain may or may not open, and may or may not close again. Release of water laden with silt can be detrimental to downstream Rector Creek and is likely to have a foul odor. The inlet opening at the drain and the outfall are 30", but the outlet is only 24".

Annual effective inflows estimated by DWR from 1964 to 1978 ranged from 2000-29000 acre feet per year when precipitation ranged from 13-53 inches per year yielding a correlation R^2 = 98% for the regression equation (Figure 10). See the Hydrology section earlier in this chapter for an interpretation of how to utilize this equation and its graphic curve.

The calculation and graphic that follows allows one to predict the reservoir inflow based on the precipitation experienced in a year. Average annual precipitation is 36 inches as measured at Veterans Home. A mildly dry year with 26" precipitation comes to 4500 Acre-feet per year raw water entering the reservoir. So even in a mildly dry year, precipitation from that water year alone would be almost adequate to fill the 4535 AF capacity estimated in 1985. This concept is validated by the observation that the reservoir does spill almost every year. DPH has indicated that 1670 acre-feet is a *"safe"* annual reservoir yield that implies that even during the driest years, 1670 af will be available (DPH Permit Report, 2001, 2008).

Figure 10. Correlation Between Annual Reservoir Inflow and Annual Precipitation

$y=3.1572\ X^{2.2977}$ where y=inflow (acre-feet) and x=annual precipitation (inches) (DWR, 2000)



Correlation Between
Annual Reservoir Inflow and Annual Precipitation
(1964 - 1978)

Table 4 summarizes a water budget beginning with source water diverted from reservoir storage. The total maximum raw water used beneficially 2002-2008 was 675 MG in 2006 (2071 acre-feet). This table includes the raw water diversion to DFG used for their fish hatchery at Region 3 Yountville headquarters facility and all other beneficial uses associated with the Division of Water Rights license. The 2071 acre feet influent term does not include water evaporated from the reservoir surface – an undetermined volume of water included within the total water withdrawal from Rector Creek authorized in the Division of Water Rights license. Water Treatment Staff indicate that raw water withdrawals also include an estimated 4% of Water Treatment Facility production volumes commonly needed as process water used in treatments converting raw water to finished water due to backwashing needs, etc (Mark Nicander, personal communication, 2002; Russell Van Voorhis, personal communication, 2008). The calculations from Table 4 suggest process water used has been higher than 4% but the includes water used in fire hydrant use, line flushing, etc.

Table 4. Yountville Veteran's Home Water Production/Consumption (Million Gallons except italicized values are in Acre Feet)									
Year	**Annual Hatchery Raw Water Influent**	**Annual WTF Raw Water Influent**	**Total Annual Raw Water Diversion*****	Max Mo WTF Influent	Max Day WTF Influent	Annual Process Water **	**Annual Finished Water Production**	**Annual Water Distributed to Veterans***	**Annual Surplus Water Sold******
2003	260	299	559	38.2	2.1	63	236	not provided	not provided
2004	200	338	538	38.8	2	55	283	187.5	95.5
2005	211	392	603	49.7	2	47	345	139.4	205.6
2006	234	441	675	59.7	2.7	78	363	170.9	192.1
2007	232	440	672	44	2.2	62	378	176.1	201.9
2008	265	366	631	40.6	1.7	41	325	157.5	167.5
Average	233.7	379.3	613.0	45.2	2.1	57.7	321.7	166.3	172.5
Avg. AF	***717.0***	***1164.0***	***1880.9***	***138.6***	***6.5***	***176.9***	***987.0***	***510.2***	***529.4***
Max AF	***813.1***	***1353.2***	***2071.2***	***183.2***	***8.3***	***239.3***	***1159.9***	***575.3***	***630.9***

WTF = Rector Water Treatment Facility
hatchery = DFG Region 3 Headquarters Fish Hatchery
* includes unaccounted water lost to leaks from tank to Vets Home taps
** includes any leaks, process, and backwash waters released to evaporation ponds
*** excludes undetermined evaporative losses which are to be subtracted from permitted water right
**** Town of Yountville, Paraduxx Winery, etc

The maximum total of raw water diverted from the source water was 2071 afa from 2003-2008. Water evaporated from the reservoir (presently undetermined) must be added to this volume as per the DWR license terms. Water evaporated from the reservoir could be as high as 3518-2071 = 1447 afa and still be within the terms of the license. Because the history of Vets Home use under this license dates back to 1942, it is likely that Vets Home holds the senior water right to Rector Creek. Vets Home"s right is thus superior in that its water right diversion must be unhindered completely by any junior right diversion operated upstream or downstream in Rector Creek such that Vets Home is able to meet its licensed diversion for the beneficial uses described in the license.

The Maximum volume of raw water entering the Rector Water Treatment Facility 2003-2008 was 441MG = 1353 af - in 2006. Finished water exiting the Water Treatment Facility was 363 MG (1114 af) that same year. The finished water volume reaching Veterans taps was 170.9MG (524 af) and the surplus water sold to other customers was 192.1 MG (589 af) in 2006.

Treatment Plant flow rates since the Roberts Filtration units were added brought average potential treatment plant production to 3MG/day (1095 MG/year or 3361 Acre-feet) and a maximum potential production capacity of 4.5MG/day (1642 MG/year or 5043 Acre-feet). These potential treatment rates greatly exceed present demands.

Surplus Water Connections

Since 1964 the Veterans Home has provided treated water to the Town of Yountville, an entity which had no independent water source of its own until a recently developed well became operational. Yountville is served by gravity from a high elevation water tank.

The Veterans Home supply is also connectable to the Napa City supply lines. Supply lines have an intertie allowing the source of potable water in the pipeline to be supplied by either the Vets Home OR the Napa City water systems. The connection can feed water in either direction, providing an emergency or backup source to both systems. A friendly "loan and borrow" relationship between the two water supply entities has been enjoyed for many years. The supply rate available to Napa from Vets Home is approximately 500 gpm which represents a minor percentage of Napa"s overall system demand rates. Yet in times of shortage, the opportunity for even a small alternate potable supply is an innovative strategy supporting the larger Napa Valley Community.

The Veterans Home has utilized Napa-produced water via the Conn Line connection (the large water supply pipeline running along Conn Creek) during the extended off-line time period caused by a large fire and subsequent prolonged ash-derived turbidity in 1981-1985, again in 1993, and again in December, 2002 during repairs when the Vets Home water treatment plant was offline for 3 weeks after a Rector Creek streambank collapsed downstream of the spillway, which threatened integrity of the raw water intake transmission pipes. The Napa City connection is able to supply the Veterans Home system with full flows, but the water must be pumped to achieve necessary pressures. The intertie is opened manually by Veterans Home personnel when needed.

In the past the Conn Line has supplied Yountville Veterans Home water to the California State Napa Mental Hospital. The Napa Mental Hospital does not currently use YVH water, but has the right to if in need. The City of Napa intertie also provided the entire water supply for Veterans Home for several years after a fire denuded vegetation across the watershed and ash washed into the reservoir incapacitating the water treatment facility due to elevated turbidities.

Surface Water Treatment Facilities and Processes

History

Prior to the dam and treatment plant, raw water from Rector Creek was taken directly from Rector Creek and piped to the Veterans Home via hollow redwood pipes (one presently on display at the Veterans Home Plant Operations Building). The dam across Rector Creek was built in 1945. The treatment plant was placed into service in 1976, after the passing of the Clean Water Act, providing in-line filtration and chlorine disinfection. In 1986 one filter was converted to a contact tank for particle flocculation. In its 1990 configuration, the treatment plant had a contact tank - one set of two filters and another set of three filters. There was no usable storage for the water system and the treatment plant had to stay on-line at all times to meet system demands, even during filter backwash. One side of filters was backwashed at a time while the other side stayed on-line to meet system demands. The plant operated continuously and the rate of flow through the plant fluctuated according to system demands.

The plant was taken off-line in January 1993 for reconditioning and was placed back into service in November 1993. During this time the water system relied upon the interconnection with the City of Napa for water supply.

In the 1990s, daily production by the system varied from 0.7 MGD to 1.6 MGD. The highest flow rate through the plant was 2,000 gpm (2.88 MGD). The maximum plant capacity based on the highest filtration rate of 3.0 gpm/ft^2 was 3600 gpm. However, the plant never operated at this high rate capacity.

The treatment system had trouble consistently meeting turbidity performance standards. A review of water quality data after May 1994 revealed that raw water turbidity was generally below 1 NTU and finished water turbidities were less than 0.1 NTU. But, when raw water turbidity exceeded 1 NTU the finished water turbidity increased during the backwash cycle, a result of keeping part of the plant on-line during the backwash cycle. Raw water turbidity above 15 NTU resulted in finished water turbidity spikes of 2 to 3 NTU for ten minutes or more. In the winter of 1995, the system violated turbidity standards in January, February and March. Raw water turbidity went as high as 80 NTU, and was above 10 NTU for over three months. Experiences during the winter of 1995 demonstrated the 1990s system could not consistently meet turbidity performance standards when the raw water turbidity exceeded 10 NTU and this spelled the need for expanding and improving the filtration aspect of the treatment plant for improved water clarification.

The last major fire that swept through the Rector Watershed was on June 22, 1981. The „Atlas Peak Fire‟ consumed 23,000 acres of brush, grass and trees and destroyed 61 homes, 91 other buildings, 40 vehicles and numerous wildlife and domestic animals. The fire consumed vegetation across the entire Rector Watershed leaving thick ash residues over bare soils that rinsed dirt and ash into the reservoir for several years incapacitating the treatment facility due to very high raw water turbidities. Water was purchased from Napa County during these years.

<u>Variable depth Intake Slots</u>

The reservoir raw water intake is a submerged concrete tower structure with 6 alternative inlets as well as a drain, all at different depths. Water quality varies according to depth and so the flexible intake avails higher water quality than would otherwise be extracted with a single-depth intake (John Urbanik -2003, personal communication). Analysis of the water conducted in 1982 as part of a treatability study indicated that in dry weather conditions there is a "layering" of water quality. Turbidity was greater deeper where specific conductance and alkalinity were lesser. In winter months test results indicated water was well mixed, with little difference at various depths. So the various inlet slots allow the operator to select the slot that draws optimal raw water quality from the reservoir‟s water column. The intake level must be changed manually.

Inlet slots in the inlet tower are located at the following depths: #1 at 28 feet below the spillway, #2 at 44 feet, #3 at 60 feet, #4 at 76 feet, and #5 at 92 feet below the elevation of the spillway.

<u>2001 Expanded Treatment Plant Online</u>

A new 4-million gallon per day packaged Roberts treatment system went online in February, 2001. There are two modular clarifier units operated in parallel. Each unit has a capacity of 1,400 gallons per minutes (gpm). There is also an internal document entitled Operations Plan For Rector Filtration Plant (2002) that describes staffing, the monitoring program, process operations, optimization, records, reliability, maintenance, and a shut-down procedure (Figures 11 and 12). The water treatment process includes the following steps:

- Chemical injection of potassium permanganate (seasonal)
- Chemical injection of 9800 aluminum chloride hydroxide (ACH) or NTU Technologies 926 (seasonally determined)
- Chemical injection of non-ionic polymer
- Mechanical mixing of pre-treatment chemicals for coagulation
- Flocculation in an enclosed 11,250 gallon pressure tank
- Filtration through five single-media roughing pressure filters
- Flow through two upflow contact clarifiers for solids removal
- Filtration though two mixed media gravity filters
- NTU Technologies 926 applied through spray on top of filters
- Injection of sodium hypochlorite for disinfection
- Injection of zinc-orthophosphate for corrosion control
- Contact time in 86,000-gallon baffled clearwell

(DPH Inspection Report, 2008, Courtesey of Guy Schott)

Figure 11. Graphical Representation of the Water Treatment Facility (SCADA system)

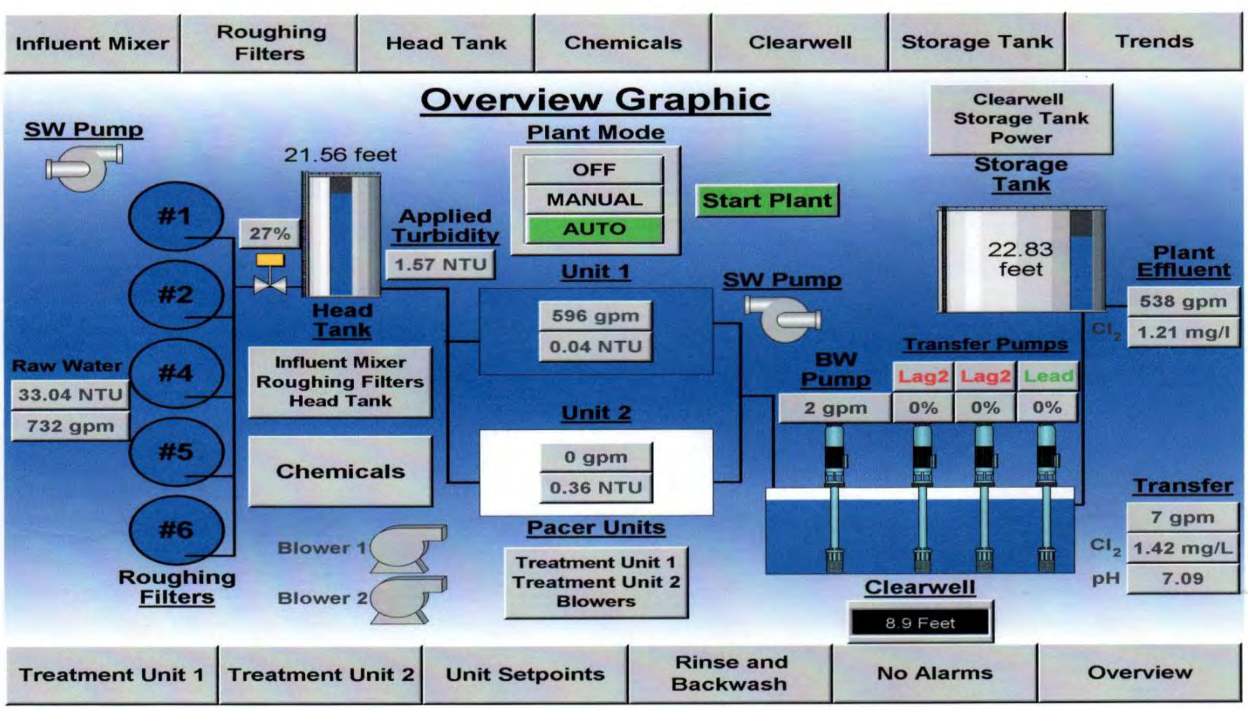
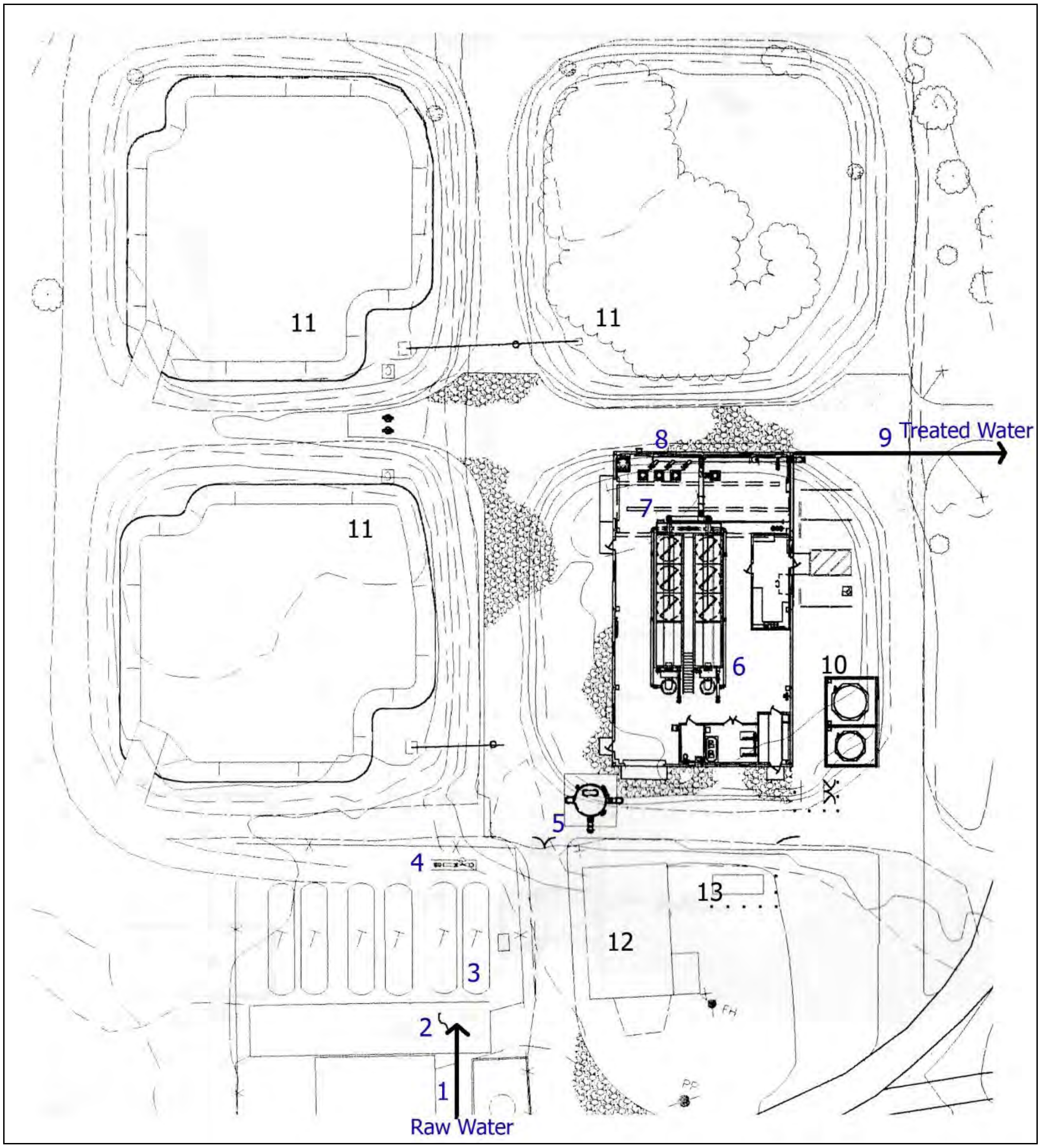


Figure 12. Map of Treatment Facility Shows the Flow of Water through the System



Key

1. 22" raw water line
2. Flash mixer
3. Roughing Filters
4. Flow control valve
5. Constant head tank
6. Treatment units
7. Clearwell
8. Transfer/High service pumps
9. 16" finished water line to storage
10. Chemical storage tanks
11. backwash ponds
12. Dry chemical storage
13. Emergency generator

Pre-Chemical Addition & Mixing

Potassium Permanganate is the first chemical injected in the raw water. The injection point is in the raw water line located at the base of Rector dam. Potassium Permanganate is used seasonally for the oxidation of manganese and to control taste and odors. Dosage is less than 0.5 mg/L. The feed pump system is a ½ horsepower Encore 700 diaphragm metering pump with a capacity of 12 gallons per hour (GPH). The booster pump for the carrier water system is located at the roughing filter site where water is blended with the potassium permanganate chemical and pumped to the foot of the dam where it is injected into the raw water transmission line.

Dosage is based on jar testing if dissolved raw water manganese is elevated. The jar test consists of adding potassium permanganate in increments of 0.05 mg/L to the raw water. Dosage is determined when a stable pink color occurs. If taste and odor is the main problem, then dosage is based on odor testing. If the raw water has elevated manganese and taste and odor, then dosage is based on jar testing.

Aluminum Chloride Hydroxide (ACH) is used as a coagulant and is injected just before the mechanical flash mixer located at the roughing filter site. Dosage is 2 – 16 mg/L. The feed pump system is a Wallace & Tiernan Solenoid metering pump with a capacity of 1.87 GPH. There is a 100-gallon day tank and a 3,000 gallon storage tank.

The ACH and raw water are mechanically mixed. The mixer is an Anco Mixer Model 500-12DS with three blades. The purpose of a flash mixer is to disperse the coagulant chemical quickly and evenly in the raw water and to destabilize the particles in the raw water.

Dosage of ACH is based on jar testing, streaming current output and plant performance. The streaming current monitor has an alarm which will shut the plant off in the event of reduction or loss of the coagulant feed.

Roughing Filters

Roughing filters were installed to remove the bulk of the turbidity in pre-treatment, insuring a higher quality finished water during turbid times. There are five roughing filter vessels and one flocculation vessel. Each vessel is 30 feet long, 8 feet diameter and has two chambers or cells. The flocculation tank is approximately 11,250 gallons. At a plant flow rate of 700 to 2,800 gpm, the theoretical contact time ranges from 16 to 4 minutes. Filter loading rates range from 0.58 to 2.3 gpm/ft^2.

Non-ionic polymer is added in the coagulated water to increase size and particle strength for retaining floc onto the filter media. Dosage is approximately 0.05 mg/L which is determined by the filtered turbidity measured downstream from the Head/Control tank. The feed pump system is a Wallace & Tiernan Solenoid metering pump with a capacity of 5 GPH. There is one 500 gallon storage tank.

The conditioned water goes through the flocculation tank before entering the roughing filters. There are two roughing filters on one side of the flocculation tank and three on the other side. Each roughing filter has two cells and contains 72 inches of Torpedo Sand (1-mm effective size).

In backwash mode one filter cell is taken off-line while the other nine cells remain on-line to produce backwash water. Control valves are adjusted manually to maintain a constant flow of 1,800 gpm which give a backwash rate of 15 gpm/ft^2 for each filter cell. Rotary surface wash, at a rate of 1.25 gpm/ft^2, is provided during the first two minutes of a backwash cycle. The length of backwash range from 6 to 10 minutes. Optimum backwash time is dependent on raw water conditions, length of filter run, and chemicals in use. There has not been adequate operation time of the roughing filters to determine optimum backwash time.

The turbidity sample point downstream of the roughing filters is located on the top of the clarifier portion of the Roberts Unit. The Roberts contact clarifier is monitored with a Hach 1720C turbidimeter and SCADA (Supervisory Control and Data Acquisition)

Head/Control Tank
Following the roughing filters, the water flows to an 11,740 gallon Head/Control tank. Its purpose is to maintain a constant supply pressure to the Roberts Treatment Units. There is a balancing between the Head/Control tank, the level control valve and the positioning valve which control the flow to the plant.

Roberts Packaged (Modular) Contact Clarifier
From the Head/Control tank, the chemically mixed raw water flows to two Roberts package treatment units. Just before each contact clarifier, the water is injected with a non-ionic polymer. Dosage is approximately 0.05 mg/L, which is determined by the clarifier turbidity. The feed pump system is a Wallace & Tiernan Solenoid metering pump with a capacity of 8 GPH. There is one 500 gallon storage tank. The purpose of the non-ionic polymer addition is to increase the size and strength of particle aggregates applied to the gravity filters.

Depending on the demand, the treatment units are operated together in parallel or alternated one at a time. The water flows upward through the contact clarifier, which contains non-buoyant media that trap coagulated particles. A screen is placed over the top of each clarifier to retain the media during a clarifier flush. Each contact clarifier has a surface area of 140 ft^2. Surface loading rates range from 5 to 10 gpm/ft^2.

To assess the performance of each contact clarifier, daily turbidity grab samples are taken throughout the day. Clarified turbidities are normally maintained less than 0.6 NTU.

The contact clarifiers are flushed after 24 to 96 hours of operation when the roughing filters are on-line. Without the use of the roughing filters, clarifiers are flushed from between 2 and 8 hours depending on raw water conditions and chemicals in use. The roughing filters greatly reduce how often the clarifiers need to be flushed. They can be flushed based on time, head loss, clarifier turbidity or manually. The operators do not allow the clarifiers to operate beyond 0.6 NTU. Each clarifier is flushed at a rate of 10 gpm/ft^2 (1,400 gpm). Flush cycles consist of 3-minutes of water and air followed by a 6 minutes flush of water.

Roberts Filtration (dual media)
After the contact clarifier, the water overflows into a partially submerged trough that runs down the middle of each treatment unit. The clarified water gravity flows down the trough where it overflows onto the filter media. The filter media consists of 18-inches of anthracite coal, 9-inches of silica sand and 3 inches of garnet sand followed by graded gravel. Each unit has a filtration area of 283 ft^2. Maximum filter loading rate is 5 gpm/ft^2 (1,415 gpm per unit).

Water gravity flows through the filter media and is collected in a lateral underdrain system. From there, the filtered water is chlorinated and treated for corrosion control before flowing to an 86,000-gallon clearwell. Each filter unit is monitored by a Hach 1720D continuous analyzer and SCADA.

In a backwash sequence, one filter remains on-line filtering water while the other filter is put into backwash mode. The flow through the filter on-line remains constant so not to upset the filtering process. Operating at plant capacity, a filter is operated 100-200 hours before put into backwash mode. A filter may also go into a backwash mode based on pressure differential (26-inches of head loss).

The water used to backwash the filters may come from the clearwell or the 1-million gallon storage tank. Normally, it comes from the 1-million gallon storage tank by gravity. Backwash rate is from 15 to 20 gpm/ft^2 based on water temperature. The length of backwash is approximately 9 minutes and is adjustable. Included in the backwash sequence is a surface wash rotary system that delivers 180 gpm (0.6 gpm/ft^2). This falls within the recommended range for rotary systems of 0.5 to 1 gpm/ft^2.

Approximately 9 minutes of filter-to-waste (adjustable) is provided after a backwash. Backwash and filter-to-waste water is discharged to one of three sludge ponds for percolation. None of this water is recycled back into the plant.

If the water system is only operating one filter unit, when that unit has gone through a complete backwash and filter-to-waste sequence, it is shut off and the other unit placed into service.

If turbidity increases above 0.19 ntu, the plant will automatically be shut down. An alarm will notify the boiler room at the YVH, who in turn will notify the operator on duty.

Table 5. Treatment Chemicals Used: (Inspection Report, DPH 2008, Courtesy Guy Schott)

Chemical	Injection Point	Frequency and Function	Dose Rate Range (during 2007)
NTU Tech 926 Polymer	Through dripline onto clarified water effluent	Daily- Filter Aide	0.5 – 1.6 mg/L
Sodium Hypochlorite	Combined Filter Effluent	Daily-Disinfection	1.00 – 2.30 mg/L
Zinc- Orthophosphate	Combined Filter Effluent	Daily- Corrosion Control	3.70 – 7.90 mg/L

<u>Chlorine Contact in Clearwell/CT Disinfection Inactivation Compliance</u>
This system has an 86,000 gallon baffled concrete clearwell tank (maximum working volume) located below grade. The tank is 52.5 feet long, 23 feet wide and 12 feet deep. This tank has three 75 horsepower transfer pumps for delivering the disinfected water to a 1 million gallon storage tank. Each pump has a capacity of 1,500 gpm. One pump is used as a backup while the other two pumps operate in a lead/lag mode.

The Roberts filtration plant is credited with providing 2.5-log (99.7%) reduction of Giardia cysts and 2-log reduction of viruses when the 0.2 NTU performance standard is met - 95% of the time. For compliance with the SWTR inactivation requirements, the system must provide an additional 1/2-log inactivation of Giardia cysts, and 2-log inactivation of viruses through chlorine contact before the first connection.

The 80,000 gallon clearwell and 1330 feet of 16" pipeline between the clearwell and the 1-million gallon tank are given contact time credit for the inactivation of Giardia cysts and viruses. The minimum operating clearwell volume is 72,000 gallons. The transmission line to the clearwell is 16-inches in diameter and 1,330 feet long for a volume of 13,890 gallons. The transmission line from the clearwell back to the treatment plant is an 18-inches in diameter and 1,280 feet long for a volume of 16,900 gallons. The total volume is approximately 30,790 gallons. No credit was given to the 1-million gallon storage tank due to the inlet/out configuration. At maximum plant capacity of 2,800 gpm, the effective contact time for the clearwell and transmission line is 20.7 minutes. At a maximum pH of 7.5 and minimum water temperature of 5^oC, the minimum chlorine residual required is 1.5 mg/L.

Chlorine Contact Post-Chlorination
Sodium Hypochlorite is injected into the filtered water at a dosage of approximately 1.2 to 1.4 mg/L as free chlorine. The feed pump system is a Wallace & Tiernan Solenoid metering pump with a capacity of 8 GPH. The feed system has a 5,000-gallon storage tank.

Corrosion Control
Zinc Orthophosphate is injected into the filtered water for lead and copper control at a dosage of approximately 6 mg/L. The feed pump system is a Wallace & Tiernan Solenoid metering pump with a capacity of 1 GPH. The feed system has a 3,000-gallon storage tank.

Transmission/Storage/Distribution Facilities

The first service connection is the Fish & Game (CDFG) facility on Silverado Trail, across from the treatment plant. CDFG requires non-chlorinated water for their fish hatchery operations so this line leaves the raw water supply upstream of KMnO4 or any chemical injection and upstream of the treatment plant. Water exiting filters flows into the clearwell where level sensors control the transfer pumps to the 1-million gallon storage tank. When the storage tank is full, the pump automatically shuts down. With the exception of CDFG and the Cal-FIRE / Napa County FIRE training grounds, water connections served are distributed from the finished water storage tank following treatment.

Transmission and Storage Facilities
The transmission line leaving the clearwell to the 1-million gallon storage tank is a 16-inch diameter PVC pipe. The 1-million gallon steel storage tank is located north of the treatment plant and west of Rector Reservoir. The tank‟s diameter is 74 feet and height is 32 feet. The outlet is 18 inches. Both inlet/outlet pipes are on the bottom.

The estimated required storage capacity (including fire demand) for the Veterans Home is based on average day demand of 2520 gallons per day per connection, which equals 2,512,440 gallons (DPH, 2008). The required storage is more than the 1,000,000 gallons that the Veterans Home has in capacity. The YVH is in the process of retrofitting a damaged 1, 250,000 gallon tank that will, combined with the 1,000,000 gallon tank, provide 90% of the storage needs. In the mean time the treatment plant has backup power which can produce 2,800 gpm or 336,000 gallons in 2-hours. Also, The Veterans Home has an intertie connection to the Napa Conn line. There is a booster pump station available with three pumps, two 800 gpm and one 350 gpm, to provide fire protection. Helicopters can also load water bags at Rector Reservoir.

Table 6. Pipe Diameters in Distribution System (DPH Inspection Report, 2008

Pipe Diameter	Length (feet)		Pipe Diameter	Length (feet)
1-inch	319		8-inch	3,094
2-inch	6,180		10-inch	3,209
3-inch	1,108		14-inch	5,000
4-inch	7,817		16-inch	3,200
6-inch	17,980		18-inch	10,600

The 10-inch Steel line connects to a 1.25 Million Gallon concrete tank that is not currently in service. The elevation of this tank is too low to provide adequate pressure to the Veterans Home distribution system and there is groundwater intrusion. A pump station was constructed circa 1990 adjacent to this tank to try to utilize the storage. However, due to hydraulic problems such as water hammer and the fact that there is only one pipeline entering the tank, pumping from the tank proved unworkable. There has also been groundwater intrusion into this tank, a concern because it is below the cemetery. The Veterans Home is in the process of updating this system by laying a 16" transmission line, updating the pumping station to pressurize the system, and re-enforcing with iron (Patrick Gilleron – 2008, personal communication).

AIR SCOUR BLOWERS

NUMBER – TWO
CAPACITY – 480 SCFM
HORSEPOWER – ____
POWER – 480 VAC, 3 PHASE

EFFLUENT TRANSFER PUMPS

NUMBER – THREE
RATED CAPACITY – 1,400 GPM
HEAD @ RATED CAPACITY – 160 FT
HORSEPOWER – 75 hp
CONTROL – VFD
POWER – 480 VAC, 3 PHASE

TYPICAL DOSAGE RANGE – 0.5–2.0 mg/L
METERING PUMP CAPACITY – 480 gpd
STORAGE TANK SIZE – 500 GAL
DOSAGE CONTROL – STROKE LENGTH – MANUAL
– STROKE SPEED – FLOW PACING

ZINC ORTHOPHOSPHATE

TYPE – DIAPHRAM METERING PUMP
NUMBER – TWO (ONE = STANDBY)
TYPICAL DOSAGE RANGE – 1.0–2.0 mg/L
METERING PUMP CAPACITY – 120 gpd
STORAGE TANK SIZE – 3,000 GAL
DOSAGE CONTROL – STROKE LENGTH – MANUAL
– STROKE SPEED – FLOW PACING

DESIGN CRITERIA

PLANT FLOW RATES

NOMINAL NOMINAL CAPACITY – 2,100 gpm (3 mgd)
MAXIMUM CAPACITY – 3,150 gpm (4.5 mgd)

EXISTING FACILITY

FLOCCULATOR VESSEL (EXISTING)

NUMBER – ONE (VESSEL #3)
DIMENSIONS – DIAMETER – 8'–0"
LENGTH – 30'–0"

ROUGHING FILTER VESSELS (EXISTING)

NUMBER – FIVE
CELLS/VESSEL – TWO
DIMENSIONS – DIAMETER – 8'–0"
LENGTH – 30'–0"
FILTER AREA – 120 SQ FT/CELL
– 240 SQ FT/VESSEL
– 1,200 SQ FT TOTAL
FILTERING RATE: W/FIVE VESSELS IN SERVICE
CURRENT MAXIMUM – 1.67 gpm/sq ft
REVISED NOMINAL – 1.75 gpm/sq ft
REVISED MAXIMUM – 2.10 gpm/sq ft
FILTERING RATE: W/ONE VESSEL OUT OF SERVICE
CURRENT MAXIMUM – 2.08 gpm/sq ft
REVISED NOMINAL – 2.19 gpm/sq ft
REVISED MAXIMUM – 2.63 gpm/sq ft

NEW SURFACE WASH BOOSTER PUMP

NUMBER – ONE
RATED CAPACITY – 150 GPM
HEAD @ RATED CAPACITY – 50 FT
HORSEPOWER – 3 hp
POWER – 480 VAC, 3 PHASE

NEW FACILITIES

HEAD CONTROL TANK:
NUMBER– ONE
DIMENSIONS – DIAMETER – 10'–0"
HEIGHT – 24'–0"
WATER LEVEL – 20'–0" NOMINAL
WATER VOLUME – 11,740 GAL
DETENTION TIME – 5.59 min @ nominal rate

MODULAR TREATMENT UNITS

NUMBER – TWO
CAPACITY EACH – 1050 GPM NOMINAL
– 1,575 GPM MAXIMUM

CLARIFIER AREA EACH – 105 sq ft
CLARIFIER RATE – 10 gpm/sq ft NOMINAL
– 15 gpm/sq ft MAXIMUM
CLARIFIER FLUSH RATE – 10 gpm/sq ft

FILTER AREA EACH – 210 sq ft
FILTER RATE – 5 gpm/sq ft NOMINAL
– 7.5 gpm/sq ft MAXIMUM
FILTER BW RATE – 18 gpm/sq ft @ 75° F
– 3,780 gpm
AUXILLARY SCOUR – ROTARY SURFACE WASH
– 150 gpm

AIR SCOUR BLOWERS

NUMBER – TWO
CAPACITY – 480 SCFM
HORSEPOWER – ____
POWER – 480 VAC, 3 PHASE

EFFLUENT TRANSFER PUMPS

NUMBER – THREE
RATED CAPACITY – 1,400 GPM
HEAD @ RATED CAPACITY – 160 FT
HORSEPOWER – 75 hp
CONTROL – VFD
POWER – 480 VAC, 3 PHASE

BACKWASH PUMP

NUMBER – ONE
RATED CAPACITY – 3,780 GPM
HEAD @ RATED CAPACITY – 35 FT TDH
HORSEPOWER – 50 hp
POWER – 480 VAC, 3 PHASE

SURFACE WASH BOOSTER PUMP

NUMBER – ONE
RATED CAPACITY – 150 GPM
HEAD @ RATED CAPACITY – 50 FT
HORSEPOWER – 3 hp
POWER – 480 VAC, 3 PHASE

TREATED WATER TRANSFER SUMP

NUMBER – ONE
CAPACITY – 80,000 GAL (@ 10 FT WATER DEPTH)
DIMENSIONS – LENGTH – 50 FT
– HEIGHT – 12 FT
– WIDTH – 23 FT
– OVERFLOW – 18 inch

TREATED WATER STORAGE TANK

NUMBER – ONE
CAPACITY – 1,000,000 GAL
DIMENSIONS – DIAMETER – 74 FT
– HEIGHT – 32 FT
– INLET – 16 inch
– OUTLET – 18 inch
– OVERFLOW – 20 inch
– DRAIN – 6 inch

CHEMICAL FEED SYSTEMS

POLYMER ; ACH

TYPE – DIAPHRAM METERING PUMP
NUMBER – ONE
TYP DOSAGE RANGE – 2.0–5.0 mg/L
METERING PUMP CAPACITY – 24 gpd
STORAGE TANK SIZE – 3,000 GAL
DOSAGE CONTROL – STREAMING CURRENT

FILTER AID POLYMER

TYPE – DIAPHRAM METERING PUMP
NUMBER – TWO
TYP DOSAGE RANGE – 0.02–0.10 mg/L
METERING PUMP CAPACITY – 192 gpd
STORAGE TANK SIZE – 50 GAL
DOSAGE CONTROL – MANUAL

POST–SODIUM HYPOCHLORITE

TYPE – DIAPHRAM METERING PUMP
NUMBER – TWO (ONE = STANDBY)
TYPICAL DOSAGE RANGE – 1.0–2.5 mg/L
METERING PUMP CAPACITY – 192 gpd
STORAGE TANK SIZE – 5,000 GAL
DOSAGE CONTROL – STROKE LENGTH – MANUAL
– STROKE SPEED – FLOW PACING

POTASSIUM PERMANGANATE

TYPE – DIAPHRAM METERING PUMP
NUMBER – TWO (ONE = STANDBY)
TYPICAL DOSAGE RANGE – 0.5–2.0 mg/L
METERING PUMP CAPACITY – 480 gpd
STORAGE TANK SIZE – 500 GAL
DOSAGE CONTROL – STROKE LENGTH – MANUAL
– STROKE SPEED – FLOW PACING

ZINC ORTHOPHOSPHATE

TYPE – DIAPHRAM METERING PUMP
NUMBER – TWO (ONE = STANDBY)
TYPICAL DOSAGE RANGE – 1.0–2.0 mg/L
METERING PUMP CAPACITY – 120 gpd
STORAGE TANK SIZE – 3,000 GAL
DOSAGE CONTROL – STROKE LENGTH – MANUAL
– STROKE SPEED – FLOW PACING

Figure 13. Hydraulic Profile of Rector Water Treatment Facility

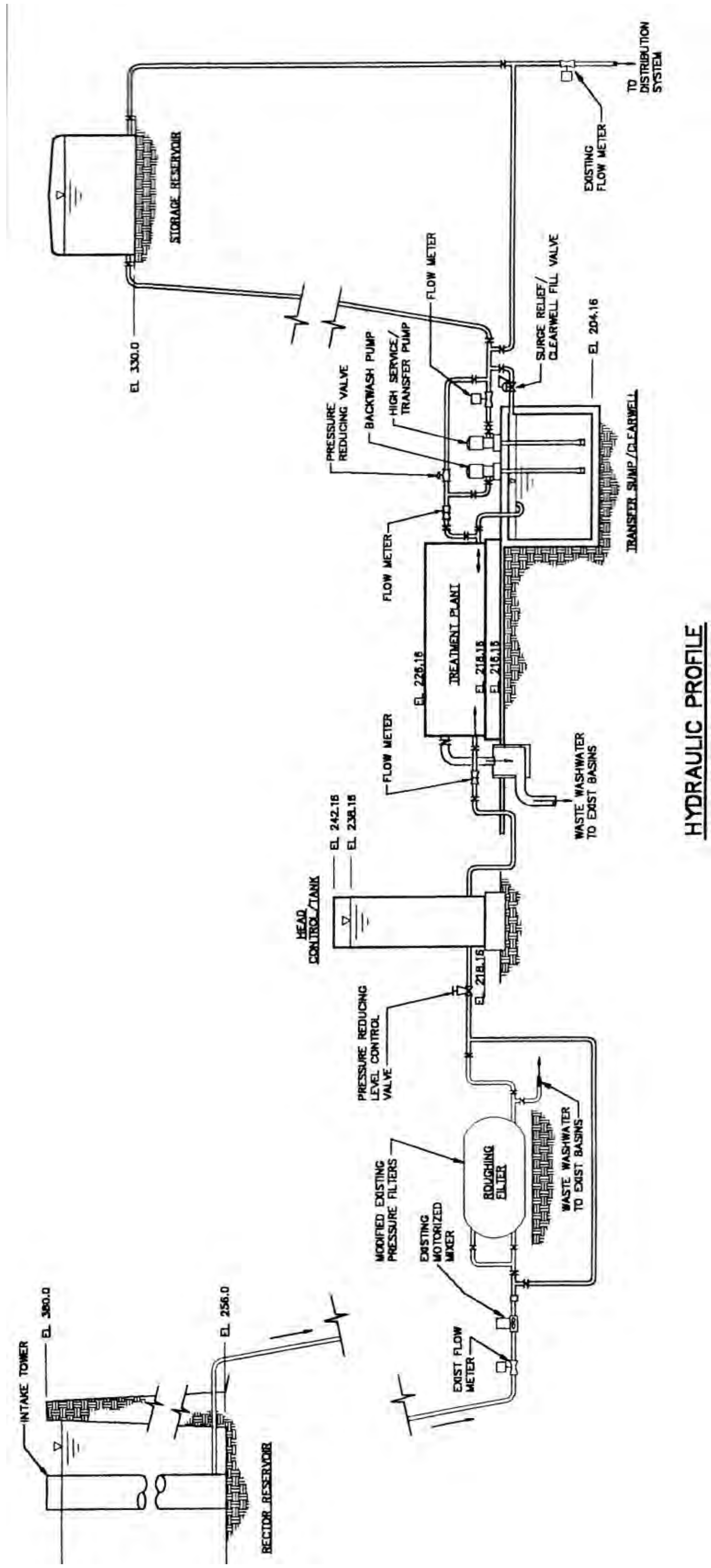
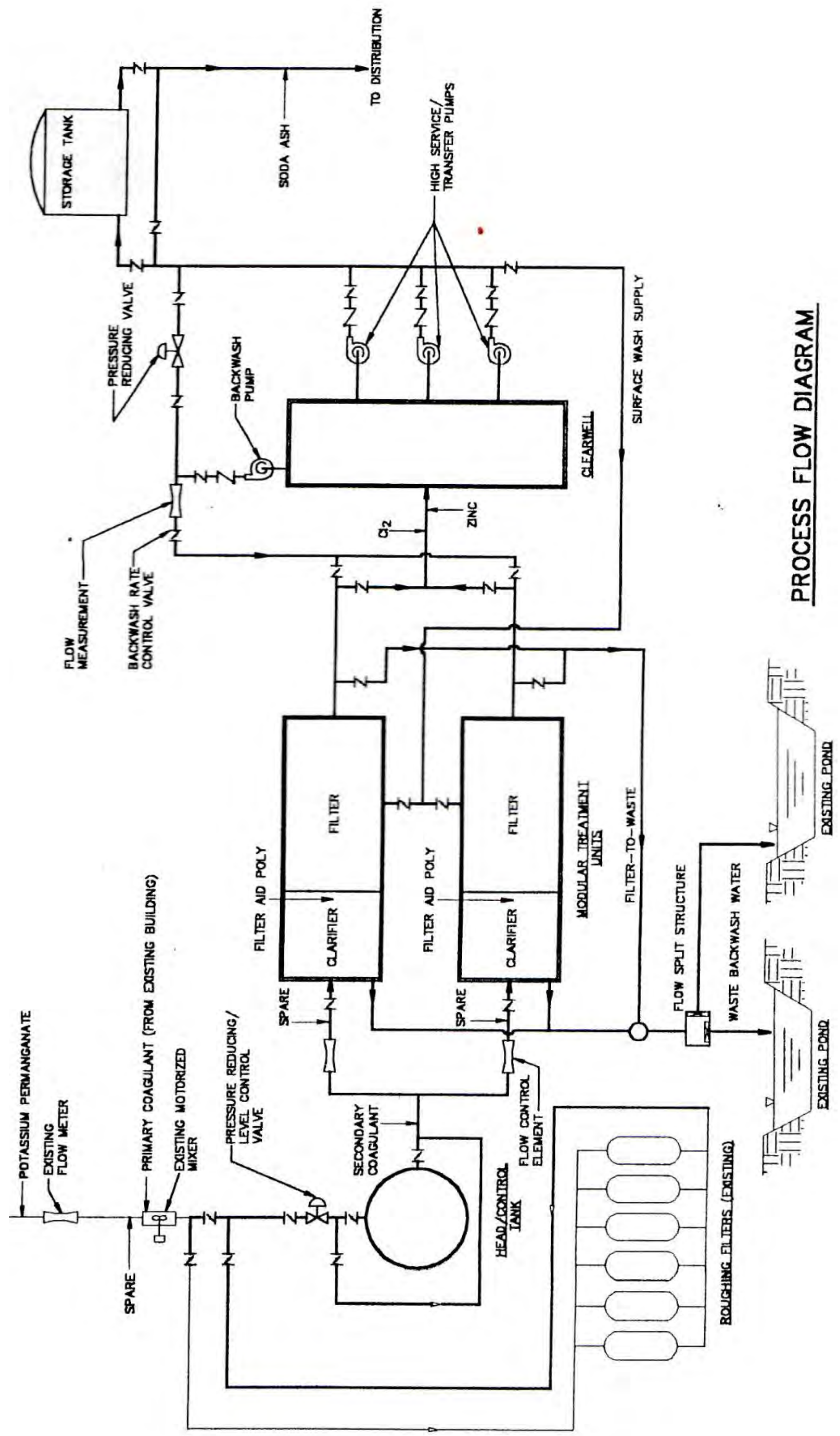


Figure 14. Rector Water Treatment Facility Process Flow Diagram



Distribution
The distribution system is fed by a 1-million gallon gravity feed storage tank, and a booster pump station. When the system is supplied by the Veterans Home treatment plant, there is only one pressure zone which serves all connections to the Veterans Home and Fish & Game. If the Veterans Home buys water from the City of Napa, then it must be boosted to provide adequate pressure to the Home. The booster pump station is located near the entrance to the Veterans Home. There are three booster pumps. Two of the pumps have capacities of 800 gpm and are controlled by the Energy Management System. The third pump has a capacity of 350 gpm and is operated manually. Two pumps are controlled by the emergency management system.

There is no documentation on the type and sizes of the distribution piping system. Some of the piping could be as old as 100 years. Most piping was replaced in the 1960s according to the operator. Based on line repairs, the pipe materials are steel and asbestos cement.

From the treatment plant the water is delivered to the Veterans Home via a four mile long steel pipe that crosses the Napa Valley to get to the Veterans Home in Yountville. Along the way, water also serves about five other connections.

Flushing Program
The lines are flushed once per year during the month of February. In addition, the Fire Department checks the flow of each hydrant, which adds to flushing of the system.

Emergency Plans

An Emergency Response Plan was prepared, and is regularly updated, in order to quickly and efficiently respond to a variety of Water Treatment Facility and distribution system crises. Emergency incidents involving the Water Treatment Facility or the distribution system may arise from infrastructure failures, accidents, hazardous materials spills, construction mishaps, cross connection violations, waterborne disease outbreaks, power outages, fire, flooding, drought, earthquake, vandalism, terrorism, or other unforeseen events. A Scene Coordinator is used to determine the immediate hazard, isolate the scene, identify the nature of the failure, make necessary notifications, coordinate activities at the scene, make decisions and authorize repairs and/or changes in processes to protect the water system from contamination, and serve as communications link between the scene and the dispatch center at the Yountville Veteran‟s Home. The dispatch center at the YVH will follow procedures by notifying all managers on duty about the emergency, who would in turn call their phone trees.

The plan has a phone contact list, information for state and California agencies, contact information for alternative water supplies, procedures for notifying the public of an emergency through media sources, and a plan to limit water use at the YVH by using canned and easily reparable foods in the Cafeteria.

Water system information and instructions in the form of maps, identification of alternative raw and treated water sources, emergency water supply calculations, emergency equipment and supplies, and instruction for YVH radio and telephone equipment are described within the plan.

In the case of a multi-agency or multi jurisdiction emergency the YVH will implement California SEMS (Standardized Emergency Management System) when the Emergency Operations Center is activated or a Local Emergency is declared. The YVH has five levels of SEMS. Command, Operations, Planning, Logistics, and Finance/administration functions are to be provided for single incident emergencies through widespread catastrophes. Activities include evaluating the situation, providing mutual aid to other jurisdictions within the County, notifications, disseminate warnings and instructions to citizens, conduct evacuation and/or rescue operations, restrict traffic to affected areas, identify potential release of hazardous materials, mobilize personnel, resources and equipment, issue materials through a documented tracking system, establish and locate the incident command system, declare a local emergency if necessary, and request mutual aid from OES (Office of Emergency Services) Area Coordinators when resources are committed to the maximum extent possible.

The Water Treatment Facility will automatically shut down if a constituent, such as chlorine or turbidity, is outside the target range. Alarms will go off, notifying the Systems Operator on duty.

3. POTENTIAL CONTAMINANT SOURCES IN WATERSHED

Survey Methods

The watershed was partitioned geographically into three distinct subwatersheds; the North Fork, Mainstem Rector Canyon, and the Lorette or South Fork. Air photo interpretation was conducted in each subwatershed in 2003, and an aerial survey of each watershed was conducted in October 2008 by Professional Hydrologist Teri Jo Barber. In July, 2008 field evaluation was conducted by watershed scientist Anna Birkas. The field evaluations occurred over a 3-day period in which time the treatment plant, reservoir, and upper watershed were explored. Russell Van Voorhis, Operator IV, provided a tour of the treatment facility, explaining the functions of each unit. Russell Van Voorhis and Winniefredo Cruz, Operator III, also provided a tour of the reservoir by boat. Three stops were made at inlets of the main tributaries. Anna Birkas walked approximately one quarter mile up each tributary to asses stream conditions and influences. Anna Birkas also toured the central watershed by car along Soda Canyon Road and its three forks, which eventually dead end at private property. This allowed for viewing of land use practices in the central watershed "mesa" region on both sides of the watershed divide. Unfortunately, we were not able to view the upper watershed on the ground because there are no public access roads.

Information was obtained from a variety of existing reports, maps, public agency file documents, personal interviews, telephone conversations, and personal observations. Additional research was conducted through review of documented information from Napa County offices of the Agricultural Commissioner, Planning and Conservation, Rector Water Treatment Plant, and Veterans Home Plant Operations. Web based research was very helpful in the investigation of pesticide and herbicides reported to be used in the watershed.

Aerial Survey and Photo Documentation

The remote nature of the watershed with minimal public roads makes survey by foot or car difficult. Because access was limited, Ridge to River conducted an aerial survey in October, 2008. Although we were looking for anything of significance, our primary goals were to 1) obtain a better understanding of erosion in the watershed, and 2) observe any obvious impacts of recent vineyard expansion. Our methods included starting at the reservoir and flying along each of the three main tributaries to „scan" for signs of recent erosion or sediment deposition. After the initial flight scans up the tributaries, areas of significance were re-visited and photographed. Sediment deltas were observed and photographed at the inlet of each main tributary. Although we timed our flight in winter – in part to allow for fall leaves to reveal more of the channel – we could not see into any channels due to thick vegetative canopy. We attempted to fly low within the canyon walls but blustery wind conditions made us choose a higher elevation for safety purposes. The upper mesa was clearly visible. We focused on tilled cropland areas, bare soil areas, and areas commonly eroded fluvially (by flowing water) – road stream crossings, vineyard rows squeezing into or displacing stream channel riparian corridors, and water storage ponds.

Potential Contaminant Sources Identified

This section describes potential contaminants and potential contaminating activities that were identified within the watershed area during the Watershed Sanitary Survey. We utilized existing documented information including EIRs, an air photo interpretation, an aerial overflight survey, and on the ground observations to identify potential contaminants.

Wastewater

There is one wastewater treatment facility on the east side of Rector Reservoir at Atlas Peak winery. The wastewater is generated from processing grapes which removes stems, leaves, and seeds. The facility consists of two holding ponds. The underlying soil of the ponds is well compacted. The winery was designed and constructed to drip irrigate vineyards from water recycled from the ponds onto the vineyards. The system is designed to avoid any runoff from these ponds.

Septic Tank Systems

There are approximately 40 septic tanks and leach fields used throughout the watershed for domestic wastewater disposal. These rural systems are scattered throughout the upper watershed, but are condensed in the area near Soda Canyon Road. Vineyards and wineries often have increased seasonal labor during harvest. These workers also use the septic systems. The installation and permitting of the septic systems is regulated by the Napa County Environmental Health Department. Parcels in Rector Creek Watershed were checked for any septic system failures or reported problems. There were no septic problems reported in the last six years *(NCEM, 2008)*. Septic repairs (due to problems) and upgrades (due to additions) are listed below, although none of these occurred in the last five years (Tables 8 & 9).

Table 8. Septic System Repairs in Rector Creek Watershed

Parcel Number	Repair	Year
32-230-22	Reported leech line problems	1983
31-060-12	Replacement of leech lines	1990
31-060-07	Repair of sewer line from guest-house	2001
31-060-14	System repair, unspecified	1979
31-060-14	System repair, unspecified	1983
32-500-41	New crossover pipe and leech lines	1994

Table 9. Septic System Upgrades in Rector Creek Watershed

Parcel Number	Year
32-030-04	Additions done in 2002
31-060-07	Addition done in 2001
31-060-27	Addition done in 2001

Reclaimed Water

The only reclamation project is at Atlas Peak Winery. The winery has two wastewater retention basins that may be used for irrigation.

Urban Runoff and Industrial Area Runoff

There are no urban or industrial areas within the watershed boundary.

Grazing Animals

There is no evidence of grazing animal husbandry within the watershed, although it is almost certain that it exists on private lands to a small degree. The access of grazing animals to Rector Creek is minimal due to the area"s steep slopes.

Concentrated Animal Facilities

No concentrated animal facilities exist within the watershed. (*NCEMD*)

Erosion and Sedimentation

In our initial meeting with our Veterans Home Client, we asked Pat Gilleran about his greatest concerns for protecting water quality and water rights from nonpoint sources of water pollution now and on into the future. Mr. Gilleran indicated he had growing concerns about the extent of vineyard expansion in the watershed. He asked that we pay particular attention to potential erosion and sedimentation from increasing vineyard developments and loaned us several EIRs pertaining to proposed vineyard expansions. We clarified that geological analysis is not our specialty. We explained that as hydrologists our work sometimes enters the realm of geology and therefore we consult with a Professional Geologist for projects that extend into the geological realm.

Professional Geologist Elias Steinbuck from the Ridge to River team mapped geology across the watershed using existing geologic maps and stereo-air photo pairs and he reviewed the Trso work for Stagecoach Vineyard and others. Steinbuck (see Chapter 2) concluded that human associated activities can contribute to slope failure when these activities include excavation and alteration of the local hydrology concentrating road run-off, or increasing soil moisture from vegetation removal. Earth materials delivered to stream systems can adversely impact water quality by causing rapid increases in turbidity levels after initial slope failure, and chronic increases in turbidity levels as disturbed soils are exposed to subsequent rainfall events prior to revegetation. No obvious evidence of point source erosion resulting in sediment delivery to a watercourse was observed on the aerial photos. However, it is possible that chronic erosion and sediment delivery to the stream system may exist in the watershed, particularly as a result of concentrated run-off from the vineyards.

As pointed out by M. Trso and also in the E.I.S, citing a 2003 GSA meeting abstract by D.G. Howell and J.P. Swinchott of the U.S.G.S., the geologic setting of the region encompassing the Stagecoach area includes "down-dropped stair steps of an uplifted pediment surface" in response to mega-landslides in the Pleistocene. Therefore the Stagecoach property, which is on the uppermost of the three downdropped blocks, is underlain by volcanic rock that might have undergone significant disturbance subsequent to its emplacement. The displacement by the downdropping of this "bedrock" would be reflected in it being more intensely fractured than undisplaced volcanic rock of the same character on the west slope of the Vaca Mountains. The more intensely fractured Stagecoach bedrock would then have different hydrological properties than less fractured but otherwise comparable volcanic bedrock elsewhere on the Vaca Mountains slopes.

Hydrological ramifications:
According to the E.I.S. (p. 4.6-11) the Napa County Water Availability Analysis allows one-half acre foot of irrigation water per year to be added to each acre of vineyards in the mountainous terrain that encompasses the Stagecoach property. Given the expected enhanced fracture-based permeability of the bedrock underlying the property, it might be prudent to reassess that allotment, especially if it was prescribed based on terrain that has not undergone the mega-landsliding. The additional 6 inches per year of irrigation water, introduced outside of the rainy season on tracts that

were originally chapparal but are now agricultural, could prolong the seasonal longevity of seeps and springs on the steep mesa slopes bordering the streams entering the reservoir, affecting the stability and erodability of those slopes. This possible enhancement of regional permeability should be considered in the assessment of the hydrological setting of the Rector Reservoir"s recharge area. For example, the rainy-season and irrigation- season productivity of seeps and springs in the Stagecoach area could be compared with the productivity of seeps and springs in terrain north and south of the area encompassing the downdropped blocks, to determine if this is a significant consideration.

To prepare this report we also consulted relevant literature on the topics of erosion and sedimentation from textbooks and handbooks. We flew over the watershed and photographed examples of vineyards and roads and deltas and the reservoir itself. We looked carefully at the assumptions made by consulting geologist PG Martin Trso in his argument that vineyards implementing BMPs actually reduce erosion and sedimentation to Rector Reservoir significantly over background rates from the native landscape condition (Trso, 2006). The topic of erosion and sedimentation includes facets of hydrology, geology, geophysical engineering, soils science, and botanical science. Our review here should *not* be considered as a substitute for a thorough geological or other analysis as that is outside the scope of work for this Watershed Sanitary Survey. Our work should not be considered to be a substitute for thorough review by a geologist or engineer specializing in erosion and sedimentation. Our work offers a common-sense hydrological perspective in the spirit of respectfully challenging the underlying assumptions used in the drawing of important conclusions – as is encouraged by the scientific process.

Geologist Martin Trso"s recent work has been the most thorough and intensive investigation to date on the subject of erosion and sedimentation in Rector Creek Watershed. The Stagecoach Vineyard"s EIR (2007) appendix B is the most comprehensive look, among those we reviewed, and predicts a lessening of erosion and sedimentation using a combination of air photo assessment, modeling, and sediment budgeting. Trso"s analytical work has led the way for vineyard developers to implement their aspirations while incorporating Best Management Practices aimed to conserve downstream beneficial uses of water.

Soil erosion is a naturally occurring watershed process that has shaped landscapes over geologic time (Easterbrook, 1993). Erosion and sedimentation can be accelerated by a number of land use activities including road network and agriculture development (Dunne and Leopold, 1978; PWA 1994). The soil loss from erosion has generally led to sedimentation delivery to downstream waterways (Tchobanoglous, 1987; Dunne and Leopold, 1978). In this case, downstream waterways would include Rector Reservoir and to some extent Conn Creek and the Napa River (Trso, 2006). Erosion of sediments from the contributing watershed drainage area, especially particles in the smaller size classes like silts and clays, are likely to increase incoming turbidity levels, making water clarity treatments more difficult to achieve. The volume of sediments that reach Rector Reservoir and deposit there diminish the water storage capacity of the Reservoir by the same volume (Trso, 2006).

Dunne and Leopold (1978) pointed out that , surface erosion includes rainsplash and sheetwash soil particle erosion Tillage operations tend to break down soil aggregates into smaller particle sizes of sand and silt that are more readily displaced by rainsplash. Raindrop impact splashes soil particles in all directions but eroded particles move further downhill than uphill.When rainfall intensity exceeds soil infiltration capacity, water accumulates on the soil surface then and runs off downhill as sheetflow. Sheet erosion occurs on bare, steeply sloping, and/or noncohesive soils including roads and agricultural fields, usually without adequate vegetative cover. The erosive force of sheetflow is proportional to the product of hillslope gradient and water depth. A thick vegetative cover intercepts virtually all the kinetic energy of rainfall and protects the soil very efficiently because raindrops fall from relatively low surfaces of vegetation from onto soil that may be further buffered by leaf litter. Both hillslope surface erosion and shallow soil creep are naturally occurring processes with the potential to be accelerated by various land use practices.

Gully erosion begins when sheet erosion collects by local topography or by human intervention eroding rills into bare soils (Easterbrook, 1993). Topsoil is eroded first into rills then enlarges to become gullies at about one foot in depth and width (Das, 2002). In gully erosion, the energy of flowing water displaces soil particles chronically, one after another, such that gullies progress in an uphill direction (Easterbrook, 1993).

In their Handbook for Forest and Ranch Roads, Danny Hagans and Dr. Weaver pointed out that roads disrupt the hydrologic network because they are relatively impervious and because they typically channel water onto soils that are not adapted to absorb it or carry it generating fluvial gully erosion. Roads are a major source of erosion and sedimentation on most managed lands Culvert failures at undersized or poorly aligned stream crossings is one of the largest sources of controllable erosion on managed landscapes. Fluvial erosion at stream crossings results when roads intercept small or large streams and flood flows are inadequately conveyed across the road due to lack of conveyance structure or an undersized conveyance structure – usually a culvert (Weaver and Hagans, 1994).

Soil creep is the slow downhill movement of superficial soil or rocky debris which may be difficult to identify directly but partially evidenced by the tilting of extended objects like trees, telephone poles, and fenceposts. Landslides tend to fail all at once or in a matter of minutes or days when the resistance of water-wetted soils is overwhelmed by the force of gravity (Easterbrook, 1993).

In Rector Watershed, due to the natural geomorphic conditions and seasonal weather patterns, most soil is eroded episodically by running water during and after rainfall *(Steinbuck, 2008; Trso, 2006).* Most sediment in streams in the Mainstem Rector Watershed emanate from hillslope surface erosion, shallow soil creep, and shallow landsliding especially within the Vaca mountains area*(Trso, 2006)*.

In what ways do vineyard cropland developments alter background chronic erosion and sediment delivery? Vineyards in the Rector Creek Watershed have been generally developed on moderately flat plateau surfaces in the upper mainstem Rector Canyon Watershed (see air photos). Trso suggests plateau surfaces and the vineyards upon them are disconnected from watercourses in terms of sediment delivery to channels because of their planar or very mild slopes (Trso 2006). Both the USGS topographic watershed drainage map (chapter 2) and the air photos indicate plateaus in some locations but they still slope toward Rector Creek and the Napa Valley. Soils are increasingly “manufactured” infill (*David Steiner, NCRCD, personal communication, 2008; Trso, 2006*). These soils often are more readily infiltrated by rainfall than are native soils (NCRCD). The term infill suggests vineyard developments might import varying volumes of fill into the watershed to perfect vineyard soils. BMPs designed to filter residual sediments from sheetflow include rock berms on the downhill side of a vineyard coupled with a riparian buffer strip (Trso, 2006). Riparian buffer strips of varying widths were identified during our overflight as depicted in the following photos. Rock berms were less visible on the photos and varied widely in width and degree of linearity. The more linear rock berms stand out in photos while the more random accumulations are less obvious. Our field experience in other watersheds indicates that streamside buffers and rock berms do minimize the delivery of sediments to watercourses, especially when the berms have rock tightly packed. Trso indicates that his measured reservoir infilling rate is higher than that determined in a previous study, suggesting a net increase in reservoir filling rate by sediments over time. However his expected net decrease over background levels seems overly optimistic because soil conditions are changed, soil volume is added to the system, and longlived native chapparal vegetation along with their mature root systems are converted to viticulture. Tilling alters soil substructure, rocky components are removed, the surface vegetation type and density are changed, thick leaf mulch is exchanged for straw-mulched soil, subsurface animal burrowing activities may be discouraged (Sholars, 2009), vineyard ways and roads are compacted with footsteps and machinery (Dunne and Leopold, 1978), roaded areas are highly impervious to infiltration and they redirect runoff from the native hydrological network to unarmored soils more vulnerable to erosion (Weaver and Hagans, 1994).

There are records of several events in the past two decades that have delivered sediment into Rector Reservoir:

- 1993 – In the same year that the spillway was raised, a wall of gravel came down Mainstem Rector Creek. It was 12 feet tall *(Mark Nicander – 2008, personal communication)*
- 1995 – Two high intensity storms in January and March of 1995 created high volume flows in Rector creek and the other tributaries. These flows caused scouring of the creek banks and channels, including uprooting of trees. The turbidity at the Rector Reservoir intake increased from a normal winter-time level of less than 5 NTU to as high as 80 NTU*(Rector Sanitary Survey, 2003).* The turbidity remained elevated through the month of April. The turbidity of the raw water from Rector Reservoir commonly varies from 1.2 NTU to 50 NTU *(Rector Sanitary Survey, 2003).* Martin Trso also noted debris flows in Rector Canyon during this period in his aerial photo analysis *(Trso, 2006)*.
- 2000 – 2005 It appears that the watershed experienced a large sediment transport event during this period based on delta sediment analysis that suggests a higher rate of sedimentation during this period *(Trso, 2006).*
- 2002 – There was a landslide in the upper reservoir in 2002. It created a Tsunami that washed over the front of the dam and caused significant damage *(Mark Nicander – 2008, personal communication).*
- In 2002 a debris torrent emanating from a road stream diversion eroded a large volume of sediment into the South Fork Lorette (Teri Barber, personal observation 2002).
- 2004- A significant amount of instream fines were found in the North Fork Rector Creek *(Trso, 2004).* In 2008 there were no fines found in this stream channel by Ridge to River staff. This suggests that there may have been an event in the winter of 2003/2004 that delivered the fines described by Trso.

High-magnitude low-frequency events suggest that a lot of erosion can happen in a short amount of time at one location. It is important that landowners with sensitive downstream beneficial uses be informed and sensitive to the significance of land use practices that might contribute to reconfiguring the native hydrological network and thus saturating soils so as to subject them to more frequent failure or failure generating a higher magnitude of soil loss. Best Management Practices (BMPs) are land use practices that minimize high magnitude geomorphic events with negative impacts on downstream beneficial uses. Clearly Trso and others advance BMPs to minimize erosion and downstream sedimentation for new vineyards. Older vineyards that have not implemented BMPs are likely to generate higher rates of erosion and sedimentation. Napa County and other California counties encourage conservation stewardship along existing vineyard croplands as well as proposed vineyard croplands.

Global climate change is a factor that may contribute to higher intensity storms and increased erosion in Rector Reservoir. Over the last century, seasonal rainfall totals may have diminished, but intensities of individual rainfall episodes have increased in California *(Goodridge, 2000).* It is important to understand that our common behaviors and land use practices may have an amplified affect on accelerating erosion, compared to a few decades ago.

In order to better discuss the erosion processes active in Rector Watershed we have divided the watershed geographically by sub-watershed, as did Trso: The Rector Creek Reservoir the three main tributaries and smaller ephemeral tributaries were examined throughout the Rector Creek Watershed Drainage Area in the air photo geologic assessment (Steinbuck, 2008). The area surrounding the reservoir up to about a ½ mile is roadless in all directions. The reservoir banks are steep and crisscrossed with game trails and perhaps soil creep scars. Ephemeral tributaries contribute from all sides but there are three main tributaries, Lorette Creek (the south fork), Mainstem Rector Creek and the North Fork Rector Creek. Our own observations and those of Geologist Martin Trso are discussed for each of these main tributaries and the reservoir itself. .

2002. North Fork Rector Reservoir photo center left. South Fork-Lorette upper photo right.

The **North Fork** watershed is about 2/3 native landscape. The other third has been developed for agricultural. Road miles were estimated at 2.65 in the 2003 Watershed Sanitary Survey. The road network in the North Fork appears to be accessible from Silverado Trail approximately 1.5 miles north of the treatment plant. This road network may also be connected to the Mainstem Rector road network through a jeep/motorcycle trail. There are some residences and at least one vineyard in this watershed, although development in general is minimal (see 2007 aerial photo, Chapter 2).

North Fork Delta (Trso Delta 3) sometimes termed Western Creek by treatment operators

North Fork Mouth as viewed from a boat

Upon the site visit 7-23-08, the North Fork Delta (identified as Delta 3 by Trso) was composed of gravel and sand. The Delta ascended relatively quickly into a steep, bedrock channel. Above the alluvial deposit, the streambed climbs into a bedrock, step pool sequence with intermittent riffles. The stream has several nice pools that are at least 3 feet deep. The streambed is of bedrock, boulders, and cobble. The stream banks are well vegetated and stable. Coarse sand composed approximately 3% of the surface area of the channel. There were no evident deposits of any smaller fines in the stream or delta. In the previous 2003 Watershed Sanitary Survey, 3 miles of road were mapped.

north fork bedload (finest portion)

Mainstem delta: alluvial stored sediment partially visible under water, turbid water, algal mats

The **Mainstem Rector Creek** (aka Rector Canyon) is a steep, inner gorge canyon with 1 major and 3 minor tributaries entering from the north and one minor tributary entering from the south along with many 1st order streams entering from both sides. Several surface water storage reservoirs were identified from the air photos and flyover. As Rector Canyon reaches upwards in elevation toward the ridges, the topography abruptly flattens out into plateaus or "mesas" – a portion of which is known as Foss Valley, with the Vaca Mountains backing the mesa (Trso, 2006). The mesa to the north has been developed into agricultural areas (mostly vineyards) with numerous intersecting dirt roads. The tally of road miles in this subwatershed summed to 20 not counting the jumble of roads in a 44-acre area likely used for recreation *(Rector Sanitary Survey 2003).*

One streamside road area exists along the headwaters of a Mainstem Rector tributary which appears to have been straightened, having a vineyard and road on both sides. Most vineyard development has taken place in this subwatershed (see 2007 aerial photo, Chapter 2).

The channel bed of Rector Mainstem is composed primarily of gravel and cobble, with about 6% sand on the surface (a visual estimate by Ridge to River staff). This bedload is similar to that of North Fork (West Rector Creek) but grain sizes are smaller. Powdery silt was shaken out of dry sand, but there were no isolated silt deposits in the channel found during the site visit. There was a flowing primary channel and a dry secondary channel in the first 0.3 miles of the stream (the extent of the field survey). The channel banks were well vegetated. There were some large deposits of sand in the secondary channel.

The mainstem Delta (identified as Delta 1 by Martin Trso) is the largest of the three deltae. Delta 1 was composed primarily of fine sand, with very little silt. Upstream, the delta was composed of gravel and cobble. The reservoir water and stream channel are both likely contributors to bank erosion along the west side of the delta/channel. This channel bed was composed mostly of large cobble and small gravel at the time of the site visit.

Mainstem channel

Mainstem alluvial bar at delta

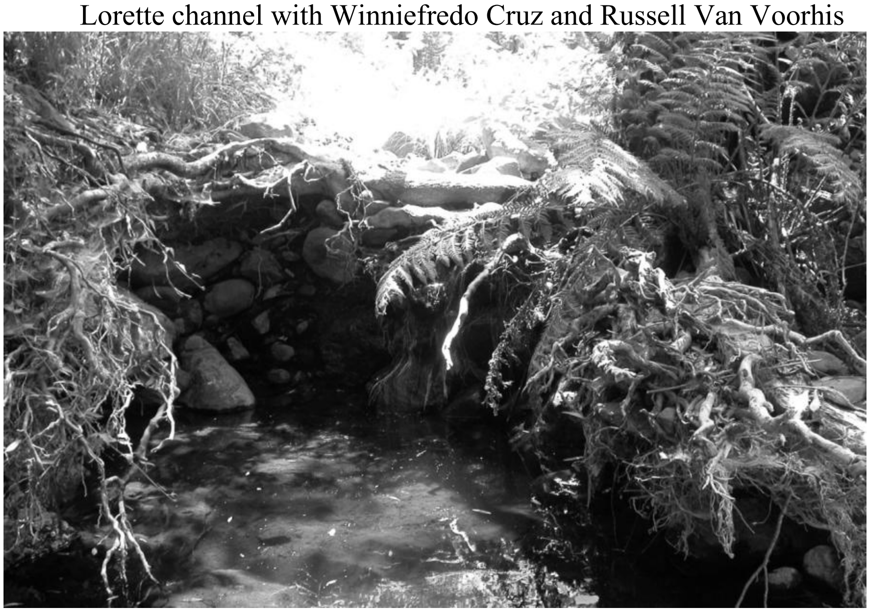
Mainstem delta looking into reservoir with boat and R. Van Voorhis in photo

Remnants of a weir was visible at the edge of the bed, however the structure was mostly covered in deposits. This weir was used in 1989 to measure inflow (Mark Nicander, personal communication, 2008).

The **Lorette or Lorette Creek** (or South Fork) drainage area appears mostly undeveloped. Eight road stream crossings were identified in that subwatershed. The crossings convey streams across the road that runs along the ridge between Lorette and mainstem from Foss Valley. Road miles in Lorette Creek totaled 3.1 *(Rector Sanitary Survey, 2003).* There are some residences and at least one vineyard in this watershed, although development in general is minimal (see 2007 aerial photo, Chapter 2).

Lorette South Fork, Trso Delta 2: no obvious turbidity plume or algal mats

Lorette channel with Winniefredo Cruz and Russell Van Voorhis



Lorette knick point head cut

Lorette Creek has a pool-riffle sequence through a channel bed of cobble and boulders with well-vegetated banks. Part of the channel bed was formed of silt. Bank erosion is visible in three places within the first quarter mile above the reservoir. There is a four-foot head cut in the channel, with bedrock channel above the headcut. Bank erosion seems to be relatively slow, as banks are held together by roots and rock. Bank erosion in this lower quarter mile may be a result of alluvial deposits that reduce the gradient of the stream and cause it to meander. Upper reaches appeared more stable. Lorette Creek is not as confined as the other two Rector forks. The hillslopes are vegetated completely down to the creek. The channel has a little room to meander and erode, pushed over by mid-channel trees, rocks, and root wads. Although a small part of the streambed is formed of silt, there are no silt deposits within the channel. Sand deposits (mostly in the secondary channel) did not form more than 5% of the surface, while silt and sand combined formed approximately 10% in the lower section (less upstream). The Lorette channel appears to be the least stable of the three creeks visited.

The Lorette Delta is composed of gravel, sand, and cobble. Silt was present and mixed with sand, but was detectible only on close inspection and did not comprise a significant portion of the Delta surface. Comparing the three tributaries during the field survey of 2008 suggested the North Fork had the least obvious erosion, the least instream fines, and the coarsest bed material, followed by the Mainstem. In 2004 Geologist Martin Trso conducted a delta survey of the three tributary mouths as part of his sediment accumulation evaluation for Artesa Vineyards *(Trso, 2004 and 2006)*. He found that the North Fork had the highest levels of in-stream fines in 2004. He attributed this to a higher rate of erosion than the other subwatersheds and possibly to episodic erosion and subsequent sedimentation. The prior Ridge to River Watershed Sanitary Survey found no fines in the North Fork, so it is likely that the fines Trso found were from an episodic event that later rinsed away. It may also be that the collection of instream fines in the deltas change with time qualitatively and quantitatively.

Martin Trso compared pre-dam topography as surveyed by the California Department of Water Resources with post-dam reservoir bottom topography measured by Trso. He calculated the volume of sediment in the reservoir based on the differences in elevation between these two surveys, and from this difference he calculated a sedimentation rate. Trso found sedimentation rate is higher than that calculated by the SFBRWQCB in 2005. Trso concluded that this difference in sedimentation rates was likely due to a sudden increase in sedimentation since 1999 *(Trso, 2006).*

Trso‟s study also estimates the rate of silt and clay delivered to the reservoir from each subwatershed. Trso‟s estimated silt and clay delivery rates are 1.0 tons/acre-yr from the Mainstem, 1.8 tons/acre-yr from Lorette, and 14 tons/acre-yr from the North Fork, with an average rate of 2.7 tons/acre-yr for the entire Rector Watershed *(Trso, 2006)*. This conclusion was based on the rates that Trso modeled and calculated for upslope erosion in the Mainstem and the size of the deltae that he measured in his boat survey (Trso, 2004 and 2006). He did not actually survey the North Fork or Lorette. All four of the EIRs that Trso has provided erosion and sediment analysis for in the watershed have been in the Mainstem. Given that our observations showed that the North Fork had no silt or clay at all, it seems unlikely that it has fourteen-times the sediment delivery rate of the Mainstem. This requires further investigation, and brings up the questions of whether the Mainstem may have a higher rate of erosion than initially calculated by Trso. Further research is also recommended by Trso. He suggests that surveys be conducted in future EIRs for Mainstem development. These surveys would (1) account for channel sediment storage, including recent changes; (2) identify natural sediment sources within the canyons; (3) identify areas within Rector Creek Watershed which may have recently experienced road or vineyard development or operations related to erosion.

The road network in Rector Watershed appears to be significantly expanded over that network mapped on the USGS quadrangle. That topographic overlay bounded by the Rector Creek Calwater Drainage Area showed just the one major road (Soda Canyon Road). The air photo assessment reveals that while Soda Canyon Road is the major artery, there are dozens of roads intersecting Soda Springs that connect vineyards, home sites, and several small reservoirs. Road crossings in Rector Mainstem Watershed were estimated to be approximately 35. However, in the Stagecoach EIR, 2006, there was estimated to be more than that number on the stagecoach property alone. This discrepancy is most likely a result of varying survey techniques. It suggests that many stream crossings do not show up on the aerial photo, and they are actually much greater in number across the watershed.

As part of vineyard expansion projects in the last five years, Napa County has required landowners to upgrade their roads across their properties in order to reduce sediment deliveries. This is one of the ways that erosion is minimized during developments such as vineyard expansion. Napa County has no mechanism to require landowners to upgrade roads unless the landowner is seeking a permit (NCCPD, 2008).

Hillslope vineyards are another potential source of erosion and sedimentation in general (Dunne and Leopold, 1978) and in the Rector watershed. The rates and magnitude of erosion from a hillside vineyard is very much dependent on the type of farming practice employed (Dunne and Leopold, 1978). Average soil loss from a typical hillside vineyard is significant and has been estimated to be anywhere from 14 to 50 tons/acre/year (*RWQCB report, 1992*). However, under the Napa County Conservation Ordinance, if the recommended practices are implemented, new hillside developments should only produce around 5 tons/acre/year of soil loss (*RWQCB report, 1992*). Most vineyard development in Rector watershed has occurred in the past fifteen years, and thus must follow the Napa County Conservation Ordinance. Recent reports by Geologist Martin Trso claim that erosion and sedimentation is actually *reduced* by vineyard expansion with proper Best Management Practices (BMPs).

Napa Country has required an Environmental Impact Report for vineyard development and expansion in the last five years because of the Agricultural Watershed zoning in Rector Creek Watershed, the Yountville municipal and domestic water supply of Rector Reservoir, and the accelerated rate of vineyard expansion. Because of the Ag-Watershed zoning, if there was an expected net increase in sedimentation, the county would not allow further vineyard development *(Bordona – 2008, personal communication).* An analysis of erosion, sedimentation, and hydrology is a required component in CEQA and EIR processes. Martin Trso, Professional Geologist, has conducted most of these analyses in the watershed to date. The 1996 EIR for Stagecoach Vineyards has the most detail, the strictest standards, and incorporates previous research conducted by Trso. We used the Stagecoach Environmental Impact as our primary reference because it appears to be the most comprehensive analysis of erosion and sedimentation available. Stagecoach Vineyards represents 16.8% of the watershed drainage area *(Trso, 2006).* It represents the current BMPs for vineyards in the watershed, as well as the minimal standards that would be required for future vineyard developments.

The erosion control plans of the last five years have many incorporated BMPs. This is now standard practice for vineyard development. For Stagecoach Vineyards these include: Storm drains, out-sloped vineyard avenues, level spreaders, rock energy dissipaters, diversion ditches, controlled outlets, water bars, rock walls, straw wattles, no-till and permanent cover crop, mulch, and streamside riparian buffers *(Stagecoach EIR, 2006*).

Geologist Martin Trso is perhaps the most informed resource professional evaluating sedimentation and erosion in Rector Watershed, as he has spent the most time on the ground studying it for vineyard expansion projects over the last six years. He concludes that sediment delivery will be reduced by 23% on Stagecoach vineyards after the vineyard expansion project *(Trso, 2006).* This is based on the assumptions that: vegetation cover is less on native soil than in vineyards, vineyards will not deliver sediment to streams and rivers, and road erosion will be negligible (Trso, 2006). Trso also states that there appears to have been a sudden increase in sediment supply to the reservoir based on his analysis of mass reservoir stored sediment since 1999 *(Trso, 2004 and 2006).* He explains this discrepancy by claiming most likely that this increase has come from the North Fork or Lorette creeks, rather than from the Mainstem *(Trso, 2006)*. To better understand the potential for sediment production by vineyard development, Ridge to River Inc conducted the photo overflight in October 2008.

Vegetation cover is a primary factor in determining the erosion potential in a given plot of land (Dunne and Leopold, 1978). Trso claims that the native vegetation cover of most tracts of land in Rector Watershed is less dense than the expected vegetation cover of the vineyards and cover crops that will replace it. Our air photos from 2009 suggest that native vegetation provides more dense soil cover than do vineyards. Trso does not state how the percentage of vegetation cover on the native landscape was determined, nor by whom. The expected post project percentage of vegetative cover to replace the native landscape‟s vegetative cover was based on an analysis of existing stagecoach vineyards and their cover crops. Fescue grasses are one of the most common cover crops in this region, and were used on Stagecoach property. Winter is when Fescue is at it fullest *(David Steiner, NCRCD, personal communication, 2008).* Some questions arise: how was the natural vegetation cover estimated, is the cover-crop coverage as high as Trso claims throughout the year? Photos taken during our aerial analysis in October show vineyard land that appears to have less cover than native vegetation (although it does look as if mulch may have been applied). These photos of Stagecoach Vineyard property cannot replace a scientific analysis but they do raise some questions about the importance of the season and the method used where findings indicate that vegetative cover on vineyards exceeds native vegetation coverage.

Ridge to River conducted an aerial photography overflight of Rector Watershed in October, 2008. This included flying along each of the three major tributaries in the watershed, and then focusing on some of the areas with recent developments. In general, neither the air photo-based geological investigation nor the air photography found evidence of large-scale fluvial erosion issues associated with vineyard development. Evidence of surface erosion is suggested in the photos below under the relatively sparse vegetation cover offered in vineyard croplands. Road developments often redistribute flowing waters and a debris flow occurred in the Lorette due to a road stream diversion reported by resident Irving Thomas to Teri Jo Barber who confirmed same in field and reported in the previous Watershed Sanitary Survey of Rector Creek Watershed (2003).


Riparian corridor protection zones some with rock "berms, vineyard roads, vineyard rows

Gazing across the upper mesa into Mainstem Rector Canyon at native chapparal and vineyard vegetation

The season that vegetation coverage is measured is important because some vegetation goes dormant during part of the year and because erosion is primarily caused by process associated with the rainy winters. Other species are dormant in the summer. As vineyard laborers walk through the rows to tend the fields and harvest grapes, dry stems of summer cover-crops will be trampled. As these stalks are degraded, foot traffic will dislodge soil particles. Plant growth will likely remain dormant until the first few winter rains provide enough moisture for growth. Soils are especially vulnerable to surface erosion in the beginning of winter in a first flush (Barber, 1998) when cover crops are likely at their minimum coverage and soil particles have likely been mechanically dislodged by foot traffic. It is important to measure percent coverage at different times throughout the years to fully understand the surface erosion potential under all conditions.

Soil erosion hazard of native soils is another aspect that requires a closer look with regard to classification, structure, and surface roughness. The Hambright soil complex is the dominant soil formation on both Stagecoach property and in Rector Watershed (Table 2). It is described as having both a low infiltration rate and a slight to moderate erosion potential. Generally, when an infiltration rate is low, the erosion potential is high *(NRCS, 1978).* However, for gravely soils with rough surfaces, this is often not the case. The rocky surface often buffers the soil from erosion *(Poesen, et al. 1994; Cerda, 2001; Descroix et al., 2001; Ballanay and Grismer, 2005)*. In his 2006 report for Stagecoach Vineyards, Trso initially stated that the Hambright soils have a slight to moderate erosion hazard based on the soil survey description. Later, when describing the Universal Soil Loss Equation *(USLE)* modeling factors, he described them as having a high erosion potential based on their hydrologic soil classification D. Throughout the Stagecoach EIR the Hambright Soils are described as having a high erosion hazard, rather than slight to moderate, as described in the USDA Napa County soil survey. This information seems contradictory and should be ultimately corrected by an unbiased soils authority.

The Universal Soil Loss Equation, developed by NRCS in the 1960‟s is a tool for predicting soil loss from hillslopes. The Revised Universal Soil Loss equation was developed in the early 1990‟s. “An additional change incorporated into RUSLE is to account for the rock fragment on or in the soil. Rock fragments on the soil surface are treated like mulch in the C-factor, while K is adjusted for rocks in the soil to account for the effects of runoff" (Renard et al., 1993). As erosion and sedimentation research continues in Rector Watershed, it is important to take soil rockiness and surface roughness into consideration and consider using updated models when specific criteria are relevant.

A third component to consider is soil structure. Soil structure is formed by shrinkage and drying (that results in cracking), channel formation by plant roots, burrowing by animals and insects, and is affected by cultivation (Wilkenson, 2000; Sholars, 2009). A study on vineyard property found that cracks in the soil were a significant factor in determining erosion in Napa County (Battany and Grismer, 2000). A well-developed soil structure has stable aggregates of soil particles separated by interpeds (large pores). Interpeds are typically larger than the pores between individual soil particles, result in less dense conditions, and are critical for air and water movement through soil (Wilkenson, 2000). As harvesters walk between vineyard rows, they compact the soil with their feet or with mechanized equipment. Even though a farmer tries to have a well-developed soil structure, as long as there is compaction, pore space is reduced. Compaction results in decreased infiltration and elevated runoff and erosion (Kozlowski, 1999; Sharrow, 2007; Jim, 1998; Wilkinson, 2000).

In Rector Watershed there are many areas of exposed bedrock and a large rock fragment component in the soils. Vineyard development often requires "manufacturing" of soils (David Steiner NCRCD – 2008, personal communication, 2008) and infill (Trso, 2006). Although these "manufactured soils" have many traits reducing erosion potential, it is important to realize that their structure has not evolved over a long period of time to handle the amount of rainfall and runoff in the watershed. The processes associated with soil structure development takes time. Such developments include mycorrhizal and microbial habitation, micro and macro-faunal pore space development, rotting of roots to form macro-pores, and adhesion of soil particles to form soil peds (Wilkinson, 2000; Sholars 2009). Under the influence of compaction, pesticides (which kill the critters that make pores and tubes), fungicides (which can kill the mycorrhiza that binds soils) and without an opportunity for roots to rot, soil structure development may be curtailed – most importantly in the form of spaces through which waters infiltrate. If waters cannot infiltrate a soil, waters run off the surface carrying a soil component with them (Sholars 2009).

Peak Flows and time of concentrations were also analyzed as part of Trso's Stagecoach Vineyard report. The same factors that may affect the USLE model results may affect these calculations. These are vegetation coverage and affects of seasonality, soil structure, soil rockiness, soil roughness, and soil erosion hazard. In addition to these factors, roads and underground water lines can speed up time of concentrations. Given the episodic nature of erosion in the watershed, and the likelihood of higher intensity precipitation events *(Goodridge, 2000)* from Global Climate Change, even a slight increase in peak flows has the potential to trigger episodic erosion – especially if native soil drainage properties are actually reduced by "manufacturing" and compaction and roads change native hydrological connectivity.

One of the main reasons that erosion rates are expected to decline on Stagecoach Vineyards is because old roads will be repaired with BMPs (Trso 2006). Properly repairing and upgrading roads will certainly reduce controllable erosion (PWA, 1994). Trso suggests that after repairs, road erosion will be negligible. It seems likely that with time, a certain amount of road degradation will lead to a significant amount of road based erosion entering nearby streams.

Impacts of development on erosion and sedimentation are greatly reduced from what they used to be with the employment of BMPs. It is important to take into consideration that in order for these reduced erosion rates to continue, the BMPs must also continue, from crew to crew, from manager to manager, from owner to owner, when it is convenient and when it is not. It seems reasonable to assume that over time certain BMPs would be overlooked. After the next storm will someone clear the inlet? Twenty years from now, when a culvert is rusted through, is someone going to remember to replace it in a timely manner? When a wildfire comes through the watershed and melts the plastic culverts in its path, who will be aware to check and replace them before the elevated winter runoff? A BMP deterioration factor should be considered. Policies by the Napa County Planning Department require landowners to submit erosion and water-quality protection plans for review and approval. More information about Napa County"s role in watershed protection is provided in Chapter 4.

Agricultural Crop Land Use

Approximately 2800 acres have been developed as agricultural lands throughout the Rector Creek Watershed, upstream of the dam and water treatment facility. Only a small area was mapped in 1978 as cropland. Since that time much more area in the upper mesa plateaus have been converted to cropland as is visible when comparing watershed air photos from 1993 and 2007 (figures 3 and 4) and in the 2002 air photo. There are approximately 26 miles of dirt and gravel roads with 48 stream crossings identified from the air photos (Rector Watershed Sanitary Survey, 2003). In additional to roads, there are several miles of vineyard avenues. Approximately 10 reservoirs exist in the watershed. Large, multi-acre bare soil areas were apparent in various stages of vineyard production. Most of this agricultural development has occurred in the past fifteen years.

Agricultural cropland use brings the highest risk of potential contamination in the watershed. Over the past two decades much of the native landscape in Rector Watershed has been converted to vineyards. Presently there are 23 vineyards in the watershed. The potential risks to water quality associated with the agricultural cultivation are increased erosion and sedimentation, the transportation and application of agricultural pesticides and fertilizers (nutrients). Only nutrients will be discussed in this section, as erosion and sedimentation and pesticide/herbicide applications are discussed in their own sections.

The primary development in the watershed has been agriculture in the form of vineyards. Development is practically limited by steep terrain, and on flat land development is limited by a Conservation Ordinance requiring landowners to maintain 60% of their tree cover and 40% of understory/chaparral. The "open space" and Ag-watershed zoning does not currently protect the Veterans Home water supply.

Plants require a variety of nutrients to thrive. Nitrogen and phosphorous are two of the most important nutrients. Almost all farming practices require the addition of nitrogen and phosphorous in the form of fertilizer, although there are many ways to secure it in the soil. The best forms for downstream beneficial water uses are the slow release types available in manures and compost that are not water soluble. Water soluble nitrogen and phosphorous are of concern to water quality because they readily rinse from the site of application on downstream. They may result in algal blooms or eutrophication in receiving waterways. Where excess nutrients mix in waters and sunlight, algae grows quickly and in quantities out of balance with the rest of the ecosystem. Dissolved, suspended, or floating algae uses up much needed oxygen in the water (moreso at night), making it difficult for aquatic fauna to respire. Algae becomes a problem for drinking water treatment for several reasons. Carcinogens such as chloroform can be created when algae mixes with chlorine, there are toxic forms, algae in drinking water can result in foul odor and taste, and the chemicals applied to kill the algae have residual concentrations in the drinking water where they are unlikely to be filtered out.

Algae blooms are a frequent occurrence in Rector Reservoir *(Mark Nicander & Russell Van Voorhis - 2008 personal communication).* Algal blooms are visible in the photo of the mainstem delta. This may be a result of nutrient laden runoff from agricultural fields, from septic systems, or may be a natural occurrence. Mark Nicander, the previous water treatment plant operator, claims that algae blooms have become more frequent and more significant. He claims that in the 1980‟s the Rector reservoir was crystal clear and that one could see about fifty feet deep. The Department of Public Health records indicate that copper sulfate was used for algae control in the reservoir as far back as 30 years. Algal blooms are currently monitored at the treatment facility by making a concentrate of reservoir water and using a rafter slide analysis *(Russell Van Voorhis, personal communications).*

Apparent nitrogen applications upslope evidenced by brilliant greenery

Russell Van Voorhis says that this method, as currently performed, is not accurate enough, and that not enough data has been collected, to determine whether or not there has been an increase in algal production over time.

Rector Creek is a tributary to the Napa River. The Napa River is on the 303(d) list for excessive nutrient contamination. Recent research suggests that the Napa River is contaminated throughout the Napa Valley in excess of water quality standards and that contamination is worst downstream of sewage treatment plants (McKee, 2008).

The photo was taken during our aerial survey, October, 2008. The bright green area in the field is likely a result of applied fertilizers (nutrients). While Rector Reservoir may have greater nutrient problems now than in past decades, we have not identified a method to confirm this. Nutrient contamination is an issue in Rector Reservoir and further agricultural development in the watershed is most likely to exacerbate that problem.

Policies by the Napa County Planning Department require landowners to submit erosion and water-quality protection plans for review and approval. Refer to Chapter 4 for more details on the Napa County Conservation Ordinance.

Bare slopes around the nose of a ridge

Concrete road's stream diversion relieves yielding debris torrent scar

Pesticide/Herbicide Applications

Insecticides, fungicides, and herbicides are applied on vineyards in the Rector Creek Watershed. Individual farmers submit monthly reports to the Napa County Agricultural Commissioner on the amounts of controlled insecticides, fungicides, and herbicides used on the vineyards. Application of the herbicides, fungicides, and insecticides is mostly by a tractor sprayer. This method is economically efficient yet while the target is most certainly reached, non-targeted soils receive the application as well. Tables 10, 11, and 12 reproduce the list of chemicals applied in the watershed as reported by the previous Sanitary Surveys of Rector Reservoir Watershed (1995 and 2003) for purposes of comparison and because records are kept only for five years by the Agricultural Commissioner. One can see that the number of chemicals applied has increased dramatically since the 1996 survey. Table 12 lists those chemicals applied and reported to the Agricultural Commissioner 2004-2008.

Table 10. Herbicides, Pesticides, & Fungicides applied 1990 to 1995 in Rector Watershed

Herbicides	Fungicides	Insecticides
Simazine	Sulfur	Dimethoate
Diuron	Mychlobutanil (Rally)	
Glyphosate (Roundup)	Fenarimol (Rubigan)	

Table 11. Herbicides, Pesticides, & Fungicides applied 1996 - 2003 in Rector Watershed

Fungicides: Abound, Champ Flowable, Dithane M45, Dusting Sulfur, Elite 45 WP, Flint, Kaligreen, Procure WS, Rally 40W, Rovral, Rubigan E.C., Thiolux Dry Flowable, Wilber-Ellis Ben-Sul85, DuPont Benlate 50 DF, Gallery 75 Dry Flowable

Herbicides: Devrinol 5-DF, Diquat, Goal 2XL, Princep 4L, Princep Caliber 90, Roundup Pro, Roundup Ultra, Roundup Ultra Max, Simazine 90DF, Surflan A.S., Visor 2E, Fire Power, Mon-6505, Slim-Trol 90DF, Trouchdown 5

Insecticide: JMS Stylet Oil, Provado Solupak, Seven Brand XLR, Telone II Soil Fumigant, Nexter Miticide/Insecticide, MBC Concentrate Soil Fumigant, Deesch Phostoxin New Coated Tablets, Ditera ES Biological Nematicide, Saf-T-Side, Sanmite Miticide Insecticide, Vangard WG, Enzone

Table 12. Herbicides, Pesticides, & Fungicides applied 2004 - 2008 in Rector Watershed With Suggested Sampling Periods and Toxicity information

Chemical Name	Months Applied	Suggested Sample Period	Active ingredients	PAN Bad Actor	Acute Aquatic Toxicity
2Micro-Sulf	Jan-Jul	March rain or First Flush	Unknown		
41-A	June	First Flush	Unknown		
Abound Flowable Fungicide	May-July	First Flush	22.9% of AZOXYSTROBIN (4037),		**YES**
Admire 2 Flowable	May-Jul	First Flush	21.4% of IMIDACLOPRID (3849)		**YES**
Admire Pro Systemic	May	Late Spring rain,	42.8% of IMIDACLOPRID		**YES**

Protect		otherwise first flush			
Applaud 70 DF Insect Growth	Jul-Aug	First Flush	70% of BUPROFEZIN (3947)		
Applaud 70WP Insect Growth	Jul	First Flush	70% of BUPROFEZIN (3947)		
Bronc Plus Dry-EDT	Jan-Jun	First Flush	Unknown		
Cayuse Plus	Nov-Feb	January or early February rain	Unknown		
Champ Formula 2 Flowable	Apr-Sep	Late Spring rain, otherwise first flush	37.5% of COPPER HYDROXIDE (151)		**YES**
Chateau Herbicide SW	Feb-Mar	January or early February rain	51% of FLUMIOXAZIN (5802)		
CMR Silicone Surfactant	Jul-Aug	First Flush	Unknown		
Degesch phostoxin Pellets	Mar-Nov	First Flush	Unknown		
Degesch Phostoxin Tablets-R	Mar-Nov	First Flush	55% of ALUMINUM PHOSPHIDE (484)	**YES**	
Dithane F-45	Apr-May	Late Spring rain, otherwise first flush	37% of MANCOZEB (211)	**YES**	
Dithane M-45 Flowable	May	Late Spring rain, otherwise first flush	0.9% of ZINC SULFATE (667), 7% of MANGANESE SULFATE (658), 27.1% of MANCOZEB (211)	**YES**	**YES**
Dupont Kocide 2000 Fungicide	Apr	May Rain	53.8% of COPPER HYDROXIDE (151)		**YES**
Dusting Sulfur	Apr-May	Late Spring rain, otherwise first flush	98% of SULFUR (560)		
Elevate 50 WDG Fungicide	Jul Aug	First Flush	Unknown		
Elite 45 DF	Jan-Aug	First Flush	Unknown		**YES**
Elite 45 WP Foliar Fungicide	Apr-Aug	First Flush	45% of TEBUCONAZOLE (3850)		**YES**
Enzone	Feb-Apr	mid-late spring rain		**YES**	
Flint	May-Aug	First Flush	50% of TRIFLOXYSTROBIN (5321)	**YES**	
Foam Fighter	Jan-Jun	Late Spring rain, otherwise first flush	Unknown		
Galigan 2E	Jan	February Rain	22.2% Oxyfluorfen		**YES**
GF-120 NF Naturalyte Fruit	Jun-Nov	First Flush	.02% of SPINOSAD (3983)		
Goal 2XL	Jan-Feb	Late February/March Rain	22% of OXYFLUORFEN (1973)		**YES**
Goal 4F	Jan	February Rain	Oxyfluorfen		**YES**
ICIA5504 2SC Fungicide	Jul	First Flush			
Kocide 2000	Mar-May	May Rain	53.8% of COPPER HYDROXIDE (151)		**YES**

Kumulus DF	Mar-Jul	Late Spring rain, otherwise first flush	80% of SULFUR (560)		
Miller Nu Film Oryzalin 4 A.S.	April-Aug	First Flush	Unknown		
Miller Nu Film P	Feb-Aug	Late Spring rain, otherwise first flush	Unknown		
Nexter Miticide/Insecticide	Jul-Sep	First Flush	Unknown		
No Foam B	Jul	First Flush	Unknown		
Nordox	Apr-May	Late Spring rain, otherwise first flush	Unknown		
Oryzalin 4 A.S.	Jan, July, and Sep	First Flush	41% Oryzalin	**YES**	**YES**
Premium Sulfur Dust	Jul	First Flush	96.8% Sulfur, 0.5% Myclobutanil	**YES**	**YES**
Prestine Fungicide	Apr-Aug	First Flush	Unknown		
Princep 4L	Jan-Feb	Late February/March Rain	41.9% Simazine		
Procure 50WS	Jun-Aug	First Flush	50% Triflumizole		
Procure Wilbur Ellis Dusting Sulfur0SC	Jun-Jul	First Flush	Unknown		
Provado Solupak Micro-Sulf% Wettabl	Jul-Sep	First Flush	75% Imidacloprid		**YES**
Quintec	May-Aug	First Flush	22.6% Quinoxyfen		
Rally 40W Agricultural Fung	May-Aug	First Flush	40% Myclobutanil	**YES**	**YES**
Red-Top Golden-Dew	Apr-Jul	Late Spring rain, otherwise first flush	85% Sulfur		
Red-Top R-Serenade Max Spreader Activator	Jun	First Flush	Unknown		
Rely Herbicide	May	Late Spring rain, otherwise first flush	11.3% Glufosinate-ammonium		
RNA Non-Ionic & Anionic SPR	Apr-Aug	First Flush	Unknown		
Roundup Original Herbicide	Jan-Aug	First Flush	41% Glyphosate, isopropylamine salt, 48.7% Glyphosate, potassium salt		
Roundup Original Max Herbicide	All Year	Late December rain or First Flush			
Roundup Weathermax Herbicide	Dec-Jun	Late February rain			
R-Serenade Max Spreader Activator	Jan-Sep	First Flush	Unknown		
Serenade ASO	Apr-Nov	First Flush	1.34% QST 713 strain of dried Bacillus subtilis		
Serenade Max	May-Aug	First Flush	14.6% QST 713 strain of dried Bacillus subtilis		

Silwet L-77 Surfactant	Apr	Late Spring rain, otherwise first flush	Unknown		
Sonata	Apr-Aug	First Flush	1.38% Bacillus pumilus strain QST 2808		
Sovran Fungicide	Apr-Jul	First Flush	50% Kresoxim-methyl	**YES**	**YES**
Special Electric Refined Su	Apr-Sep	First Flush	98% sulfur		
M Sulfur DF	Mar-Jun	Late spring rain, otherwise first flush	80% sulfur		
Surflan A.S. Agricultural H	Jan	February Rain	40.4% Oryzalin	**YES**	**YES**
Sylgard 309	May-Sep	First Flush	Unknown		
Tactic	Apr	Late Spring rain, otherwise first flush	3.25% Fenthion, 1.4% DDVP	**YES**	**YES**
Thiolux Dry Flowable micron	April-June	First Flush	80% Sulfur		
Thiolux Jet	Mar-Jun	Late Spring Rain	80% Sulfur		
Topsin M WSB	Feb-Mar	March	70% Thiophanate-methyl	**Yes**	
Vangard WG	May-Jun	First Flush	75% Cyprodinil		
Wilbur Ellis Dusting Sulfur	Mar-Aug	First Flush	Unknown		

Courtesy PAN = Pesticide Action Network, 2009

Pesticides, herbicides and fungicides are hazardous by nature, in that they are created to kill living organisms. In most cases, they are toxic to humans as well. The degree of this toxicity depends on many factors and is much disputed. Because there are so many chemicals applied in the watershed, it makes since to focus on those that are most dangerous. Table 12 shows chemicals that are known to be either PAN „bad actors‟ or toxic to Aquatic Organisms. Chemicals that are *suspected* to be PAN bad actors or toxic to aquatic organisms were left out. This is because research is not yet confirmed and the veterans home will be busy enough studying the many chemicals that are known to be harmful. However, Veteran‟s home staff should familiarize themselves with <u>all</u> of the chemicals mentioned by visiting the webpages mentioned in the recommendations section, Chapter 6. The following excerpt from the PAN webpage describes PAN bad actors:

Pesticide Action Network (PAN) Bad Actor Pesticides

In order to identify a "most toxic" set of pesticides, Pesticide Action Network (PAN) and Californians for Pesticide Reform (CPR) created the term PAN Bad Actor pesticides. These pesticides are at least one of the following:

- Known or probable **carcinogens**, as designated by the International Agency for Research on Cancer (IARC), U.S. EPA, U.S. National Toxicology Program, and the state of California's Proposition 65 list.
- **Reproductive or developmental toxicants**, as designated by the state of California's Proposition 65 list.
- **Neurotoxic cholinesterase inhibitors**, as designated by California Department of Pesticide Regulation, the Materials Safety Data Sheet for the particular chemical, or PAN staff evaluation of chemical structure (for organophosphorus compounds).

- Known **groundwater contaminants**, as designated by the state of California (for actively registered pesticides) or from historic groundwater monitoring records (for banned pesticides).
- Pesticides with **high acute toxicity**, as designated by the World Health Organization (WHO), the U.S. EPA, or the U.S. National Toxicology Program.

The category of acute aquatic toxicity is not included in the PAN bad actor definition because these chemicals are not necessarily toxic to humans. They were included because water is the topic of concern. This category is based on an average toxicity to several species tested. To get information about a specific species, one must go to that *organism group* for that chemical on the PAN website *(Pesticide Action Network, 2009).*

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Pesticides, herbicides, and fungicides are applied seasonally, depending on their purpose. When testing for such chemicals, it is important to test during a period when they would have most recently washed into the reservoir. Table 12 shows the months when the chemical was applied and a recommendation of when to test for that chemical. This recommendation is based on when rains might wash a given chemical into Rector Creek.

Sulfur is the most widely used chemical and acts as a fungicide against powdery mildew on grape vines. Sulfur is oxidized by bacteria and becomes sulfate, which is not likely to leach into ground water or adversely affect surface water (RWQCB). Sulfur is an approved fungicide in certified-organic agricultural enterprises.

The Atlas Peak vineyards have drainage controls in place to divert runoff into ponds. The vineyards are mostly over 1 mile away from Rector Reservoir, so that potential for chemicals to influence the reservoir source are lessened compared to vineyards in closer proximity to the reservoir without drainage retention.

Wild Animals

Wildlife that have been observed in the watershed are described in Section 2. Wildlife are considered to be a potential source of contamination because their feces can spread a source of Giardia and Cryptosporidium to Rector Creek and on into the reservoir. In the Rector watershed, wildlife of concern are beaver and deer.

The California Department of Fish and Game indicated that beavers have been a part of the watershed at one time but were hunted out. The Milliken Reservoir watershed is reported to support beaver, and beavers could return to the Rector Watershed, according to Fish & Game (*CDFG, 2003*).

While animals can certainly spread disease, the treatment plant is designed to disinfect against these diseases and so their relative threat to water quality is low. In addition, wildlife like mountain lions, bear, deer, etc as well as smaller less visible wildlife like bees, gophers, salamanders, snakes etc play important roles in ecosystem stability and flexibility – and even in watershed health. Burrowing animals, for example, sustain subsurface pore spaces that facilitate greater rainfall infiltration and groundwater recharge than would otherwise occur. In other words, without wildlife, populations of animals like insects that are lower in the food web might flourish and cause plant diseases, spread other disease, stimulate fire, etc. It is more healthy for the water quality to support the wildlife in the watershed than to eradicate it. In no way do we advocate acts that destroy wildlife in the name of protecting water quality.

Unauthorized Activity

Trespassing

During the July, 2008 field survey a hobo camp was discovered in the north fork. One resident was present. In September of 2008 this „resident" had not yet been served an eviction notice by police because every time they visited to try to serve the notice, he was not there. By California law, a notice is required to be served to this „resident‟ before he can be evicted. This „resident‟ had previously been caught trespassing on the road by Russell Van Voorhis several months before the discovery of his camp, so he has been there for at least half a year. One would assume he is defecating in the watershed. The treatment facility is designed to treat for fecal coliform, so there is no immediate health threat. A less likely but potentially more detrimental consequence would be sabotage of the water source.

Occasional swimming, fishing, and hunting have been observed around Rector Lake. This is officially prohibited and discouraged. The largest concern associated with trespassing is sabotage and terrorism, or contamination of the reservoir with something the treatment facility does not test or treat for.

Marijuana Production

Marijuana production does not appear to be prevalent in Rector watershed *(NCPD, 2008).* Illegal marijuana gardens are often irrigated from streams using diesel pumps. Risk of a diesel spill is one of the greatest environmental concerns associated with marijuana production.

Methamphetamine Labs

Less common unauthorized dumps with more dangerous ramifications are posed by methamphetamine laboratories. In her article about meth use in Napa County, Patricia Lynn Henley interviewed Gary Pitkin of the Napa Special Investigations Bureau. He says "Meth is probably the biggest drug problem we‟re facing in Napa County right now" *(Henley, 2008).* There have not been any known problems with methamphetamine laboratories in the watershed thus far *(NCPD, 2008).*

At a recent presentation Wayne Briley, one of Mendocino County‟s Hazmat specialists indicated that primary toxicity in the waste product generated in these labs is presented by solvents. While a variety of methods can be used to manufacture methamphetamine, the most common method used is the Red Phosphorus and Iodine method. In this method ephedrine – which is an essential ingredient available as Pseudoephedrine in a variety of over-the-counter drugs - must be extracted from its starchy binding agent by grinding it into a powder and exposing it to heat, a variety of solvents, phosphorus, rock salt, and sulfuric acid gas. Typical solvents used include paint thinner, Coleman white gas, acetone, xylene, toluene, and/or benzene which are all classified as volatile organic contaminants on the US EPA‟s Drinking Water Contaminants website www.epa.gov/safewater/hfacts.html.

Illegal Dumping

There have been no known illegal dumping of chemicals, paints, or any other toxic materials in the reservoir nor the watershed. The reservoir itself is surrounded by wildlands with no authorized road access where illegal dumping might directly contaminate the reservoir. Roads in the upper watershed are utilized by landowners and vineyard staff and to some extent by the public and suppliers. In the 2003 field survey trash in the form of aluminum cans, bottles, and plastic packaging was observed in and around small streams. In the 2008 survey, very little trash was observed on roadsides or stream crossings. It can be presumed that to some extent a few private owners, guests, or employees may choose to dump a variety of wastes to detour the cost and inconvenience of disposal in designated landfills.

Mine Runoff
According to the Napa County Planning Department and the Division of Mines and Geology, there is no active or inactive mining, nor any mineral deposits in Rector Watershed (*NCPD, DMG, 2003*).

Solid and Hazardous Waste Disposal Facilities
No solid waste nor hazardous waste disposal facilities are located in the watershed.

Logging
The Rector Watershed has very little timber of commercial value and therefore logging is not a present or anticipated land use.

Recreational Use
Recreational use of the reservoir is prohibited. However, some unauthorized fishing and swimming does occur. Boating is a prime source of MTBE, the gasoline additive used especially in 2-cycle engines. The reservoir is patrolled monthly, as staff time permits. Patrol is done sometimes by boat and other times by foot. The reservoir is inspected daily during deer hunting season (*YVH*).

There is no hiking, hunting, or off-road vehicle use permitted on lands owned by the Veterans Home. However, these activities likely do occur to some extent on privately owned lands.

Underground Fuel Storage Tanks
According to the Napa County Environmental Management Department, there are no known underground fuel tanks in the watershed area. Atlas Peak winery has above ground tanks that are permitted and regulated by the California Regional Water Quality Control Board, San Francisco Bay Region. (RWQCB). Smaller above ground storage tanks are expected in rural areas, such as those developments accessed by Soda Canyon Road and Old Stagecoach Road. Gasoline products such as MTBE are widely found in water supplies and are potential human carcinogens (Kahlman and Lund, 1998).

Traffic Accidents/Spills
Traffic accidents are most likely to occur on Soda Canyon Road, the only public road leading into the watershed. All other roads are privately owned. The potential for any hazardous spill is very minimal because there is no industry (other than wineries), moderate agricultural activity, and limited access to the public. Hazardous material that might be trucked into the watershed area would be fuel, fertilizers, ammonia, and chemical pesticides, herbicides, and fungicides primarily for vineyard use. There are several places that a road crosses a tributary to Rector Creek. These tributaries are far from Rector canyon and far from the reservoir and these are usually dry during most seasons. However, MTBE is found frequently in low concentrations in road runoff, according to USGS (Reuter, et al 1998). There are no industries besides viticulture and wine production in the area (*NCPD*).

Ground Water which Influences Surface Water Quality
Private land owners have ground water and springs for domestic and agricultural uses. There are natural springs that contribute to the Rector Creek tributaries. There are no records of gas, oil or geothermal wells on the watershed.

Seawater Intrusion
Seawater intrusion is not a potential contaminant within the watershed.

Geologic Hazards
The geologic assessment by Registered Geologist Elias Steinbuck (Chapter 2) shows that there are no active faults in the watershed. Landslides and episodic erosion are the predominant path for

naturally occurring sediment transport. Erosion, sedimentation and turbidity will always be an issue due to natural geologic processes. However geologic hazards can be exacerbated by land management activities like roads that disrupt and redirect native hydrological patterns.

Fire

Fires can significantly impair water quality by increasing erosion and runoff (Helvey, 1980). This results in more turbid waters in streams and rivers. As water turbidity increases, more treatment chemicals, such as chlorine, are required to purify drinking water.

Fires result in an increase in erosion and runoff for five main reasons: 1) Absence of vegetation – Vegetation intercepts rain, reducing the force with which it hits the soil. Vegetation also absorbs water from the soil and transpires it, so the soil is not as readily saturated. 2) Absence of duff and leaf litter – duff and leaf litter protect the soil from impact, slow water flowing over the slope, and hold water between pore spaces. 3) Surface sealing by fines - When a fire burns, it leaves ash on the surface. These ash particles fill micropores in the soil surface, which prevents infiltration. 4) Soil hydrophobicity - As a fire burns, phenolitic plant compounds in the duff and litter layer vaporize. As they cool, they condense, and are drawn down into the soil, forming a water repellent layer. 5) Raindrop Impact – As raindrops hit bare ground, they dislodge soil particles that are easily carried by overland flow (DeBano, 1981: Shakesby et. al., 2000; USDA, 2000).

The fire hazard for most of the area within Rector Watershed is considered very high (Figure 16). Small portions within the watershed are considered to be at high risk or moderate risk. The last major fire that swept through the Rector Watershed was on June 22, 1981 (Figure 17). In 7 hours, the Atlas Peak Fire consumed 23,000 acres of brush, grass and timber and destroyed 61 homes, 91 other buildings, 40 vehicles and numerous wildlife and domestic animals. The fire front was up to seven miles across and moved at 4,500 feet per hour. The fire was started by seven arson set fires. Rumor has it that the fire was spread, at least partially, by a grey fox racing by with its tail afire *(Mark Nicander -2003, personal communication).* The conditions that day were 103 ^{o}F temperature, 18 mph winds, and humidity less than 4%. The fire consumed vegetation across the entire Rector Watershed and other areas as well (*NCPD, 2003*). The ash from the fire contaminated Rector Reservoir for several years during which Veterans Home purchased all their water from the City of Napa‟s intertie. The natural fire return interval in unsuppressed areas of this vegetation type and climate range from 10-40 years. Four other fires burned part of the Rector Watershed within the 22 years previous to the all consuming Atlas Peak Fire. One of these fires was only 12 years prior to the Atlas Peak Fire. Twenty-seven years have passed since the Atlas Peak Fire, so another can be expected at any time.

During a wild fire, fire control lines are cut into the native soil with bulldozers. After the fire is put out, diversion dams or water bars are put in by bulldozers along the control lines to minimize erosion during rains. (*CDF, 2003*)

The 1981 fire created significant problems for the Rector Reservoir source. The very rainy winter which followed this fire produced high turbidity runoff, due to excessive erosion of the denuded slopes and ash residue. Two years later, the Veterans Home was still having difficulty treating the water, because of a very fine ash deposited by the fire, and high turbidities. The Veterans Home shut down their treatment plant for four years until the water quality improved and appropriate treatment equipment was installed. During this time water was obtained from the interconnection with the City of Napa. (*DPH files, 2003*)

The California Department of Forestry (CDF) has developed a Fire Hazard Severity Scale in order to evaluate and designate potential fire hazard areas in wildland areas. According to this rationale, the Rector Creek Watershed has a high fire severity potential.

The scale is based on the following criteria: (*NCPD, 2003*)

- Fuel loading (vegetation); chaparral is most flammable
- Fire weather (wind, temperature, humidity, and fuel moisture content)
- Topography (degree of slope)

Napa County has a Mediterranean climate generally without rainfall during the hottest months. There are long and dry summers from May to November. Winds accelerate the spread of wildfire and provide fast infusion of oxygen that sustains the combustion process. Steep slopes contribute to fire hazards by intensifying the effects of wind and making fire suppression difficult.

The Napa County Fire Department provides wildland and structural fire protection services to the unincorporated areas of Napa County through a volunteer fire department and a contractual agreement with the CDF (*NCPD, 2003*). The following pie chart gives statewide fire ignition sources, from CDF.

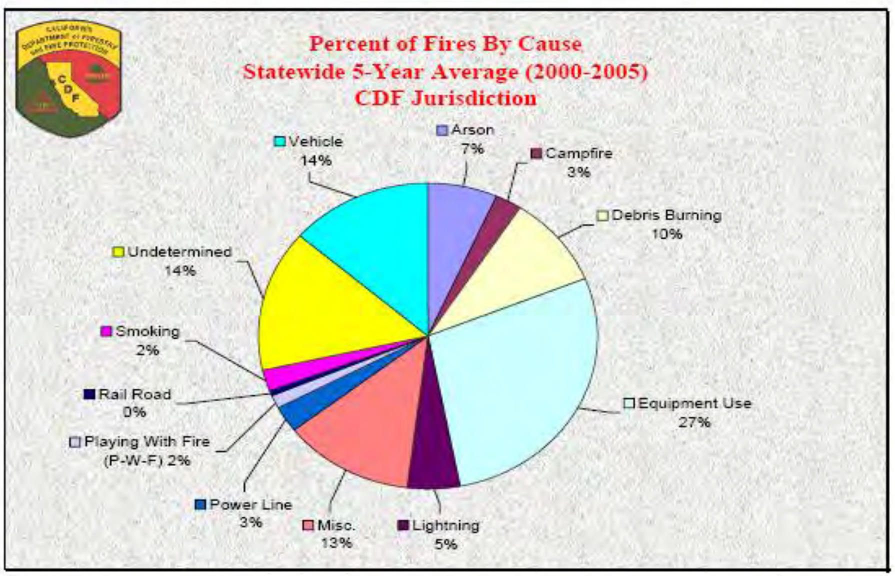
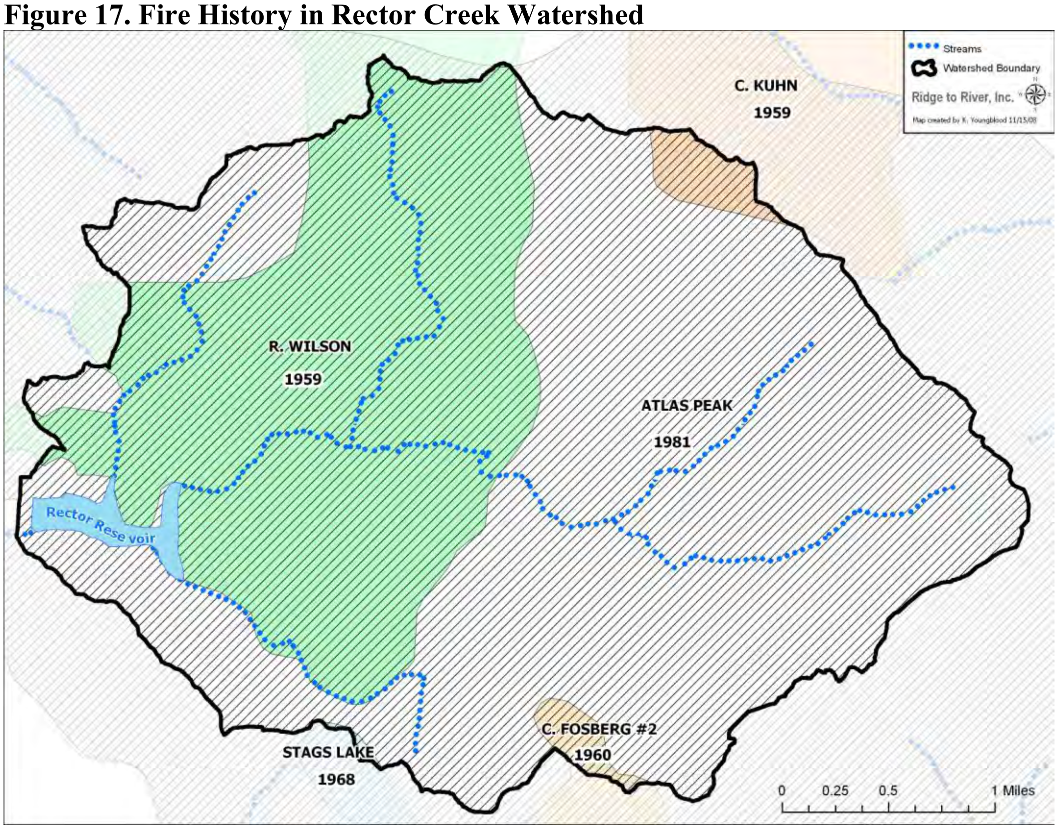


Figure 15. Causes of California Fires in CDF Jurisdiction, Courtesy of CalFire (http://cdfdata.fire.ca.gov/admin/cdf/images/incidentstatsevents_106.pdf).

Figure 16. Fire Hazard Rating at Rector Creek Watershed

Figure 17. Fire History in Rector Creek Watershed



Significance of Potential Contaminant Sources

The most significant potential contaminant sources in the Rector Reservoir"s Watershed are

- Erosion and Sedimentation
- Fire
- Nutrient applications to Agricultural Lands
- Pesticide/Herbicide/Fungicide/Insecticide applications to Agricultural lands

The significance of various potential contaminant sources discussed in this chapter is summarized in the Watershed Sanitary Survey Checklist at the beginning of this document. The checklist shows each potential contaminant source, an assessment of its potential to impact water quality and comments relating to that assessment.

Fire is ranked as having a high potential to impact water quality. Fire creates ash and increased erosion, both of which produce increased raw water turbidity. A devastating fire has already swept through the area and history will repeat itself as fire is a natural recurring watershed process.

Erosion and sedimentation are ranked as having a high potential to impact water quality. High intensity rainfall increases erosion and sediment runoff which produces increased raw water turbidity. This process is intensified on bare ground or where vegetative density is sparse.

Pesticide, Herbicide, and Fungicide applications have greatly increased since 1995 and many of these have chemicals have toxic effects on non-targeted human, fish and wildlife.

These potential contaminant sources are viewed as high, or significant because there is direct evidence as to their existence in the watershed. Their influences are assumed to be present in the raw water and perhaps the finished water. While turbidity effects result from agricultural development, roads, and natural background erosion, and while fire produces turbidity as well, the chemical pesticides, herbicides, insecticides and fungicides are not targeted by treatment plant processes and are likely to pass right through the treatment plant, on to the unsuspecting water consumer.

Anticipated Growth within the Watershed

According to the 2000 census, unincorporated Napa County had a reduction in population, in contrast to the County in general, which had a 12% increase. Based on the fact that no septic systems were developed in the last five years, residential growth in Rector Watershed appears to be stable at this time.

Vineyard expansion continues, but at slower rate than during the 1990"s boom. There is only so much arable land in the watershed, and already soils are being manufactured for vineyard production. None the less, several hundred acres have been converted to vineyards since the 2003 survey. It is expected that vineyard development will continue, but also continue to slow both because of restraints imposed from Napa County and because much of the available land is already used.

More information about potential growth and development in the watershed is presented in Chapter 4, Watershed Control and Management.

Projected Changes in Sources of Contaminants

Population and development growth in the watershed are anticipated as described above, and so the rate of contamination will be proportional. Continued development will likely increases the range, frequency, and magnitude of contaminant sources, including increased runoff and soil erosion from additional vineyard development, more unauthorized dumping, and increased application of chemical pesticides, herbicides, insecticides, and fungicides on vineyards. As discussed in more detail in Chapter 4, most Napa County vineyard plantings are required to be in accordance with an approved erosion and water quality protection plan specifically adopted for municipal water supply watersheds. The economic crisis consuming individuals and families is likely to cause the homeless population to increase and those homeless will look to wildlands, in part, for quiet and uninterrupted shelter.

4. WATERSHED CONTROL AND MANAGEMENT PRACTICES

A water agency‟s control over its watershed is related in part to the amount and location of property the agency owns, and its relationship with private landowners and regulatory agencies with watershed management authority. As was proved recently by the Sierra Club, an organization can exert significant influence over watershed management policies even without property ownership: the Sierra Club claimed that Napa County was not adequately complying with CEQA and their point of view was acknowledged, with the County, now requiring watershed-by-watershed EIRs for proposed developments.

The Veterans Home owns approximately 1,900 acres, of which 1,070 acres lie within the watershed boundary with remaining acreage just outside it *(Rector Sanitary Survey, 1996; Patrick Gilleran, 2008).* These 1070 acres comprise the reservoir itself, the lower 15% of the Rector Reservoir Watershed drainage area. The Veterans Home owns the dam, the reservoir, its perimeter, and the inlets of the tributaries. The entire watershed is located within the unincorporated area of Napa County and is therefore under the jurisdiction of Napa County policies, zoning, regulations and plans. Functionally, control of watershed issues is all exercised by Napa County Planning Department.

Recreational uses such as swimming, boating, hunting, fishing, and camping are prohibited in the watershed but still occur to some extent. During the Ridge to River watershed survey, a resident was discovered in the North fork. Despite efforts to have the "resident" evicted by the sheriff, he was still there after three months *(Russell Van Voorhis - 2008 personal communication).*

Veterans Home Management Practices

Organizational Structure

The Veterans Home of California is a division of the California Department of Veterans Affairs. Daily Water Treatment Facility plant operations are conducted by Russell Van Voorhis and Winniefredo (whose qualifications are provided below) under the supervision of the Chief Engineer II, David Kernohan. In turn, David Kernohan reports to William Hargis, Chief of Plant Operations III.

Table 13. Rector Water Treatment Facility Operator Certifications

Name	Certificate Level	Certificate Expires (date)
Russell Van Voorhis	T-4	10-01-2010
Winniefredo Cruz	T-3	6-01-2010
Mark Nicander: Relief Plant Operator	T-2	10-01-2011

The Veterans Home is responsible for the management of the Rector Reservoir. However, no overall watershed management plan has been adopted for the Rector Creek Watershed. The Veterans Home, as a state agency, has no control over the decisions of Napa County Departments. The Chief Engineer will review proposed projects on the watershed, if informed of the proposals. The treatment plant Supervisor regularly conducts inspections by boat of the reservoir. Ridge to River staff accompanied Winniefredo Cruz and Russell Van Voorhis on one such inspection. Winniefredo Cruz and Russell Van Voorhis have been at the treatment facility for about two years. They do not have the history there to notice long-term changes in the reservoir or recount historical events. Mark Nicander, the previous operator, worked at the treatment facility for over a decade. He still works at the Veteran‟s Home and was happy to discuss historical events.

Watershed and Reservoir Management

Besides occasional monitoring of the reservoir and visits to the upper watershed, the Veterans Home has no active Watershed Management policies. Treatment Facility operations management certainly values water quality and requests that landowners in the basin follow the Napa County Conservation Ordinances pertaining to the Ag-Watershed zoning. Veterans Home values and respects the rights of private property owners.

Land Ownership and Right-of-way

The Veterans Home owns approximately fifteen percent (15%) of the total watershed. A public road, Soda Canyon Road, provides access to the eastern part of the watershed. This road is initially paved, but turns to dirt/gravel. It forks and becomes private before ending at various vineyards. The private section of Soda Canyon Road has numerous intersections leading to vineyards. It circles around the upper Rector watershed and back around to Silverado Trail several miles north of the Treatment Plant. The Veterans Home does not allow public use of any roads into their portion of the watershed.

Public Access Control

Most of the land surrounding Rector Reservoir is owned by the Veterans Home. Rector Reservoir is not open to the public and no fishing, hunting, boating or body contact (swimming) recreation is permitted. The Veterans Home has a fence and security gate to prevent access to the facilities and reservoir. There are posted signs, and verbal warnings are issued to trespassers if/when a trespasser is found.

Napa County

Watershed Development: Conservation, Development, and Planning Department

Rector Creek Watershed is zoned Agricultural-Watershed (Ag-Watershed, or AW). Presently, each parcel in an Ag-Watershed is limited in its land clearing operations such that landowners must conserve 60% of forested areas and 40% of chaparral *(NCDPC, 2008)*. Land uses such as building or agriculture within an Ag-Watershed (Rector Creek Watershed) require a use permit from the Napa County Planning Department. Napa County Planning Department was sued by the Sierra Club for failing to comply with California Environmental Quality Act (CEQA). Rector is now termed an “impaired watershed” by the County such that all developments within the watershed require an Environmental Analysis. This put a hold on proposed developments within the Rector Watershed for over 5 years. As a result of this lawsuit, Napa County batched development proposals by watersheds. Napa County Resource Conservation District acts as a fee-free liaison between landowners and governmental organizations to assist landowners in adopting sound conservation-minded developments.

In 2003, The Napa County Board of Supervisors passed an ordinance to set more restrictive standards on developments in Ag-Watersheds, such as Rector. The ordinance is #02626 was prepared in response to a debris flow in 12-2002 associated with a vineyard in Friesen Lakes Watershed. The Ordinance is intended to provide additional protection for sensitive drinking water supply reservoirs and will:

a) Expand the explicit purposes of the Conservation Regulations to include the protection of selected specified drinking water supply reservoirs;
b) Expand the definition of domestic water supply drainages to include the Lake Curry, Lake Madigan, and Friesen Lakes drainages;
c) Establish that drainage facilities in domestic water supply drainages must be designed to convey the 100-year storm;

d) Require notice of erosion control plan submission to owners/operators of water supply systems located within the area flowing into their reservoirs;
e) Require submission of a geotechnical report for projects in a domestic water supply drainage;
f) Require that the project engineer oversee implementation of his/her plan;
g) Require that the property owner see that the erosion control measures installed are routinely inspected, properly maintained, and annually monitored;
h) Provide a procedure and timelines for dealing with failures of erosion control facilities;
i) Require mid-winter county inspections of erosion control plans paid for by the property owner for 3 years after the project is completed and stabilized;
j) Require County spot checks of finished erosion control plans to assure that they are operating properly and provide for necessary right of entry;
k) Clarify that bonding can be required by the Director of Planning to guarantee effective erosion control plan implementation and expand the circumstances under which a bond can be required; and,
l) Provide new definitions and other related text changes as needed.

According to the policies of the Napa County General Plan, the current minimum lot size is 160 acres. However, smaller lots do exist in the watershed.

Presently, an Erosion Control and Water Quality Protection Plan must be submitted by the landowner to the Napa County Planning Department in order to receive a permit for building or developments on slopes steeper than 5%. These are often passed to the Napa County Resource Conservation District for review and comment (as are development proposals).

Septic System Regulations: Napa County Environmental Management Department

Septic systems in the watershed are permitted and regulated by the Environmental Management Department. As described in the Napa County Sewage Ordinance, a permit is required to install, alter, expand or repair any sewage disposal system (septic system).

Grazing Practices and Wildlife Management: Napa County Planning

There is no grazing on lands owned by the Veterans Home. There is likely to be minimal grazing on privately owned lands but we have no evidence to quantify or otherwise describe it. Wildlife management is encouraged by the Napa County Planning Department when lands are converted to agricultural use.

Pesticide and Herbicide Applications: Napa County Agricultural Commissioner

Lawful pesticide and herbicide chemical applications are reported by landowners to Napa County Agricultural Commissioner‟s office. Pesticide regulations are determined by the State of California and are listed under the California Code of Regulations Title 3, Division 6. The Department of Pesticide Regulations (DPR) is the state agency responsible for protecting human health and the environment by regulating pesticide sales and use. In order for a Pesticide to be approved for use in California, the chemical must first be evaluated by DPR. Toxicologists, Biologists, Entomologists, and Plant Physiologists must first determine the risks associated with a pesticide. Based on the findings of the studies, the pesticide is assigned a risk assessment. In order to ensure that the risk involved with the pesticide used on an agricultural level, and that proper caution is taken to address these risks, the applicator must be trained and certified with DPR. If the pesticide is approved for use in California, the pesticide is then registered with the County Agricultural Commissioner‟s office. The County Agriculture Commissioners are responsible for local enforcement of pesticide activities. Detailed information about pesticides in the Rector Reservoir Watershed can be found in Chapter 3.

Road Maintenance: Napa County Public Works

The northernmost mile of Soda Canyon Road is publicly owned and maintained by the Napa County Public Works Department. The remainder of the roads in the watershed are spur roads and jeep trails off Soda Canyon Road and are privately owned and maintained. Roads and stormwater facilities are reviewed by the Napa County Public Works Department. Any stream crossings, no matter the classification, would require permitting by California Department of Fish and Game"s 1600 Stream Alteration Permit *(NCCPD, 2003)*. California Department of Fish and Game standards require permanent road stream crossings be designed to pass 100-year flood flows.

Water Quality Monitoring

Chapter 5 has a more detailed section describing water quality monitoring and results. Water quality monitoring is regulated by California Department of Public Health"s Drinking Water Division located in Santa Rosa.

The Veterans Home conducts raw and finished water quality monitoring for compliance with DPH regulations.

Riparian Management

Water Rights

The Veterans Home has primary riparian rights of the water supply in the watershed. The only other major permitted user of water in the watershed is Atlas Peak Winery. The winery diverts water into a 950 acre-feet storage reservoir during the winter rains. If Rector Reservoir requires water, Atlas Peak Winery is required to release water from their storage reservoir to satisfy Veterans Home senior water right.

Riparian Buffer Zones

In 1991 Napa County enacted “Conservation Regulations” to minimize soil erosion through establishing stream setbacks that limit encroachments by earthmoving and other developments to stream channels. Setback distances are required for all streams, including “blue-line streams”, class I fish-bearing or water supply streams, Class II streams hosting aquatic invertebrate, amphibian, or aquatic plant life forms, and Class III intermittent and ephemeral streams. Setback distances were defined by hillslope steepness adjacent to the watercourse. These setbacks ranged from 35 feet for hillslope gradients of 1% to 150-foot setbacks for hillslopes of 70%. Distances for setbacks are to be measured from the top of the high bank of a watercourse and onto the property in question.

Inspection and Surveillance of the Watershed

Rector Reservoir is inspected by boat once per month on average. The upper watershed is inspected approximately every couple of years, usually when there is something specific the treatment operator wants to inspect. Napa County inspects Erosion Control Plans either directly or with the aid of the Napa County Resource Conservation District.

<u>Wastewater Discharge Requirements</u>

The San Francisco Bay Regional Water Quality Control Board (Regional Board) issues National Pollutant Discharge Elimination System (NPDES) permits for wastewater and stormwater discharges to surface waters. Filter backwash is presently collected, percolated and evaporated from ponds adjacent to the Water Treatment Plant and so these do not discharge to surface water. Because Rector filter backwashes discharge to land (adjacent to the treatment plant), Vets Home should retain an NPDES permit for land discharge. In March, 2003, the San Francisco Bay Regional Water Quality Control Board published a permit application especially formatted for municipal water suppliers:

http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adoporders.shtml

In Napa County, the Environmental Management Department issues annual permits to those applying waste to lands and they conduct annual inspections and review monitoring data. In the Rector watershed, Atlas Peak Winery is the only facility that has been permitted for wastewater disposal. The Atlas Peak winery waste is stored in ponds and is then used for drip irrigation of the vineyards. Before irrigation the wastewater from the ponds must meet the following requirements: Biochemical Oxygen Demand (BOD) less than 50 ppm; pH greater than 6 and less than 9; Dissolved Oxygen (DO) greater than or equal to 2.0 mg/L. The winery has met these requirements (*J. Michel, NCEMD, personal communication*).

<u>Stormwater Regulations</u>
The Regional Water Quality Control Board regulates stormwater discharges through the NPDES permit process. The State of California has established permit processes governing municipal stormwater discharges, construction site stormwater discharges, and discharges of stormwater associated with industrial activity. With some exceptions, permits are not typically issued for individual sites, rather a statewide "General Permit" was adopted by the State Board and compliance is achieved by filing a "Notice of Intent" to comply with the provisions in the statewide permit. The Regional Board maintains a listing of entities that are permitted under the General Permit, but the actual facilities constructed to comply with the provisions are reviewed by Napa County.

<u>Lease Agreements</u>
As a condition of the Atlas Peak Winery water rights permit, the winery must release water from the winery"s 950 acre-ft reservoir whenever notified by the Veterans Home that Rector Reservoir is deficient in water storage.

Open Space and Watershed Policies

Open space is described in the adopted Conservation and Open Space Element of the Napa County General Plan as including the following uses: (*NCPD, 2003*)

- Managed production of resources (forest, range land, agriculture, ground water recharge, fisheries, and major mineral deposits).
- Public health and safety (earthquake fault zones, unstable soil areas, flood plains, high fire risk areas, and water reservoirs).
- Outdoor recreation (outstanding scenic, historic and archeological values; access to rivers, and streams; links between major recreation and open space reservations, including utility easements, banks of rivers and streams, trails and scenic highway corridors).

Policies for the uses above have been developed for airport approach zones, ecologically sensitive areas, environmental quality, fire management, limited development areas, open space areas, open space character, transmission line corridors, resource extraction, watershed protection, and water supply protection. The open space designations are temporary, in that any building project can be built in an area previously termed open space *(NCPCD, 2003).*

These policies are described in detail in the Napa County General Plan, or Conservation Ordinance.

Erosion Control/Soil Management Policies

The Napa County Planning Department"s "Conservation Regulations" require the landowner, for crops planted on slopes greater than or equal to five percent (5%), to submit an Erosion Control and Water Quality Protection Plan to the Planning Department. The plan may be developed by the landowner, consultant, or by the United States Department of Agriculture Natural Resource Conservation Service Program (NRCS). All plans are reviewed and approved by the NRCS before they are approved by the Planning Department.

The Regulations apply to most agricultural and land development activities in Napa County. The Regulations mandate soil erosion control planning for developments on slopes greater than five percent, use permits for slopes greater than thirty percent, and a variance for slopes greater than fifty percent. It also restricts vegetation removal, and requires varying setbacks from streams based on side hill slope and stream class, protection for areas near municipal water supplies, and temporary soil stabilization measures (e.g., cover cropping). The Regulations specify that, in municipal water supply watersheds, any new agricultural use of land or earth moving activity must maintain a minimum of sixty percent of the existing canopy cover, with 40% retention of any existing understory vegetation. If vegetation consists of shrub and brush without a tree canopy (chaparral), a minimum of forty percent of the shrub, brush and associated annual and perennial herbaceous vegetation are to be maintained.

The NRCS in Napa County promotes conservation in agricultural farming by sharing the cost of approved conservation practices. Its aim is to conserve water, control soil erosion, reduce pollution, and improve water quality. The NRCS is a voluntary participation program that provides free help and is available to all land users.

Natural Resource Conservation Districts are local, usually county-wide units of government that are guided by a board of directors made up of local farmers, ranchers, other land users, and community leaders in a county. In Napa County, the district is called the Napa County Resource Conservation District.

Fire Management

Fire management within the watershed is under the auspices of the California Department of Forestry (CDF) and the Napa County Fire Department (NCFD). The CDF and NCFD have developed policies and guidelines for fire hazard protection. These policies are not part of the Uniform Code of Fire Standards and therefore are not enforceable. The policies are described below:

Minimizing Wildland Fire Damage**:** A basic planning and land use approach to wildland fire reduction in Napa County would be the incorporation of the Fire Hazard Severity Scale into planning policies and standards. Some of these policies and guidelines are to: 1) restrict urban development in high wildland fire hazard areas, 2) develop a prescribed fuel management program, 3) adopt regulations for clearance around structures, minimum road widths, evacuation routes and maximum road grades, 4) develop standards for construction in high fire hazard areas, 5) develop a county-wide fuel break program, and 6) rezone open space lands subject to high fire risk (*NCPD*).

Minimizing Structural Fire Damage: As noted above, structural standards such as building design standards (roofing, vents, glass, siding and overhangs) can be integrated with the Fire Hazard Severity Scale and applied through the Uniform Building Code and adoption of the Uniform Fire Code. Some proposed guidelines for reducing structural fires are: 1) amend the Uniform Building Code to regulate the design and construction of buildings in high fire hazard areas, 2) adopt the Uniform Fire Code to establish Fire Protection standards, 3) require new and existing development to comply with established fire safety standards, 4) direct County fire officials to expand fire education programs, and 5) advocate by Board resolution revisions in the State Penal Code to impose criminal liability on property owners for fires resulting from identified and uncorrected fire hazards. (*NCPD*)

Research New Ways of Reducing Fire Losses: These policies and programs are to: 1) encourage continued research in the field of fire safety, 2) strengthen existing codes and ordinances pertaining to fire hazards, and 3) develop and support the use of new technology in the suppression and prevention of fires. (*NCPD*)
Currently, the CDF and NCFD give landowners ongoing guidance as to personal to fire protection.

Recommended Control Measures

As described in this chapter, the Napa County Planning and Conservation Department measures provide a control mechanism to protect Rector Watershed (as a municipal supply watershed) from problems resulting from continued development. The procedures of the Environmental Management Department and the Public Works Department, Napa County Resource Conservation District, as well as the Regional Water Quality Control Board, provide avenues for control.

We recommend the Veterans Home Water Treatment Plant staff make it a point to notify Napa County about its concerns in relation to the filling of Rector Reservoir with sediment and potential water pollution with application of agricultural chemicals. With the County as an ally, Veterans Home can consistently become informed about - and comment on - proposed developments within the Rector Creek Reservoir Watershed. As a municipal water supplier, Veterans Home has a responsibility to supply clean potable water to its customers and the quality of its source waters is certainly influenced by upstream/uphill land use practices. The Napa County Conservation Planning Department should be contacted to express Veterans Home‟s interest in such developments so that proposals could be routed to them for comment. Specifically, we believe Veterans Home should be concerned with steep roads, roads that cross streams, hydro-modification that diverts natural water courses and/or concentrates runoff, and the transportation, collection, storage, and application of toxic chemicals including petroleum products, fertilizers, and pesticides. Natural watercourses should stay within their natural channels unless diversion is absolutely necessary. Once a watercourse has been diverted, it is difficult to avoid detrimental effects to the watercourse that was robbed of its supply and to the non-watercourse that receives the water. The situation is even worse if plain topsoil is receiving the diverted water because almost certainly this situation will cause gullying or landsliding of the receiving hillside. Eroded sediments will be transported into Rector Creek and into Rector Reservoir.

5. WATER QUALITY

The Rector drinking water treatment facility successfully produced clear and refreshing water to its residences since the last sanitary survey. This is due to the excellence infiltration and clarification afforded by the online treatment plant and the dedication of the Water Treatment Facility Operators. The new treatment units were designed specifically to filter suspended sediments from the raw water to improve water clarity (reduce turbidity). Turbidity remains as a watershed constituent of concern, as it is a watershed supplied contaminant. Fortunately, filtration and clarification technology work well to clean and clear the water. Yet effective erosion control at the source is as important as control of turbidity at treatment because sediments suspended yielding turbidity are part of the incoming sediment stream filling the reservoir. There are other impurities besides turbidity that are not so easily observed but which may be present either in the raw or finished water. One of the most difficult constituents to monitor are pesticides. This is because their chemical composition changes frequently with air, water, and time and their application in the watershed is not reported on a realtime basis.

Water Quality Monitoring Programs and Results

Drinking Water Regulations and the Surface Water Treatment Rule

The federal Surface Water Treatment Rule (SWTR) became effective on June 19, 1989. California"s Surface Water Filtration and Disinfection Treatment Regulations (SWFDTR), which implement the federal SWTR, became effective in June 1991. The SWTR established treatment and performance requirements in lieu of maximum contaminant levels (MCLs) for turbidity and the microorganisms Giardia, virus, Legionella, and heterotrophic plate count bacteria. More recent updates of the Surface Water Treatment Rule (SWTR) include

- Interim Enhanced Surface Water Treatment Rule (IESWTR)
- Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)
- Filter Backwash Recycling Rule (FBRR)

In the basic form, the SWTR requires that all public water systems which use a surface water source must ensure the consumer"s safety from pathogenic bacteria, viruses and Giardia cysts, by providing multi barrier treatment which, at a minimum, achieves a total of 99.9 percent (3 log) removal and inactivation of Giardia cysts, and a total of 99.99 percent (4 log) removal and inactivation of enteric viruses. This level of treatment also provides protection from heterotrophic plate count bacteria and Legionella as required in the federal SWTR. Filtration and disinfection are needed to achieve these goals.

It is possible that a source water may have the potential to contain virus and Giardia levels so high that a 3-log Giardia/4-log virus reduction is inadequate to ensure reliable public health protection. Higher levels of removal must be required under these circumstances. The state SWFDTR Guidance Manual requires that source waters that have coliform concentrations over 1000 MPN/100 ml must be provided with a higher level of Giardia and virus removal.

In order to insure that safe drinking water is being produced, both the source water and the finished water must be monitored. Monitoring of the source water insures that the treatment facility can target appropriate contaminants. Monitoring of the finished water insures that these contaminants, and those used in the treatment process, have been effectively removed.

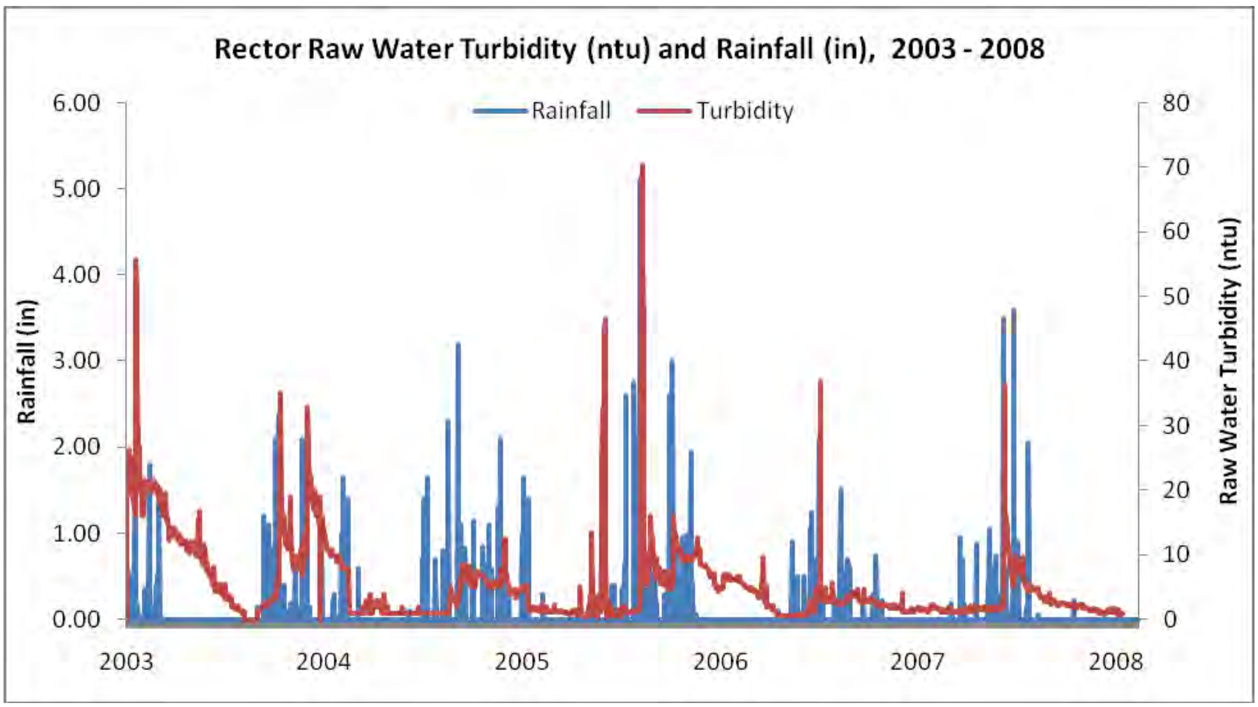
Source Water Monitoring

Precipitation and runoff is the mechanism by which most contaminants in the watershed reach the reservoir. These contaminants reach the reservoir by being washed along with soils into streams. There are many contaminants that bind with soil and can enter the water along with "turbidity". These include bacteria, chemicals, and heavy metals. Because rainfall drives erosion and erosion drives sedimentation and turbidity, peak storm events coincide with peak raw water turbidities and other likely elevated contaminants. Keeping an eye on weather reports will allow treatment plant operators to be prepared and especially vigilant during times when higher contaminant loads would be expected.

Turbidity

As soils erode from the watershed, particles become suspended in the water column, imparting a brown, muddy appearance that clouds the water. The cloudy, or opaque nature of the muddy water is termed turbidity. These soil particles are present in the raw water and must be removed in large quantities by the filtration and clarification processes at the treatment facility to provide clear potable water. Peak turbidity coincided with winter storms experienced in the area (Figure 18) . Turbidity ranged from 0-60 ntu (nephelometric turbidity units) in the data we reviewed. Finished water has its own spikes but averaged at about 0.1 ntu.

Figure 18. Rector Raw Water Turbidity and Rainfall 2003-2008



Bacteria

Total coliform, fecal coliform, and E. (*escherichia*) coli are monitored weekly in Rector Reservoir. Coliform rises in response to intense rainfall that rinses them into raw source waters, as may be inferred when comparing the rainfall and coliform charts. Testing is done for these bacteria in order to determine possible contamination from human, bird, or other mammalian fecal waste. Coliform bacteria, including fecal coliform, E. coli, are naturally occurring in the large intestines of warm blooded mammals and birds. *Escherichia coli* (named after Theodor Escherich who isolated the type species of the genus) is one of the most frequent causes of many common bacterial infections, including cholecystitis, bacteremia, cholangitis, urinary tract infection, traveler's diarrhea, and other clinical infections such as neonatal meningitis and pneumonia.

Coliforms are found naturally in the soil. Both the Center for Disease Control and the EPA have determined the normal amount of these bacteria expected in a water sample and have set guidelines to determine what reading may be a cause for concern. If there are elevated counts of E. coli in a water sample, an assumption can be made that there is possible contamination from human or animal fecal waste. Sources of this type of contamination usually originate from failed septic systems, failed sewer lines, large pastures of cattle or horses and sometimes even a high population of water fowl or other wildlife in a concentrated area. Elevated result readings for these indicator bacteria are to be expected when samples are collected just after a rainstorm. However, an elevated reading in dry weather or a high reading after a succession of rainstorms is an indication that there is an ongoing source of contamination.

The San Francisco Bay Basin Plan specifies a fecal coliform bacteria objective of less than 20 MPN/100 ml, total coliform <100 for all surface waters (*SWRCB, 2009*. http://www.swrcb.ca.gov/sanfranciscobay/basin_planning.shtml). They do not differentiate between flowing streams and still lake waters. This is based on the log mean of a minimum of five consecutive samples, equally spaced over a 30-day period. The San Francisco Bay Basin Plan‟s water quality objectives for municipal supply waters are based on MCL values taken from Title 22.

Previous monitoring conducted from 1963-1964 indicated coliform levels less than 1000 MPN/100 ml, with a median coliform density less than 45 MPN/100 ml (*Rector Sanitary Survey, 2003*). Average Total Coliform for the last 5 years was 54 MPN/100 ml, with levels up to 1600 MPN/100 ml. However, in the last two years, coliform levels have been lower. In 2007, the last year for which we have data, they were 15 MPN/100 ml. Average fecal coliform and E. coli were 3.2 MPN/100 ml and 2.4 MPN/100 ml for the last five years, respectively. For 2007 average fecal coliform and E. coli were 1.0 and 0.4, respectively (Figures 19, 20, see trendline). One would hope that recent low levels of coliform bacteria are part of a trend, although they may just be an anomaly.

Figure 19. Rector Rainfall Compared with Fecal Coliform and E. coli Bacteria 2003-2007

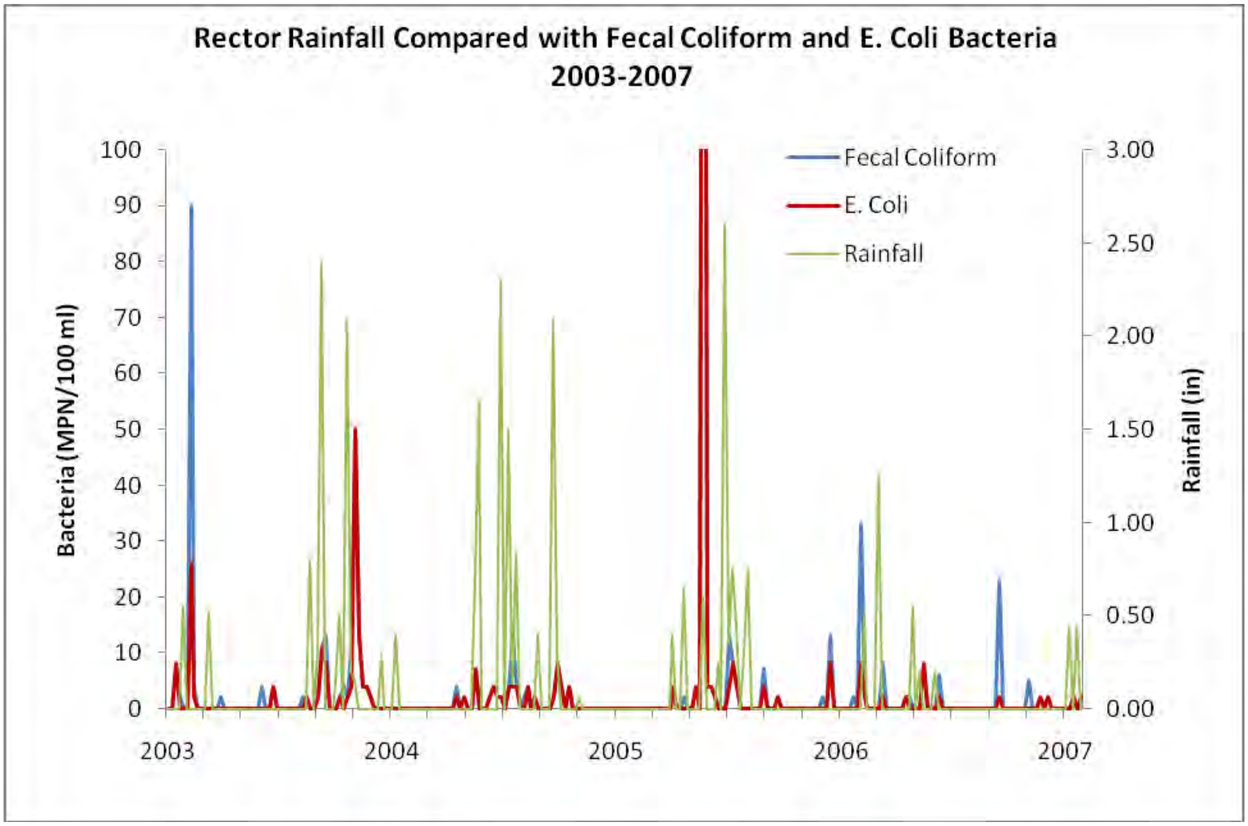
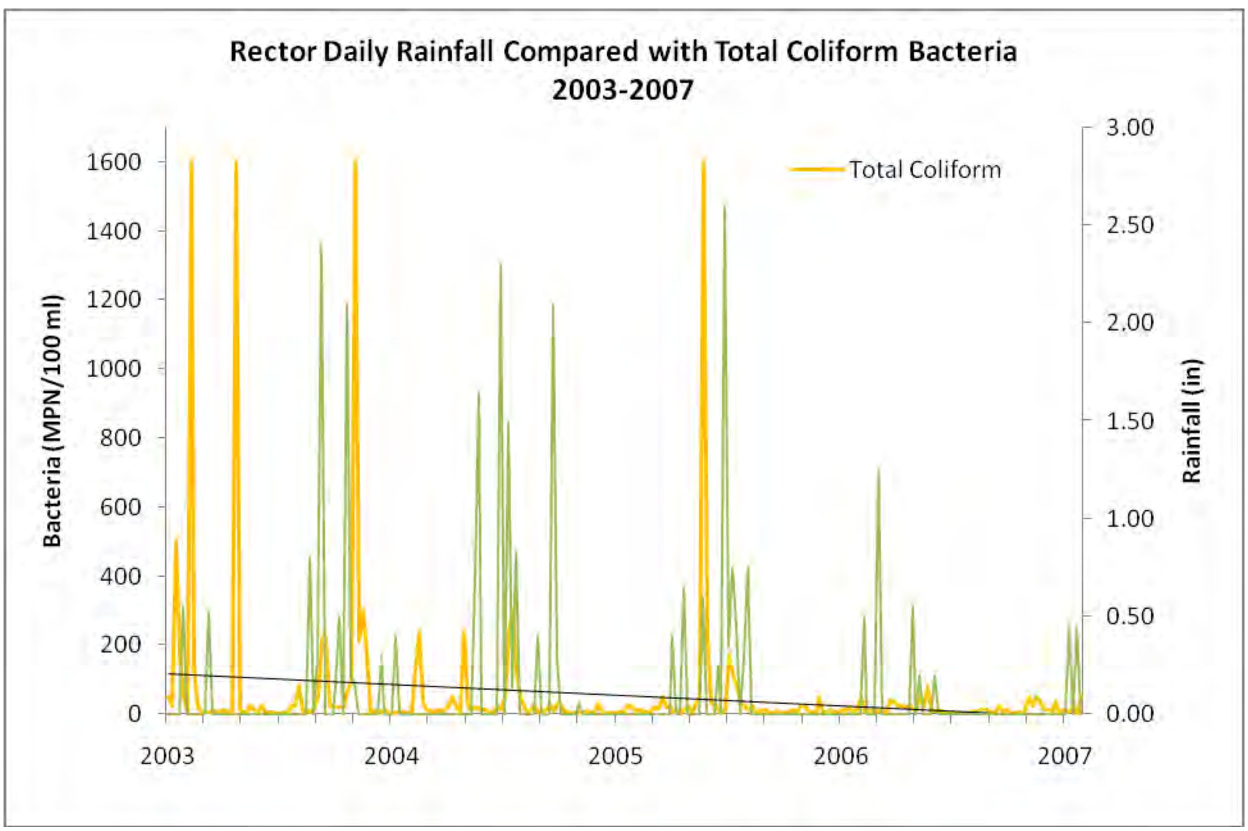


Figure 20. Rector Daily Rainfall Compared with Total Coliform Bacteria 2003-2007



Algae
The Veterans Home monitors for plankton in the reservoir during late spring, summer, and early fall to predict and control algae blooms. Algae and plankton are sometimes a source of turbidity in the reservoir and result in lower dissolved oxygen. Dissolved oxygen and temperature are tested at the treatment facility daily and at the intake tower weekly to determine where to extract water with high oxygen concentration and low temperature to optimize incoming source water quality. Jar testing is performed on the water coming into Rector Reservoir for adjusting chemical dose rates.

Department of Public Health Monitoring Requirements
The Veterans Home also conducts water quality monitoring for compliance with DPH regulations. Table 14 presents a summary of water quality monitoring currently required by California Department of Health Services (DPH). The physical sampling location for this monitoring is the raw water intake line from Rector Reservoir intake, or taps from the Boiler Room at Veterans Home, as indicated.

Table 15 presents a summary of raw water chemical monitoring results. As indicated in Table 15, with the exception of iron and manganese, constituent levels are well below established finished water MCLs.

Mineral Constituents

All primary standards were met. Review of secondary standards show that the level of iron has ranged from ND (non-detect) to 680 ug/l, and that the level of manganese has ranged from <34 – 61 ug/l, both slightly higher than 2003 levels and above the MCL . DPH Standards for iron and manganese are secondary, concerned with aesthetic values in water quality, because neither iron nor manganese produce harmful health problems. The secondary MCLs are 300 ug/l or 0.3 mg/l for iron and 50ug/l or 0.05 mg/l for manganese. Both iron and manganese concentrations exceeded the MCL for these minerals at least once. But this is not cause for alarm. Both iron and manganese are found in native rock and soil and so can be expected in natural waters. Indeed iron is a mineral needed by the human body. The MCLs for these minerals are a secondary standard for aesthetics because they may tend to impart a stain in the water itself, in plumbing fixtures, in laundry, and result in poor taste and odor.

Organic Chemicals

All organic chemicals were below the MCL. Three chemicals had higher levels than in the 2003 survey, for which they were a non-detect. These were all trihalomethanes: chloroform, bromodichloromethane, and Dibromochloromethane. This may suggest an actual increase in chemical levels, or just be a result of changing sampling techniques or frequency.

Atrazine and Simazine are active ingredients found in pesticides. They were found in the sourcewater once at a concentration of 1.0 microgram per liter, which is within their DPH MCL standards of 3, and 4 micrograms per liter, respectively *(Rector Sanitary Survey, 2003).* Our research into registered chemicals applied in the watershed and reported to the County Agricultural Commissioner indicated that Simazine *is* applied in the watershed, as the active ingredient of Princep 4L and Princep 90. Atrazine was not found to be reported to the Agricultural Commissioner but its presence in the raw water and presence as the active ingredient of Princep indicates it is an important chemical to watch, and to monitor in the Source Water (Rector Sanitary Survey, 2003). EPA considers Simazine to be a general use pesticide in the class IV, practically non-toxic. A lethal dose in 50% of lab animals (rats, mice, and rabbits) is >3100 mg/kg. No case of human poisoning has ever been reported.

Table 14. 2008 California Department of Health Services Water Quality Sample Schedule

Source Chemical Monitoring Requirements

Note: well sources must be operated at least 15 minutes before samples are collected. If well pump cannot be operated continuously for 15 minutes, collect samples toward end of well cycle. All samples must be collected before treatment.

Date of report: **8/8/2008**

System Name: **Veterans Home of California** System number: **2810008**

Source Name : **RESERVIOR INTAKE** Source class: **CLSP**

Source Code : **2810008-001**

Includes special monitoring for TOTAL COLIFORM AND FECAL/E. COLI (ENUMERATE)

Chemical Group : 64432- Primary - Inorganics

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
Aluminum	660.00	ug/l	1000	3/25/2008	Once per year	Mar 2009	
Antimony	< 6.00	ug/l	6	3/25/2008	Once per year	Mar 2009	
Arsenic	< 2.00	ug/l	50	3/25/2008	Once per year	Mar 2009	
Barium	< 100.00	ug/l	1000	3/25/2008	Once per year	Mar 2009	
Beryllium	< 1.00	ug/l	4	3/25/2008	Once per year	Mar 2009	
Cadmium	< 1.00	ug/l	5	3/25/2008	Once per year	Mar 2009	
Chromium	< 10.00	ug/l	50	3/25/2008	Once per year	Mar 2009	
Fluoride	< 0.10	mg/l	2	3/25/2008	Once per year	Mar 2009	
Mercury	< 1.00	ug/l	2	3/25/2008	Once per year	Mar 2009	
Nickel	< 10.00	ug/l	100	3/25/2008	Once per year	Mar 2009	
Perchlorate	< 4.00	ug/l	6	3/4/2008	Once every six months	Sep 2008	
Selenium	< 5.00	ug/l	50	3/25/2008	Once per year	Mar 2009	
Thallium	< 1.00	ug/l	2	3/25/2008	Once per year	Mar 2009	

Chemical Group : 64432- Primary - Asbestos

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
Asbestos	0.00	MFL	7 MFL	5/27/2008	Once every nine years	May 2017	

Chemical Group : 64432.1 -Nitrate/Nitrite

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
Nitrate (as NO3)	< 2.00	mg/l	45	3/25/2008	Once per year	Mar 2009	
Nitrite(as N)	0.00	ug/l	1000	3/28/2006	Once every three years	Mar 2009	

Chemical Group : 64449-A & B - Secondary Standards

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
Bicarbonate	37.00	mg/l		3/25/2008	Once per year	Mar 2009	
Calcium	6.10	mg/l		3/25/2008	Once per year	Mar 2009	
Carbonate	0.00	mg/l		3/25/2008	Once per year	Mar 2009	
Chloride	4.90	mg/l	500	3/25/2008	Once per year	Mar 2009	
Color	10.00	UNIT	15	3/25/2008	Once per year	Mar 2009	
Copper	< 50.00	ug/l	1000	3/25/2008	Once per year	Mar 2009	
Foaming Agents (MBAS)	< 0.10	mg/l	0.50	3/25/2008	Once per year	Mar 2009	
Hydroxide	0.00	mg/l		3/25/2008	Once per year	Mar 2009	
Iron	440.00	ug/l	300	3/25/2008	Once per year	Mar 2009	

8/8/2008 Page Number: 1

System Name: **Veterans Home of California** System number: **2810008**

Source Name : **RESERVIOR INTAKE** Source class: **CLSP**

Source Code : **2810008-001**

Includes special monitoring for TOTAL COLIFORM AND FECAL/E. COLI (ENUMERATE)

Chemical Group : 64449-A & B - Secondary Standards

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
MTBE (Secondary)	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
Magnesium	4.20	mg/l		3/25/2008	Once per year	Mar 2009	
Manganese	85.00	ug/l	50	3/25/2008	Once per year	Mar 2009	
Odor	< 1.00	unit	3	3/25/2008	Once per year	Mar 2009	
Silver	< 10.00	ug/l	100	3/25/2008	Once per year	Mar 2009	
Sodium	6.40	mg/l		3/25/2008	Once per year	Mar 2009	
Specific Conductance	96.00	uMho	1600	3/25/2008	Once per year	Mar 2009	
Sulfate	2.70	mg/l	500	3/25/2008	Once per year	Mar 2009	
Total Alkalinity	30.00	mg/l		3/25/2008	Once per year	Mar 2009	
Total Dissolved Solids	80.00	mg/l	1000	3/25/2008	Once per year	Mar 2009	
Total Hardness	33.00	mg/l		3/25/2008	Once per year	Mar 2009	
Turbidity	11.00	NTU	5	3/25/2008	Once per year	Mar 2009	
Zinc	< 50.00	ug/l	5000	3/25/2008	Once per year	Mar 2009	
pH	6.92			3/25/2008	Once per year	Mar 2009	

Chemical Group : Section 64441-Radioactivity

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
Gross Alpha	0.29	PC/L	15	2/5/2008	Once every nine years	Feb 2017	

Chemical Group : TABLE 64444-A - Volatile Organic Chemicals

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
1,1,1-Trichloroethane	0.00	ug/l	200	1/23/2007	Once every three years	Jan 2010	
1,1,2,2-Tetrachloroethane	0.00	ug/l	1	1/23/2007	Once every three years	Jan 2010	
1,1,2-Trichloroethane	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
1,1-Dichloroethane	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
1,1-Dichloroethylene	0.00	ug/l	6	1/23/2007	Once every three years	Jan 2010	
1,2,4-Trichlorobenzene	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
1,2-Dichlorobenzene	0.00	ug/l	600	1/23/2007	Once every three years	Jan 2010	
1,2-Dichloroethane	0.00	ug/l	.5	1/23/2007	Once every three years	Jan 2010	
1,2-Dichloropropane	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
1,3-Dichloropropene	0.00	ug/l	.5	1/23/2007	Once every three years	Jan 2010	
1,4-Dichlorobenzene	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
Benzene	0.00	ug/l	1	1/23/2007	Once every three years	Jan 2010	
Carbon Tetrachloride	0.00	ug/l	.5	1/23/2007	Once every three years	Jan 2010	
Dichloromethane	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
Ethylbenzene	0.00	ug/l	300	1/23/2007	Once every three years	Jan 2010	
MTBE (Primary)	0.00	ug/l	13	1/23/2007	Once every three years	Jan 2010	
Monochlorobenzene	0.00	ug/l	70	1/23/2007	Once every three years	Jan 2010	
Styrene	0.00	ug/l	100	1/23/2007	Once every three years	Jan 2010	
Tetrachloroethylene	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
Toluene	0.00	ug/l	150	1/23/2007	Once every three years	Jan 2010	

System Name: **Veterans Home of California** System number: **2810008**
Source Name : **RESERVIOR INTAKE** Source class: **CLSP**
Source Code : **2810008-001**

Includes special monitoring for TOTAL COLIFORM AND FECAL/E. COLI (ENUMERATE)

Chemical Group : TABLE 64444-A - Volatile Organic Chemicals

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
Trichloroethylene	0.00	ug/l	5	1/23/2007	Once every three years	Jan 2010	
Trichlorofluoromethane	0.00	ug/l	150	1/23/2007	Once every three years	Jan 2010	
Trichlorotrifluoroethane (FREON 113)	0.00	ug/l	1200	1/23/2007	Once every three years	Jan 2010	
Vinyl Chloride	0.00	ug/l	.5	1/23/2007	Once every three years	Jan 2010	
Xylenes (total)	0.00	ug/l	1750	1/23/2007	Once every three years	Jan 2010	
cis-1,2-Dichloroethylene	0.00	ug/l	6	1/23/2007	Once every three years	Jan 2010	
trans-1,2-Dichloroethylene	0.00	ug/l	10	1/23/2007	Once every three years	Jan 2010	

Chemical Group : TABLE 64444-B - Synthetic Organic Chemicals

Chemical	Last result	Units	MCL	Date of last	Frequency	Next due	Notes
2,4,5-TP (Silvex)	0.00	ug/l	50	1/22/2002	Once every nine years	Jan 2011	
2,4-D	0.00	ug/l	70	1/22/2002	Once every nine years	Jan 2011	
Atrazine	< 0.50	ug/l	1	3/25/2008	Once every three years	Mar 2011	
Dalapon	0.00	ug/l	200	1/22/2002	Once every nine years	Jan 2011	
Simazine	< 1.00	ug/l	4	3/25/2008	Once every three years	Mar 2011	

Table 15 – Rector Raw Water Chemical Monitoring Results

Constituent	**MCL** (ug/L)	**Concentration** Average, minimum, and Maximum
Alkalinity		42.53 (29 to 72.07)
Aluminum	1000	265 (nd to 1000)
Antimony	6	nd
Arsenic	50	0.14 (nd to 2)*
Asbestos	7	nd
Barium	1000	nd
Beryllium	4	nd
Bicarbonate (as CaC03)		45.10 (0 to 68)
Cadmium	5	nd*
Calcium		6.97 (5.6 to 10.79)
Carbonate		nd*
Chloride		4.59 (2 to 6.18) *
Chromium	50	1.71 (nd to 14)
Copper	1000	nd
Fluoride	2,400	0.09 (nd to 0.69)
Foaming Agents (MBAS)	500	0.03 (nd to 0.28)

Hardness		36.29 (13 to 62.64)
Hydroxide		nd
Iron	300	248 (nd to 680)
Lead	15	nd
Magnesium		4.14 (3.4 to 6.01)
Manganese	50	22.6 (nd to 85)
Mercury	2	nd
Nickel	100	nd
Nitrate (NO_3)	45000	1.07 (nd to 2.4)
Nitrite ($N0_2$)	1000	28.27 (nd to 200)
Perchlorate	6	4
pH		7.14 (6.75 to 7.7)
Potassium		1.72 (1.5 to 1.9)
Selenium	50	nd
Silver	100	nd
Specific Conductance		121.85 (80 to 230)
Sodium		6.34 (3.9 to 8.5)
Sulfate		2.38 (nd to 4.4)
Thallium	2	nd
Total Dissolved Solids (TDS)		92.87 (68 to 180)
Vanadium	NA	0.23 (nd to 3.2)
Zinc	5000	3.07 (nd to 40)*
Gross Alpha	15	1.4 (nd to 3.17)
Volatile Organics		
2,4,-D	70	nd
1,1 Dichloroethane	5	nd
1,1, Dichloropropene	UR	nd
1,1,1, Trichloroethane	200	nd
1,1,1,2-Tetrachloroethane	UR	nd
1,1,2, Trichloroethane	5	nd
1,1,2,2,-Tetrachloroethane	1	nd
1,1-Dichloroethylene	6	nd
1,2 dichlorobenzene	600	nd
1,2 Dichloropropene	5	nd
1,2, Dichloroethane	0.5	nd
1,2,3,-Trichloropropane	UR	nd
1,2,4 Trichlorobenzene	5	nd
1,3,5, -Trimethylbenzene	UR	nd
1,3,-Dichloropropane	UR	nd
1,4 Dichlorobenzene	5	nd

2,2, Dichloropropane	UR	nd
2,4,5,-T	10	nd
2,4,5,-TP (Silvex)	50	nd
2-Chlorotoluene	UR	nd
4-Chlorotoluene	UR	nd
Atrazine	3	nd
Bentazon	18	nd
Benzene	1	nd
Bromobenzene	UR	nd
Bromochloromethane	UR	nd
Bromodichloromethane	_	0.21
Bromoform	_	nd
C-1, 2 Dichloroethylene	6	nd
Carbon Tetrachloride	0.5	nd
Cis-1,2-Dichloroethylene	6	nd
Chloroethane	UR	nd
Chloroform	_	0.47 (nd to 1.4)
Dalapon	200	nd
Dibromochloromethane	_	nd
Dibromomethane	UR	nd
Dicamba	_	nd
Dichlorodifluoromethane	UR	nd
Dichloromethane	nd	5
Dinoseb	7	nd
Endrin	0.2	nd
Ethyl Benzene	700	nd
Hexachlorobutadiene	UR	nd
Lindane	4	nd
M,p –Xylene	_	nd
Methoxychlor	100	nd
Methyl t-butyl Ether (MTBE)	_	nd
Monochlorobenzene	70	nd
Naphthalene	UR	nd
N-Butylbenzene	UR	nd
o-Xylene	_	nd
Pentachlorophenol	1	nd
Picloram	500	nd
p-Isopropyltoluene	UR	nd
Sec-Butylbenzene	UR	nd
Simazine	4	nd

Styrene	100	nd
Tert-butylbenzene	UR	nd
Tetrachloroethylene	5	nd
Toluene	150	nd
Other		
Color		16 (0 to 60)
Odor		0.93 (0 to 6)
Turbidity		
Aggressiveness index		10.172 (10 to 11.2)

ND = Less than the detection limit for purposes of reporting.
MCL= Maximum Contaminate Level, EPA standards
UR= Unregulated organic chemicals, no MCL.
NT= Chemical not tested for

Finished Water Monitoring

Treatment Byproducts
Chlorinated organic chemicals known as Trihalomethanes (THMs) and Haloacetic acids (HAA5) are byproducts of the disinfection treatment process and are often found in municipal water supplies. These chemicals form when raw water with dissolved organic chemicals (from algae, bugs, detritus, etc) come into contact with free chlorine which is used in water treatment processes for disinfection from disease causing organisms like cholera, shigella, etc., which devastated human health all over the world in times gone by until the advent of chlorination.

Trihalomethanes were detected in 2003 as chloroform, with concentrations of 1.4 ug/L. Trihalomethane chemicals manufactured during the treatment process are not without side effects including an unpleasant taste to the water and can have toxic effects on customers. Some individuals may react to chronic exposure to trihalomethanes in excess of the MCL and may experience liver, kidney, or central nervous system problems, and may increase their risk of cancer (*Calpirg, 2001*).

HAA5 is a group of 5 chemicals that are formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The regulated haloacetic acids, known as HAA5, are: monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid (EPA at www.epa.gov/enviro).

pH
Water quality objectives for protection of beneficial uses of surface waters in the San Francisco Bay Basin have been established by the California Regional Water Quality Control Board. The San Francisco Bay Basin Plan specifies a pH objective of 6.0 to 8.5 for municipal supply waters. The Rector waters are consistently within this range

Chemical
Table 15 presents a summary of available raw water chemical monitoring results for 1998-2008. The constituents listed in this table are those for which a finished water maximum contaminant level (MCL) has

been established under Title 22, California Code of Regulations (CCR). The San Francisco Bay Basin Plan's water quality objectives for municipal supply waters are based on MCL values taken from Title 22, CCR.

As indicated in Tables 14 and 15, with the exception of iron and manganese, mineral constituent levels are well below established finished water MCLs. Iron and Manganese exceeded secondary drinking water standards a few times within the past 10 years that we examined. Neither of these minerals pose a health problem and are regulated only because they may be undesirable due to stains on plumbing fixtures.

Toxic Organic Chemicals

Organic chemicals were not detected in the raw water source in the past ten years. Prior to this time period Simazine, Atrazine, and MTBE (Methyl t-butyl ether) had been detected *(Rector Sanitary Survey, 2003).* It is not known whether these would exist in the finished water because they are generally tested from raw, untreated samples. Because the treatment processes do not target organic chemicals, it is likely that when they exist in the raw supply, that they also exist in the treated supply. Simazine is the active ingredient in Princep, a pesticide applied to Rector vineyards.

Lead and Copper Metals Leaching from Home/Business Plumbing

Lead and copper in drinking water supplies often has its source in metals and metal alloys within common household plumbing pipes and fixtures. Both lead and copper can be harmful to human health with chronic exposures. California Department of Health Services adopted the federal Lead and Copper Rule into state regulations during 1995. The Veterans Home lead and copper tap monitoring history is recorded on the table below. Twenty samples were taken in each round. The 90th percentiles of samples taken in both rounds were below the action level for lead and copper. In 1998 the Veterans Home changed corrosion control treatment with pH adjustment to zinc orthophosphate addition. The change in corrosion treatment required a new set of monitoring. Neither lead nor copper were detected in the latest tap tests.

Table 16. Lead & Copper at Yountville Taps

Date	lead concentration, mg/L	Lead MCL	copper concentration, mg/L	Copper MCL
2003	ND	50	ND	1000
2004	ND	50	ND	1000
2005	ND	50	ND	1000
2006	ND	50	ND	1000
2007	ND	50	ND	1000
2008	ND	50	ND	1000

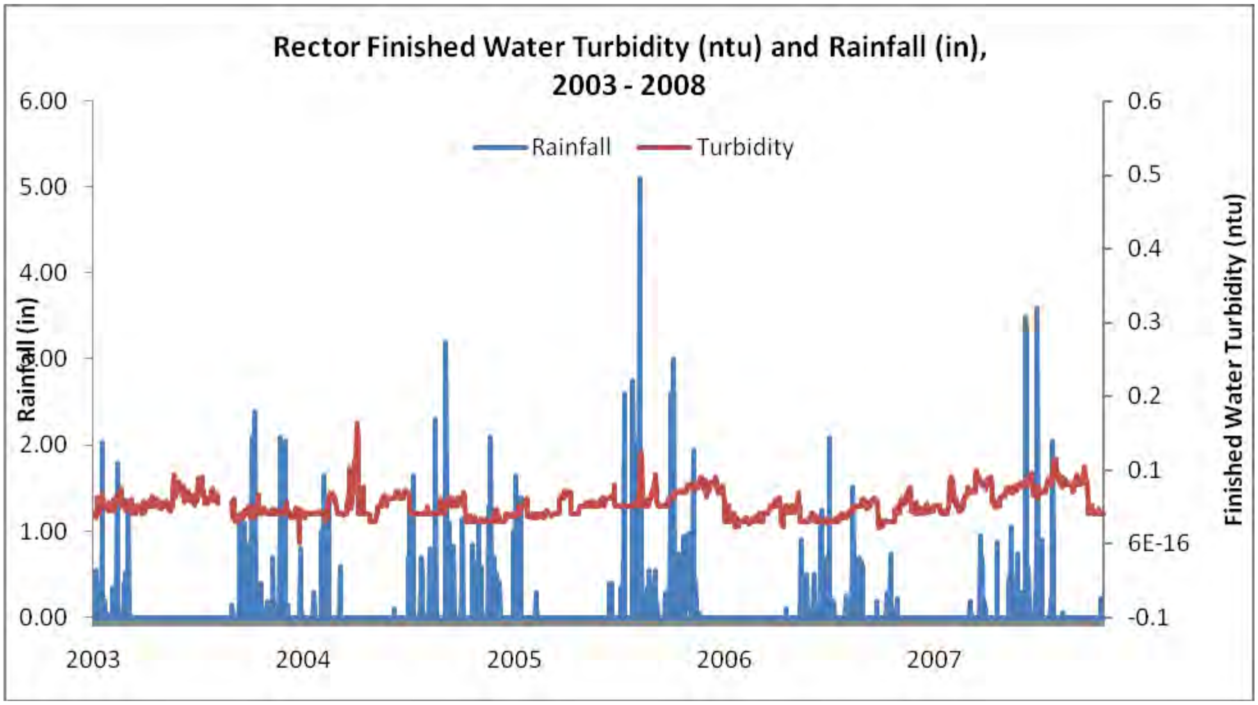
Lead action level = 0.015 mg/L. Copper action level = 1.3 mg/L.

Turbidity

The turbidity of the filter effluent is monitored continuously and recorded on a chart recorder and on the SCADA system. There is a high turbidity alarm currently set at 0.19 NTU. There is an alarm chlorine level that is set at 0.3 mg/L and 4mg/L. In the event that an alarm is triggered, the facility will automatically shut down and call the operator *(DPH Inspection Report, 2008)*

Finished water turbidity data have been plotted against time and are shown relative to local rainfall in Figure18. By looking at figures 18 and 21 one can see that both raw and finished water turbidity respond to rainfall, however the finished water response is muted, and in many cases shows little response. This is a good sign, showing that the treatment facility is able to adequately deal with large rainfall events.

Figure 21. Rector Finished Water Turbidity and Rainfall



Bacteria and Other Pathogens
Total coliform and fecal coliform are tested weekly in the finished water in four locations throughout the distribution system. Total coliform includes all types of coliform bacteria and as a whole are thought to be naturally occurring. Fecal coliform are those coliform found in human and animal feces. All sorts of bacteria are killed in the disinfection process by exposing filtered water to chlorine. Neither bacteria nor pathogens were found in samples of finished water tested.

Evaluation of Ability to Meet Surface Water Treatment Regulations

Turbidity

Turbidity in the finished waters were well within all SWTR standards. Filtered water turbidity over the last five years averaged 0.05 NTU, with the monthly maximum being 0.16 NTU. The DPH standards require that:

* The turbidity level of the filtered water shall be equal to or less than 0.2 NTU in 95% of the turbidity measurements taken each month,
* The turbidity level of the filtered water shall not exceed 0.50 NTU at any time.

Beyond these requirements, Rector"s permit requires that the turbidity level of the filtered water from each multimedia filter shall not exceed 0.20 NTU for more than eight consecutive hours while the plant is in operation. When any individual filter unit is placed back into service the filtered water turbidity shall not exceed 0.20 NTU at any time and 1.0 NTU after it has been operation for four hours.

Prior to the treatment plant renovation, backwashes produced turbidity spikes in the water supply and the Surface Water Treatment Rule (previous version) was violated. This scenario was clearly evident during the moderately severe winter of 1995. In that year, Veterans Home violated the turbidity performance standard in January, February and March 1995 because the system failed to meet the requirement that 95% of the turbidity readings be less than or equal to 0.5 NTU *(Rector Sanitary Survey, 2003)*.

After much initial trouble-shooting, the use of the new treatment units have proved a great success. The Rector Treatment Facility is well equipped to continue providing clear waters within the SWTR requirements.

Chlorine Contact Compliance

Raw water bacteriological data indicates that coliform levels were 15.4 MPN/100 ml in 2007. Inactivation of Giardia and viruses is accomplished by liquid chlorine disinfection (sodium hypochlorite). Contact time with the chlorine is provided in the pipeline from the water treatment facility.

Although coliform bacteria are the only types currently tested for, other pathogens carried by wildlife may also be present. One of these of concern is chryptosporidium. The LT2 Long Term 1 Enhanced Surface Water Treatment Rule (LT1IESWTR) indicates that "for systems using flowing stream sources, if the mean annual E. coli concentration is greater than 50 E. coli per 100 milliliters then cryptosporidium monitoring will be required at a rate of at least twice per month for 12 months or once per month for 24 months".

> *Cryptosporidium* live in the intestine of infected humans or animals. Millions of these parasites can be released in a bowel movement from an infected human or animal. Once an animal or person is infected, the parasite lives in the intestine and passes in the stool. The parasite is protected by an outer shell that allows it to survive outside the body for long periods of time and makes it very resistant to chlorine-based disinfectants. During the past two decades it has become recognized as one of the most common causes of waterborne disease (recreational water and drinking water) in humans in the United States. The parasite is found in every region of the United States and throughout the world (Centers for Disease Control and Prevention, Division of Parasitic Diseases, webpage, 2008).

The sourcewater of Rector Creek has not exhibited average E. coli levels high enough to trigger cryptosporidium testing at this point. This may be due to the low level of development in the watershed, such that most fecal coliform is from wildlife rather than a human source. It is just as likely that the 2007 results are an anomaly, and cryptosporidium testing will be triggered in the future.

Organic Chemicals

The schedule for sampling for organic chemical residuals is every three years. These appear to be due in 2010. Because many chemicals are applied to the watershed at vineyards it is wise to monitor for the organic chemicals applied in the watershed. The YVH should check with the Napa County Agricultural to obtain data on pesticide application rates and dates so that chemical testing can correspond with actual chemical application. See Chapter 3 for the list of chemicals applied to the watershed.

Lead and Copper in Taps

Lead and copper monitoring programs are required by Section 64670 through 64692, Title 22 of the California Code of Regulations and as directed by the California Department of Public Health. Tap water monitoring sampling at customer taps for lead and copper concentrations are to be conducted once per year.

Recommended Water Quality Monitoring Program

Recommendations for Monitoring
In addition to all current monitoring and the routine monitoring required by the Department of Public Health, additional monitoring is recommended. By acquiring data about constituents likely affected by development, the YVH will have stronger ground to stand on when fighting development upstream.

Algae
There is anecdotal evidence that algae has increased in the reservoir over the last two decades. In addition to the rafter slide analysis, find a more robust method for monitoring algal growth in the reservoir over time. Operators should spend time at the City of Napa Treatment Facility to study their algal analysis technique, as recommended by Russell Van Voorhis.

Water Clarity
There is anecdotal evidence that water clarity has decreased over the last two decades. Measure water clarity on a regular basis using a secchi dish.

Watershed Monitoring
Treatment plant operators should be familiar with the reservoir and the streams entering it. Monitoring of the first few hundred feet of stream beds should be conducted at least twice per year, and after all large scale rainfall events. A field notebook should be kept to record observations. Special attention should be given to deposits of fines (silt or clay) in the streambed, and to any deposit in general that looks like it occurred in a single event. Upper watershed monitoring should be conducted annually. The company of Mark Nicander, and any other available previous operator, should be requested to accompany Russell Van Voorhis and Winniefredo Cruz within the next year to discuss and record historical conditions at the deltas and streambeds.

Raw Water Organic Chemical Water Quality Monitoring
Many pesticides are applied to vineyards in the Rector Creek Watershed. Pesticide is a term that officially includes fungicides, herbicides, and insecticides. It is likely that some concentrations of these chemicals exist in the raw water, and possibly the treated water as well. We suggest that a sampling program like that offered in table 12 of Chapter 3. If this proves to difficult, then at least sample during “first flush” every year (during or immediately following the first rains of the year). This would be the time when the top layer of soils are rinsed by rainfall, a layer that has accumulated the entire dry season‟s chemicals that have not volatilized. Certainly when the organic sampling schedule is due, these known to be applied chemicals should be tested for.

6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Water Quality and Production

The Veterans Home routinely tests raw and finished water to assist in optimizing treatment and chemical dosages. Monitoring criteria is regulated by the Surface Water Treatment Rule, and overseen by the Department of Public Health. The Veteran‟s Home water production staff and management has been effective at meeting all the standards. No contaminants have exceeded MCLs. There are, however, chemical contaminants applied in the watershed that aren‟t required to be sampled and other contaminants whose sampling is required but the applied target chemical‟s nature changes as it responds to soil, water, climate, and microorganisms making its presence in source water difficult to confirm or deny. Of special concern are pesticides that may pass through the system into finished waters undetected and sedimentation that induces turbidity and fills the reservoir from the bottom up with sediment that depletes water storage.

Overall the conclusion we have drawn from this evaluation is that incoming raw water quality and treatment methods practiced by Veterans Home indicate a high quality tap water. Other entities in California would enjoy both the raw water quality and the finished water quality afforded to veterans residing at the home and supporting staff there.

Contaminant Sources in the Watershed

The contaminant sources identified in the Checklist (p.4) and in Chapter 3 (p.50) are those sources we determined to have a potential impact on water quality. Evidence suggests the following sources were most likely to impact water quality in the Rector Reservoir‟s contributing watershed area:

- Fire
- Erosion and Sedimentation
- Nutrient applications to Agricultural Lands
- Pesticide/Herbicide/Fungicide/Insecticide applications to Agricultural lands

Evidence suggests that sources of moderate potential to impact water quality include:

- Growth and Expansion of land uses in the watershed
- Landsliding
- Incoming raw water quality

In our initial meeting with our Veterans Home Client, we asked Pat Gilleran about his greatest concerns for protecting water resources from nonpoint sources of water pollution now and on into the future. Mr. Gilleran responded that he had growing concerns about the extent of vineyard expansion in the watershed and asked that we give special attention to potential erosion and sedimentation from increasing vineyard developments. Mr. Gilleran loaned us several recent EIRs pertaining to vineyard expansions proposed in the Rector Creek Watershed. The Erosion and Sedimentation section of Chapter 3 presents the results of our evaluation.

As hydrologists our work at times enters the realm of geology and so we collaborated with both Elias Steinbuck (Professional Geologist #7538) and Harold Wollenberg (Registered Engineering Geologist #797) overall and particularly in the Erosion and Sedimentation section of the project. Their geological expertise was particularly directed to evaluate the overriding notion recently popularized by geological vineyard consultant Martin Trso (Professional Geologist) that certain techniques championed in the art and science of vineyard development actually reduce watershed erosion and subsequent downstream sedimentation. That claim conflicts with a basic tenant of watershed hydrology – that widespread disturbance of native landscapes increases erosion. The follow up tenant is that sediments eroded are likely transported downhill courtesy of gravity and once instream are delivered downstream to watercourses and reservoirs.

Erosion and sedimentation generally increase turbidity in downstream waters and sedimentation of the reservoir will deplete is water storage capacity which is a common sense notion validated by a variety of literature sources and experts in the field of hydrology, geology, and geomorphology (Dunne and Leopold, 1978; Tchobanoglous, 1987; PWA, 1994).

The rapid rate of recent vineyard expansion is most expediently conveyed by comparing air photos from 1993 and 2007 (figures 3 and 4). Recent vineyard expansion proposals in the watershed have been required by Napa County to include detailed plans as to how erosion and sedimentation will be minimized to protect downstream beneficial uses and satisfy the public trust. Many of the recent plans and analyses leading to permitted vineyard construction to date have been conducted by the same scientist, Professional Geologist Martin Trso who makes the claim that erosion and sedimentation are likely to *decrease* with vineyard developments that implement state of the art BMPs (Trso, 2004 and 2006). Trso"s predictive conclusions have alleviated concerns of regulatory agencies empowered to protect downstream beneficial uses so far.

Because Veterans Home water resources decrease volumetrically in proportion to increasing sedimentation, our team evaluated Mr. Trso"s logic carefully as a part of this Watershed Sanitary Survey of non-point source pollution. While we commend Mr. Trso"s extensive efforts in Artessa Vineyards and Stagecoach Vineyard"s Erosion & Sedimentation Assessments (2004 and 2006) and for bringing BMPs into practice with developers, we found some of the underlying assumptions and observations were not consistent with our own training and experience, our literature references, nor in our overflight or field observations. We employed geologists registered in the State of California to evaluate a sampling of proposed Rector Watershed development plans provided through Veterans Home to assess the logic, assumptions, and evidence supporting this surprisingly sweeping conclusion based on predictive computer modeling, and sediment budgeting without validation monitoring that would confirm or refute these same predictions. Trso"s surprising generalization deserves careful scrutiny and testing because its precedence-setting claim reverses the concept of cumulative sedimentation impacts and as such will likely subject Rector Creek Watershed and other locales to further vineyard expansion.

Trso"s work is comprehensive and robust utilizing extensive modeling that requires a specialized skillset and a Registered Geologist. Challenging Trso"s work will be difficult and time consuming yet just such a 2nd opinion is needed. Such a challenge does not construe a negative evaluation but is simply in the spirit and practice of the Scientific Method.

We suggest that the following questions be answered by a qualified independent party compensated by a public agency to assure no bias:
1) Does the annual cover crop vegetative density or percent vegetative cover on vineyards actually exceed that of native vegetation in the pre-development condition? Our aerial overflight photos suggest this may not be the case.
2) Percent vegetative cover and stem density layers vary seasonally on a vineyard and from year to year. Does this same variability mimic the pre-disturbance condition?
3) Is the duff and litter layer covering bare soils thicker on vineyards than that duff and litter layer covering the native soils that they replaced? Photographic evidence indicates this may not be the case.
4) Are planar and mildly sloped areas in the watershed actually separated from stream networks for the purposes of sedimentation either by themselves or by rocky berms on vineyard edges or by streamside vegetative buffers? A good time to evaluate this separation would be on the ground during a heavy downpour when vineyard runoff would otherwise enter adjacent watercourses.
5) Based on bathymetric measurements and previous works, Martin Trso suggest that the sedimentation rate of Rector Reservoir has likely increased significantly since 1999. He hypothesizes that the erosion rates

in the north fork and Lorette are mostly responsible for the increase. The North Fork‟s erosion rate was estimated at fourteen times that of the mainstem and erosion rates from the Lorette was estimated at almost twice that of the mainstem. He bases these hypothesis on modeling his client‟s vineyards in the mainstem subwatershed with his own model and several other employed models and sediment budgeting. An independent analysis should take place to reassess the erosion rates of all three tributaries compared to sedimentation rates entering the Rector Reservoir.

6) How long will it take "manufactured soils" to redevelop naturalized soil structure equal to that of native soils referenced in Chapter 2 - given compaction and pesticides?

7) What is the likelihood that BMPs will continue to be monitored and maintained on a long-term basis? For example, who will insure that when a culvert plugs that it will be cleaned before the next storm arrives? Who ensures this storm after storm?

8) Can road related sediment delivery be completely eliminated with BMPs over time?

9) Is it possible to have a net zero increase in peak flow discharges within and off the property in a post-project condition from storms in the 2-100-year return period across vineyards as well as road networks?

Pesticides are being applied to the vineyards throughout the year in Rector Reservoir. Many of the pesticides being applied are PAN bad actors, known to be carcinogens, reproductive or development toxicants, and neurotoxins. These have the potential to harm the population served as they can pass through the treatment system unnoticed. The companies that produce these chemicals are not required to give out their entire list of ingredients. Additionally, many pesticides are applied during only one or two months out of the year, so monitoring of organic chemicals, conducted once every three years, is more likely than not to miss most of the pesticides applied. Consider monitoring during "First Flush".

Nutrients nitrogen and phosphorus are common soil amendments that nourish plants, but these nutrients – especially nitrogen and phosphorus – lead to eutrophication and algal blooms in downstream water bodies. An algal bloom at the mouth of the mainstem suggests the likelihood that agricultural fertilizers are reaching the reservoir.

Fire creates ash, which is difficult to remove in the treatment process, and increases the potential for erosion on the burned areas. It is inevitable that fire will again come through the watershed and likely that when it does Yountville will need to rely on another source of water for up to several years following the event.

System Operations

Turbidity has been the most obvious and persistent contaminant that YVH staff has had to address. System upgrades over the last decade have been effective in reducing turbidity. The roughing filters, effectively on-line for the last two years, are effective at filtering out the majority of turbidity entering the plant. System operations also became more effective because of the two filtering/clarifying units and the addition of a water supply tank added in 2001. This allows backwashing of the filters without staying online to provide continual service because demand is drawn from the water supply tank. Turbidity is continually well within the standards set by the Surface Water Treatment Rule. The electronic SCADA system helps to automate the system and to aid in examining the processes from a desktop.

Watershed Management

The Napa County Planning Department‟s measures with which to review proposed development provide a control mechanism for protecting the watershed. The Veterans Home has taken little action to voice their opinions on such developments. We would like to suggest that Napa County is interested in Veterans Home views and is sensitive to the vulnerabilities of Rector Reservoir to sedimentation pesticide pollution. The importance of stating and repeating concerns to Napa County as pending developments go through the CEQA process cannot be overstated. Involvement through Napa County Conservation Building and Planning and through the Napa County Resource Conservation District is recommended.

Education is perhaps the most effective watershed management tool which could be used to notify Rector Watershed residents and landowners as to

- the likelihood of surface erosion on poorly drained unsurfaced roads
- the likelihood of plugged and failing stream crossings at roads with undersized culverts
- the effects of these road-based erosion problems on water quality
- techniques that remedy these road based problems
- how to minimize chemical application rates
- types of chemicals that are most dangerous and least likely to be filtered
- how to maximize the pesticide‟s target‟s application and minimize water pollution
- conservative nutrient fertilization to save costs and prevent algal blooms in the lake

This could take the form of an annual or semiannual mailer reminding upper watershed land managers about downstream water quality. It could assist in neighborly relations while reiterating the multiple use of Rector Creek soil and water.

Recommendations

1. As the California drought continues, water conservation strategies should be adopted that minimize applications of potable water such as leak detection and repair, irrigation system modifications that minimize evaporation, backwash recycling, and domestic education programs designed to enlighten users about the decreasing availability of fresh potable waters.
2. The water right license includes in the authorized diversion an undetermined volume of water lost to evaporation over the surface area of the reservoir, estimated at 70 acres. In keeping with the water right permit, an assessment of evaporative losses should be undertaken. An average rate of 0.1 inch per day might be used but more site specific evaporation estimates would increase the accuracy of such an estimate based on local climatic conditions which vary with wind, heat, cloud cover, etc.
3. Reach out to educate upland watershed neighbors regarding the sensitivity of downstream water quality for citizens of Yountville, Veterans Home, etc. Express concern about excess agricultural chemicals leaching into the water supply and about erosion and sedimentation. Ask them to limit their use of PAN bad actor chemicals (Table 12 Chapter 3) and fertilizers. Request that applied chemicals be minimized by using cover crops, mulch. Outslope and surface roads with gravel, replace culverts in a timely manner with capacities to convey 100-year recurrence interval floods.
4. Monitor organic chemicals during periods described in Chapter 3 or during "first flush".
5. Operators and YVH staff should study the characteristics of the pesticides applied in the watershed to better understand how the can avoid passing them on to customers. Valuable information can be found at ExToxNet: http://extoxnet.orst.edu/ and at Pesticide Action Network: http://www.pesticideinfo.org/ as well as many other organizations.
6. Conduct monthly reservoir surveys and annual upper watershed surveys. Keep a camera, and notebook with notes regarding what is seen. Take specific notes that future operators could read, understand, and repeat measurements. Establish landmarks and photo points.
7. Tour the reservoir and tributary mouths with Mark Nicander and other YVH staff familiar with features in the historical context. Have them take notes regarding changes since their previous visits.
8. Use a secchi disk to measure cloudiness of reservoir water. Monitor and record results monthly.
9. Consider utilizing a portable turbidimeter to test incoming tributaries of Rector Watershed to determine their turbidity units relative to one another.
10. Contact the USGS to determine the feasibility of instrumenting incoming tributaries toward monitoring incoming waters in cubic feet per second entering the reservoir.
11. Measure algae using a reliable methodology that can be repeated from year to year. Visit the City of Napa Treatment Facility to study their methods.

12. Maintain a dialogue with Napa County Planning Department, and Natural Resource Conservation Services and Napa County Resource Conservation District to provide input into proposals for development in the Rector Creek Watershed. If the YVH is intimidated by the complexity of the EIR, then hire a professional to help comment. Use the information found in Chapter 3 of this document on Erosion and Sedimentation, Pesticides, and Algal growth as part of the argument against further development. Request an independent party to repeat some of the work that Trso has done and press for more in stream monitoring of all three Rector tributaries. Request further research into all the questions described above in the Conclusions section.
13. Improve communication with other entities that have responsibility for watershed control measures:

    - **Napa County Planning Department**

      The NCPD should refer plans for all proposed development on the watershed to the Veterans Home for review and comment. To date, Veterans Home has received no such proposals for their consideration or comment.

    - **Napa County Environmental Management**

      The NCEMD made it clear during the Ridge to River office visit that they would not notify the YVH of failures of septic systems on the watershed, any changes or problems with the waste disposal system for wineries, or any proposed septic systems on the watershed. The YVH should be pro-active and request any proposals every six months.

    - **Regional Water Quality Control Board**

      The RWQCB should notify the Veterans Home of any proposed NPDES permits or waste discharge requirements on the watershed, however, they may not do so. Call them annually to request updates in activity.

    - **Property Owners on the Watershed**

      The Veterans Home should find out from Napa County Agricultural Commissioner annually the type and quantity of chemicals applied, as well as from vineyard owners in the watershed. The Veterans Home should try to develop a communication link with all the property owners on the watershed so that the owners can inform the Veterans Home of any suspected activities that may affect water quality.

14. Comment on all developments proposed in the Rector Creek Watershed.
15. An NPDES permit is required for applying backwash waters to ponds. Order number R2 2003 0062, Titled: Region Wide General National Pollution Discharge Elimination System (NPDES) Permit for Discharge from Surface Water Treatment Facility for Potable Supply (General Permit), can be obtained at:
    http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adoporders.shtml
16. Improve access control measures at the reservoir by posting signs and increased patrols by Veterans Home staff.
17. Plan for growth while keeping in mind the recommended fish bypass flows of 1670 acre feet and evaporative losses.
18. Update the Operations Manual, which is now outdated.
19. Write a backflow device testing plan
20. Test old pipes for asbestos and leaks
21. Investigate non-chlorinated disinfection processes such as ozonation or ultra violet radiation that avoid toxic disinfection byproducts that contaminate finished water. The public chooses bottled water in part to avoid chlorine. Until and unless the SWTR changes, chlorine disinfection, that generates a chlorine residual that can be monitored to confirm disinfection, will still be required but these alternative forms of disinfection can do the bulk of the disinfecting work.

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From: Harold Wollenberg [woll@mcn.org]
Sent: Wednesday, July 01, 2009 2:38 PM
To: terijo@ridgetoriver.com
Subject: Re: Rector

TeriJo,
I have reviewed the copy of the sedimentation chapter of the Rector Report with its most recent changes, and see that my comments, corrections and suggestions have been incorporated.

Harold (Skip) Wollenberg

California C.E.G., No. 797