CHAPTER 2: OVERVIEW OF DISTRICT LANDS & WATER SUPPLY

2.0 Introduction

This chapter begins by providing a regional overview of the Santa Cruz Mountains, followed by a general description of the San Lorenzo River watershed. The chapter then provides a more detailed description of District-owned watershed lands, and an overview of the District's surface and ground water supplies.

It should be noted while reading this overview that significant impacts from climate change are likely occurring throughout the regional, watershed, and landscape scales. Locally, predicted climate change impacts include temperature rise, increased droughts and more intense rainfall events. Chapter 7: Local Climate Change Assessment discusses some of the scientific research and policy recommendation to date, especially in regard to water resources.

2.1 Regional setting: The Santa Cruz Mountains

The Santa Cruz Mountains covers an area of 3,592 square kilometers (1,387 square miles) on the central coast. The region is bounded on the north by the Golden Gate, on the east by San Francisco Bay and the Santa Clara Valley, on the south by the Pajaro River and on the west by the Pacific Ocean. The Santa Cruz Mountains is defined as a bioregion, as shown in Figure 2.1. It is acknowledged as one of the more biologically diverse areas in California.

Figure 2.1. The Santa Cruz Mountains Bioregion

Source: Santa Cruz Bioregional Council, 2007

According to the Santa Cruz Mountains Bioregional Council (2007):

"The region is essentially one of heavily populated lowlands surrounding a core of forested uplands, with small to large pockets of everything from salt marsh to chaparral intermixed. It is rich in endemics and many other natural features of special interest, some of whose past and current distributions are well known, others hardly at all."

The region's Mediterranean climate is characterized by relatively cool, dry summers and moderate-to-heavy rainfall in the winter months. Approximately 90 percent of the annual rainfall in the region occurs between November and April. The region is known for its coastal redwoods, which depend on coastal fog.

Streams flowing from the Santa Cruz Mountains drain into the Monterey Bay or the Pacific Ocean. The Monterey Bay was declared a National Marine Sanctuary in 1992.

The Monterey Bay Marine Sanctuary is the nation's largest marine sanctuary, encompassing over 5,300 square miles along the Central California coast. The sanctuary ranges from Cambria, San Luis Obispo County northward to Rocky Point in Marin County. The sanctuary contains some of the world's largest underwater canyons, important habitats, and some of the most productive and diverse deep ocean waters and floors in the world.

2.2 The San Lorenzo River watershed

The District's surface water and groundwater supplies originate entirely within the San Lorenzo River watershed, depicted in Figure 1.1, is one of the major watersheds in the Santa Cruz Mountains.

2.2.1 Topography

Elevation ranges in the watershed from the 3,214 feet at the summit of Castle Rock Peak, down to sea level at the mouth of the river. With its headwaters at an elevation of approximately 2,900 feet, the San Lorenzo River drops 2,000 feet in the first 3 miles (CCRWQCB, 2002). Small, steep tributaries feed the river from the west at Ben Lomond Mountain, while wider, more gently sloping tributaries feed the river from the east and northeast. The San Lorenzo River flows to the north end of the Monterey Bay. Refer to Chapter 3, Hydrology, Geomorphology, and Water Quality for more information about the topography of the watershed.

2.2.2 Climate

Annual rainfall varies between 15 inches to more than 100 inches throughout the watershed, depending upon location and year. Ben Lomond Mountain, source of the District's surface water, averages near the high end of the range. Rainfall averages approximately 46 inches per year in the watershed above Big Trees, but less than that in the remainder of the watershed, down to the beach. Six to ten consecutive days of rainfall is not unusual for the San Lorenzo River watershed (Swanson Hydrology, 2001). Coastal fog is an important part of the summer climate, creeping into inland valleys at night and in mornings.

Average daily temperatures vary throughout the watershed, generally ranging from 30^{o} F and 90^{o} F. The lowest temperature recorded at Ben Lomond Station was 15^{o} F, on December 23, 1977, and again on December 22, 1980. The highest temperature recorded at Ben Lomond Station since 1972 was 112^{o} F in October 1996. Refer to Chapter 3: Hydrology, Geomorphology, and Water Quality for more information about the watershed's climate. Refer to Chapter 7: Local Climate Change Assessment for more information about the probable impacts of climate change on the San Lorenzo River watershed.

2.2.3 Biodiversity

The San Lorenzo River watershed supports a wide variety of natural plant communities, which in turn support a diverse range of wildlife species. Plant communities include redwood forests, chaparral, the rare sandhills, grassland, oak woodland and riparian woodland. Many of these plant communities can be found on District-owned lands. Refer to Chapter 4, Biotic Resources for more information about the biodiversity of the watershed.

Approximately 26 miles of the San Lorenzo River, and at least nine of its major tributaries, support steelhead (*Oncorhynchus mykiss*). Historically, the San Lorenzo River supported the largest coho salmon and steelhead fishery south of San Francisco Bay, and the fourth largest steelhead fishery in the State of California (County of Santa Cruz, 2001). Coho salmon and steelhead of the San Lorenzo River are listed as endangered and threatened, respectively, under the federal Endangered Species Act. Coho salmon had not been recorded in the watershed since the early 1980s (Smith, 1982), until 2005, when at least a dozen adult coho were observed at the city of Santa Cruz Felton diversion fish ladder. Refer to "Appendix A: Fisheries" for more information about steelhead and coho salmon in the San Lorenzo River watershed.

2.2.4 Geology and soils

The tectonic compression of the earth's crust that originally produced the Santa Cruz Mountains continues to shape the region, the San Lorenzo River watershed, and the District's watershed lands. The San Andreas Fault runs parallel to the northeastern boundary of the watershed. Along this fault, two major tectonic plates meet: the Pacific Plate to the west and the North American Plate to the east. Throughout geologic history, major events along this plate boundary have helped create the unique geology and topography of the San Lorenzo River watershed. The watershed itself is divided by two faults--the Zayante and the Ben Lomond faults--into three areas of distinct geology, topography, soil and groundwater characteristics. The Zayante Fault divides the watershed in half, running approximately east-west. The Ben Lomond Fault runs south to north along the San Lorenzo River until it meets the Zayante Fault. Refer to Chapter 3, Hydrology, Geomorphology, and Water Quality for more information about the geology and soils of the watershed.

2.2.5 Human uses in the San Lorenzo River watershed

This section describes the prominent human uses throughout the San Lorenzo River watershed, including development, timber, mining, water extraction, farming and ranching, recreation and tourism, and open space.

2.2.5.a Development

The watershed is home to approximately 41,000 residents inhabiting 17,174 developed parcels, outside of the City of Santa Cruz (County of Santa Cruz, 2001). Approximately 3,150 of the developed parcels are within the City of Scotts Valley (County of Santa Cruz, 2001).

The County has influenced the quality and rate of development through planning, zoning ordinances, and regulations. The result has been that the San Lorenzo River watershed retains many of its aesthetic characteristics and viewsheds.

The San Lorenzo Valley was sparsely inhabited and dominated by summer homes through the 1950s. Since then, houses within the watershed have been converted to permanent residences and some 3,300 new units were built by the 1970s (County of Santa Cruz, 2001). The County (2001) reports that, "Growth rates of over 30% occurred in Bear Creek, Upper Zayante, Bean Creek, and Branciforte." Scotts Valley also experienced an increase in development of 80% from 1980 to 2000 including large industrial complexes (County of Santa Cruz, 2001). According to the Santa Cruz County Draft Watershed Management Plan (2001):

> The overall growth rate in the watershed outside Scotts Valley was 17%. In the 1990s, growth in Scotts Valley was greater than in the remainder of the unincorporated watershed. High rates of development in the Scotts Valley area

> resulted in erosion of sandy areas, paving of groundwater recharge areas, and increased pumping of groundwater."

The rate of development has slowed more recently. Early development in the watershed filled most of the flatter areas and lined most creeks, replacing valuable riparian habitat and damaging the riparian ecosystem before environmental regulations were in place. Much recent development has been in more remote, steeper areas of the watershed. Development increased the extensive road network initiated by historical logging. Roads throughout the watershed are today considered a primary contributor to erosion and sedimentation of streams (Ricker and Butler, 1979; Hecht and Kittleson, 1998; Swanson Hydrology, 2001; CCRWQCB, 2002; Alley et al., 2004). To begin to address some of the problems caused by poorly constructed and maintained roads throughout the watershed, Santa Cruz County, the Central Coast Regional Water Quality Control Board and the Santa Cruz Resource Conservation District have initiated several grant-based restoration and repair programs.

Development and conversion of summer homes to permanent residences also contributed to erosion, stream sedimentation, reduced streamflow and groundwater recharge, increased polluted-urban runoff, and failing septic systems.

The US Geological Survey (1995) reported that, generally, development within a basin reduces recharge, because significant precipitation falls on impervious surfaces such as streets and roofs, and is routed directly to surface drains. Generally, increased runoff rates from impervious surfaces result in decreased groundwater recharge, which in turn reduces water supply from wells and stream baseflows that are fed by groundwater (Dunne and Leopold, 1978).

In the Quail Hollow, Olympia and Mission Springs areas of the San Lorenzo Valley, a 1979 county study found that total runoff had increased from about 6 percent to 10 percent, resulting in an 11 percent reduction recharge, due to development in the area to that date (County of Santa Cruz, 1979.

However, natural recharge rates can be maintained or even exceeded in developed areas, where household waste water is disposed of in septic systems. The USGS demonstrated this phenomenon with hydrologic modeling (US Geological Survey, 1995). Because the San Lorenzo Valley relies on septic systems rather than a centralized sewer system, much of the water that is pumped out the river and from aquifers eventually finds its way back into the stream system (County of Santa Cruz, 1979). The cities of Santa Cruz and Scotts Valley, on the other hand, have sewer systems, which channel treated wastewater directly to the bay (Alley et al., 2004). The Scotts Valley Water District (SVWD) operates a 625,000-gallon recycled water storage tank, a recycled water booster pump station, and six miles of recycled water distribution mains to supply irrigation water to its landscaping customers (SVWD website, 2007). Recycling of wastewater both reduces pumping from an overdrafted aquifer, and reduces the amount of wastewater that is channeled directly to the bay.

2.2.5.b Timber

Historically, timber resources were the foundation of industry in the San Lorenzo River watershed (Camp, Dresser & McKee, 1996). From the late 1800s through the early 1900s clear-cut logging impacted most of the watershed, altering the natural forest ecology and introducing a pervasive road network, which remains the principal impact in the watershed today (Balance Hydrologics, 1998; Swanson Hydrology and Geomorphology, 2001; Alley et al., 2004). Small tributaries were dammed for mills to transport logs (Alley et al., 2004). By 1880, 50 logging mills were operating in the Santa Cruz Mountains (Greenlee and Langenheim, 1990). Entire hillsides were clear-cut and burned to facilitate the removal of the old growth logs. The majority of the watershed was logged in this manner.

Large scale clear-cutting in the region was disallowed by the State Forest Practice Rules several decades ago. Today, only one local sawmill remains, but much of the locally harvested timber is trucked and processed outside the county. Small, scattered patches of old-growth trees are found throughout the watershed, but the only significant stands of old-growth redwoods and Douglas fir lie within State Park lands. Forests that were clear-cut have re-grown to what is known as second-growth. The timber industry has steadily logged these second-growth forests under single-tree selection logging. Some maturing second-growth forests have attained old-growth characteristics, though the trees have not yet approached the size of ancient redwoods, such as those found in Big Basin State Park. The disappearance of most of the old-growth forest has compromised the functional characteristics of the forest ecosystem, resulting in increased susceptibility to catastrophic wildfire, and a loss of habitat characteristics necessary for native species, such as the federally threatened marbled murrelet (Singer, 2007).

The volume of commercial timber harvested in the watershed fluctuates with the market price of timber. Nearly half of the San Lorenzo River watershed was zoned for commercial timber production until 1999 (Camp, Dresser & McKee, 1996). Timber harvests were common throughout the watershed on residential parcels between five and 40 acres. Due to increasing neighborhood conflicts and failure of the state Board of Forestry to adopt the county’s proposed rule package in 1998 and 1999, the county board of supervisors in 2000 limited commercial logging primarily to parcels zoned specifically for timber production (TP). In 2007, the county changed the minimum parcel size for rezoning to TPZ from 5 acres to 40 acres. Only a few private companies in the county, including Redwood Empire, Red Tree, Cemex, and Big Creek Lumber own more than 2,500 acres of forest land zoned TPZ (Camp, Dresser & McKee, 1996). For more information about logging regulation in the county, see Appendix B, History of Logging Regulation in Santa Cruz County.

2.2.5.c Mining

Many “limestone” mines on Ben Lomond Mountain produced lime for cement, to rebuild San Francisco after the 1906 earthquake. Much of the early logging was done to fuel the lime kilns scattered across Ben Lomond Mountain. Sand and gravel quarrying of the Santa Margarita Sandstone formations has occurred within much of the eastern part of the watershed.

The San Lorenzo River watershed contains several closed sand pit mines and many closed historic limestone quarries. Active quarries include granite gravel and rock mine in Felton and one active sand quarry in the sand hills area. This quarry is the only one in the area that harvests sand fine enough for the production of glass. Two other sand quarries have closed and are in the process of completing reclamation.

The San Lorenzo Valley and North Coast Watersheds Sanitary Survey (Camp, Dresser & McKee, 1996) describes mining in a regulatory sense:

The quarries are regulated under the Surface Mining and Reclamation Act (SMARA) and by the County Mining Ordinance. The County Mining Ordinance requires that the application package be submitted to the water purveyor in the drainage area of the quarry. The County inspects the quarries four times each year and the State inspects annually. The County conducts an extensive review each five years. At that time, the County Planning Commission can impose conditions on the quarry as part of the Certificate of Compliance. Mining adjacent to riparian corridors must be conducted in accordance with the Riparian Corridor and Wetlands Protection ordinance. The Regional Board issues NPDES permits that set limits on contaminants that can be discharged to surface waters from quarries. Surface discharges of both active and inactive mines to receiving streams are regulated by the Regional Board under the Waste Discharge Requirement permit program. Mines typically meet these requirements by various best management practices (BMPs).

2.2.5.d Water extraction

All of the residents of the watershed receive their water from either ground or surface water sources within the watershed. The City of Santa Cruz Water Department obtains approximately 65% of its water from the San Lorenzo River (Johnson, 2008 *in progress*). San Lorenzo Valley Water District obtains approximately 50% of its water from tributaries of the river.

Water diversions and impoundments were developed soon after settlement of the watershed for private and industrial use, and were sought after to supply the growing City of Santa Cruz. Many small flashboard dams scattered along different streams of the watershed were used by camps, summer homes, or communities to create swimming areas during the summer months. Few of these dams still operate today, but many of the structures or remnants of them still exist.

Adequate streamflow is necessary to remove deleterious sediments. Adequate streamflow is crucial to recruit and maintain beneficial gravels, cobbles, boulders and large instream wood. All aquatic organisms, from insects to steelhead and coho salmon, rely on these habitat features for cover, migration and food.

Today, the health of the San Lorenzo River is significantly affected by the volume of water diverted for human use. Reductions in streamflow caused by these diversions reduce the quantity and quality of aquatic habitat. Inadequate stream flow impacts habitat area, water depth, water velocity, water temperature, dissolved oxygen, escape cover, and surface turbulence (which oxygenates water, and provides habitat).

Diversions and wells are found throughout the watershed. The largest water users are the City of Santa Cruz, the San Lorenzo Valley Water District, the Scotts Valley Water District, and Big Basin Water Company.

District's water diversions from tributaries to Boulder Creek and from tributaries to the mainstem have a significant, yet undefined, impact on the downstream aquatic ecosystem. The same is true for the Felton diversion dam on the mainstem and the Loch Lomond dam on Newell Creek, which are operated by City of Santa Cruz. For more information about the potential impacts of the District's water diversions, refer to Chapter 4: Biotic Resources.

A smaller diversion dam on Lompico Creek serves the Lompico County Water District. Other smaller dams include the Ben Lomond dam and the Boulder Creek Recreation District dam on the mainstem of the San Lorenzo River.

2.2.5.e Farming and ranching

Horses are kept in most sub-basins and drainages within the San Lorenzo watershed, often close to streams. There are several large commercial equestrian facilities, and many residences throughout the watershed have one or two horses. Many trails are used by equestrians throughout the watershed. Only four head of cattle were identified in the San Lorenzo watershed during the field survey for the San Lorenzo and North Coast Watersheds Sanitary Survey (1996). Due to soils and the general steepness of the watershed, agriculture is limited to scattered small Christmas tree farms, vineyards, orchards, nurseries, and small home-style farms.

2.2.5.f Recreation and tourism

Recreation has always been popular within the San Lorenzo River watershed. When a majority of the watershed was used for summer homes, creeks were commonly dammed for swimming pools. A few of the larger and some private swimming areas still remain today. Locals have always enjoyed hiking throughout the watershed. The California Department of Parks and Recreation owns and manages about 9,000 acres (Camp, Dresser & McKee, 1996) of public parks within the watershed, as shown in Figure 2.2. Historically, sport fishing has been economically important to the San Lorenzo River watershed. The San Lorenzo River was for years the largest steelhead fishery south of San Francisco (CCRWQCB 2002), and remained popular for trout fishing into the 1970s (Johansen, 1975). Both local residents and tourists continue to be attracted to the watershed's recreational opportunities. Trail use by hikers, runners, bikers, and equestrians is very popular, both on and off legal trails. Big Basin State Park has one of the highest annual uses within the State Park System.

According to the San Lorenzo River Watershed Management Plan (1979):

> Recreation patterns in the watershed have changed in recent years. Initially the users of recreational resources in the Watershed were out-of-County tourists and summer residents. Today, because of an increasing tendency toward year-round residency, younger families, and day-trip tourism, many recreationists are local residents. As the population in the Watershed continues to increase, so will the recreational needs of residents. In some cases, these needs are identical with the needs of regional recreationists and can be met jointly. In other cases, resident recreational needs are distinct and require separate facilities. Some good examples of resident recreational needs are local parks that provide playgrounds for children and sports playing fields for older children and adults. Local recreation needs of this sort are not being adequately met (as cited in the District's Watershed Protection Plan, 1985).

Development of recreational facilities in the watershed has not kept pace with residential and commercial development. However, it should be noted that the region's environmental constraints and scarcity of available flat land limit the areas that could be developed as parks. For more information about recreational resources, refer to Chapter 6, Cultural, Historic, Recreational, and Educational Resources.

2.2.5.g Open space

Much of the San Lorenzo Valley is still held in large tracts of public open space land, as shown in Figure 2-2. The District owns one contiguous piece of land of approximately 1,620 acres for water supply and watershed protection on Ben Lomond Mountain, 252 acres in the Felton/Fall Creek watershed, and another 325 acres in the Zayante Creek area. The City of Santa Cruz owns 3,880 acres of watershed land, including approximately 2,760 acres around Loch Lomond, and 880 acres near Zayante Creek (Swanson Hydrology & Geomorphology, 2001). State Parks owns tracts of open space land including Henry Cowell, Fall Creek, Big Basin, and Castle Rock State Parks. State Parks recently acquired the Waterman Gap property, which is now part of Castle Rock State Park. This 1,340 acre parcel, previously owned by the District, was sold to Sempervirens Fund to facilitate its eventual transfer to State Parks. Unfortunately, due to severe budget problems, State Parks has not been able to manage many of its holdings to the standards that it once did.

Figure 2.2 Protected areas within the San Lorenzo River watershed.

(11 x 17 color fold-out)

2.3 Overview of the District's land, water supply, and distribution system

The District's surface water supply flows primarily from creeks on the western side of the watershed. Together, these creeks, which are tributaries to the San Lorenzo River, provide approximately half of the District's total water supply. The District's groundwater sources come primarily from the Santa Margarita Sandstone and Lompico Sandstone formations, on the eastern side of the watershed. The District has a substantial stake in protecting and enhancing the health of the San Lorenzo River watershed.

The District currently operates four standalone water systems with separate water supplies: The Northern System, the Southern System, the Mañana Woods System and the Felton System. Together, these four water systems serve approximately7,400 connections (22,500 people). The Northern System serves the unincorporated communities of Boulder Creek, Brookdale, Ben Lomond, Zayante and parts of Felton. The Southern System and the Mañana Woods System each serve a portion of the Scotts Valley area. The Felton System serves the community of Felton.

The Northern System is supplied by both surface water and groundwater sources (approximately 57% surface water). It relies primarily on surface water during the wet season and on groundwater during the dry season. The Southern System and the Mañana Woods system rely solely on groundwater. The District has begun planning an inter-tie between the Northern and the Southern systems that would enable the two water supplies to be shared. The Felton water system relies completely on surface water.

Prior to the District's acquisition of the Mañana Woods system in 2006 and the Felton System in 2008, the average water production from 2000 – 2004 of the Northern and Southern Systems together was 1.9 million gallons per day, with the Northern System supplying approximately 80 percent of the District's water use (Johnson, 2005). The District has not yet completed estimations of current production data including all four systems.

Table 2.1 Connections, population served and type of supply of the District's four standalone water systems

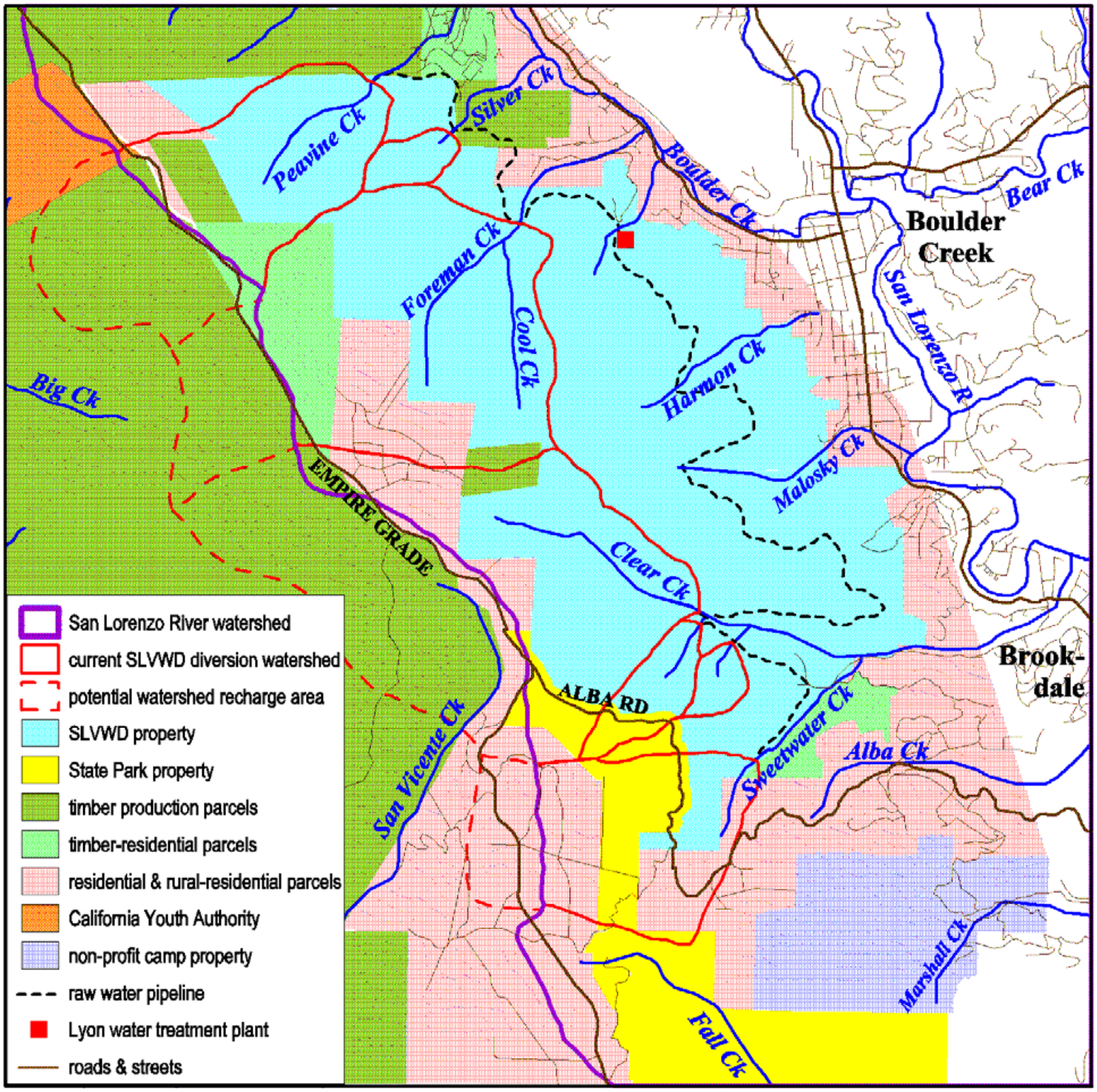
Service area	Service connections	Approximate population served	Type of supply
Northern	5,300	16,500	Ground and surface
Southern	670	2,200	Ground
Mañana Woods	113	300	Ground
Felton	1,300	3,500	Surface
Total	7,383	22,500	

2.3.1 District watershed lands

As shown in Figure 1-1, the District owns approximately 252 acres in the Fall Creek watershed land that supply the Felton water system, and approximately 1,623 acres of watershed land, in one continuous piece on Ben Lomond Mountain that supply surface water to other parts of the

San Lorenzo Valley. The District's Ben Lomond watershed lands partially encompass the District's water supply streams, which are tributaries of the San Lorenzo River: Clear Creek, Sweetwater Creek, Peavine Creek, Foreman Creek and Silver Creek. Figure 2.3 shows the primary land uses in the vicinity of the District's surface water sources. These lands are typically rugged, steep, and forested, as shown in Figure 2.4. District water intakes are located near the headwaters of these creeks. Generally, the land is mountainous, and prone to landslides. The land supports wildlife, including deer and feral pigs. The soils are predominately sandy loams, and the streams receive significant groundwater recharge from the headwaters areas surrounding them. Rainfall averages 58-60 inches per year (Johnson, 2005).

Figure 2.3. Primary land uses in the vicinity of the District's surface water sources.



Source: Johnson, 2007.

2.3.1.a Foreman Creek

Foreman Creek has a total area of 580 acres upstream of its confluence with Boulder Creek, northwest of the community of Boulder Creek. The District diverts from an intake at elevation 927 feet above mean sea level. Foreman Creek has an eastern branch about 3,000 ft long upstream of the diversion. The mainstem above the intake is 3,800 ft. long. Flows diverted from Foreman Creek are conveyed to the District water treatment plant through about 0.5 miles of pipeline. Baseflows may be augmented by groundwater recharged within a roughly 120 acre area immediately west of the watershed divide along the crest of Ben Lomond Mountain (Johnson, 2005). The District owns about 55 percent (approximately 265 acres) of the watershed upstream of the intake. There are 30 - 40 septic systems located in the Foreman Creek watershed.

Figure 2.4. District-owned watershed land is typically forested, rugged, and steep.

Herbert, 2006

The District surface water intakes are located high in the watershed, which is relatively undisturbed.

2.3.1.b Peavine Creek

Peavine Creek has a total area of 293 acres upstream of its confluence with Boulder Creek, northwest of the community of Boulder Creek. The District diverts from an intake at elevation 1,264 feet above mean sea level. The mapped length of Peavine Creek upstream of the diversion is approximately 3,100 feet. (In the past, when the District diverted water from Silver Creek, it was combined with flows from Peavine Creek.) Flows are now diverted solely from Peavine

Creek and conveyed to the District water treatment plant through about 1.4 miles of pipeline. Baseflows may be augmented by groundwater recharged within a roughly 180 acre area immediately west of the watershed divide along the crest of Ben Lomond Mountain (Johnson, 2005). The District owns more than 60 percent (approximately 150 acres) of the drainage are upstream of the intake. Nearly the entire watershed is undeveloped, with some timber land and scattered residences.

2.3.1.c Silver Creek

Silver Creek has a total watershed area of 102 acres upstream of its confluence with Boulder Creek. The District previously diverted from an intake at elevation 1,250 feet above mean sea level with a drainage area of 32 acres. The mapped length of Silver Creek upstream of the water intake is approximately 500 feet. When the District diverted water from Silver Creek, it was combined with flows from Peavine Creek and conveyed to the District water treatment plant through about 1 mile of pipeline. The District owns almost the entire Silver Creek watershed, and it is entirely undeveloped, consisting primarily of forest land.

2.3.1.d Clear Creek

Clear Creek has a total watershed area of approximately 1, 050 acres, and joins the San Lorenzo River near Brookdale. The District has three separate water intakes on Clear Creek; one on the mainstem, and two on its tributaries. Water intakes range in elevation from 1,330 to 1,358 feet above sea level. Clear Creek diversions were moved upstream in 1995 to allow gravity conveyance to the District's new treatment plant. The mapped length of Clear Creek upstream of the main-stem diversion is approximately 3,800 feet. Baseflows may be augmented by groundwater recharge within a roughly 300 acre area immediately west of the watershed divide along the crest of Ben Lomond Mountain (Johnson, 2005).

Flows diverted from Clear Creek are conveyed to the District water treatment plant through about 4.5 miles of pipeline. The District owns approximately 264 acres of the Clear Creek drainage upstream of the diversion intakes. Approximately three fourths of the watershed is undeveloped, consisting of timber land, State Park land, and District land. The crest of the watershed includes residential areas with up to 40 septic tank systems.

2.3.1.e Sweetwater Creek

Sweetwater Creek is tributary to Clear Creek, accounting for approximately 30 percent (335 acres) of the total Clear Creek watershed upstream of its confluence with the San Lorenzo River near the community of Brookdale. The District water intake is at elevation 1,330 feet above mean sea level. The mapped length of Sweetwater Creek upstream of the intake is approximately 1,300 feet. The Sweetwater Creek diversion was moved upstream in 1995 to allow gravity conveyance to the District's new treatment plant.

Flows diverted from Sweetwater Creek are conveyed to the District water treatment plant through about 4.5 miles of pipeline. Baseflows may be augmented by groundwater recharged within a roughly 75 acre area immediately west of the watershed divide along the crest of Ben Lomond Mountain (Johnson, 2005). The District owns approximately 27 acres of the drainage area upstream of the intake. Approximately half of the watershed is District and State Park land. The other half contains residential areas that include about 70 septic tank systems.

2.3.1.f Fall Creek

The District owns approximately 252 acres of property in the Fall Creek watershed, also tributary to the San Lorenzo River. The northern boundary of the property is adjacent to Fall Creek State Park, and the southern boundary is adjacent to rural residential land. District water intakes are on Fall Creek, Bennett Springs, and Bull Springs. Fall Creek is steelhead habitat. The property is steep, rugged and forested. It contains several old quarries, historical limekilns, and a network of old logging roads. For more information, refer to Appendix A: Fisheries.

The District has not yet conducted a Drinking Water Source Assessment for Fall Creek to document potential impacts to the District's drinking water sources in the Fall Creek watershed. The Fall Creek property and water rights were acquired from California-American Water in 2008.

2.3.1.g Zayante Creek

The District owns approximately 183 acres of property on both sides of Zayante Creek, which does not serve as a water source for the District. The land is forested, and the creek is good steelhead habitat. The southern property boundary is approximately 3.8 miles north of the intersection of Quail Hollow Road and E. Zayante Road, at the bridge where Zayante Creek flows under E. Zayante Road.

2.3.2 District water supply from surface diversions

The District's newly acquired Felton surface water sources are in the Fall Creek watershed. The California Department of Fish and Game (CDFG) stipulated minimum bypass flows on Fall Creek for the benefit of aquatic habitat. Required minimum bypass flows vary from 0.05 – 1.5 cubic feet per second, depending on the cumulative monthly runoff of the San Lorenzo River, as measured at the Big Trees gage.

To supply its northern service area, the District obtains approximately half its total water supply of 1,600 to 2,100 acre-feet per year (af/yr) from seven surface stream intakes, with a combined contributing watershed area of approximately 1,400 acres on Ben Lomond Mountain.

The District's water rights for its surface water sources on Ben Lomond Mountain do not specify minimum bypass flows. However, CDFG has stipulated that the Clear Creek diversions should not capture the entire flow. The District leaves a minimum bypass flow of 30 gallons per minute (0.07 cubic feet per second) at Clear Creek for the benefit of aquatic habitat.

For more information about the impacts of stream diversions on aquatic habitat, refer to "Chapter 4: Biotic Resources," paragraph 4.6.4.a.

It is within keeping of the District's mission statement to know approximate annual and monthly streamflows, in order to estimate how much water it can divert, and how much to leave in the streams to support aquatic ecosystems. Because of difficult site conditions, there are no streamflow gages on the streams that supply surface water to the District (and none on the San Lorenzo River upstream of the Big Trees gage at Felton). The total average annual discharge of the District's water supply streams has, therefore, been estimated by hydrologists (Geomatrix, 1999). These estimates were based on calculations using available precipitation data in the watershed, and the known annual discharge of streams that are gaged (Geomatrix, 1999).

Thus, Johnson (2008) estimated the combined average annual streamflow of the District's northern system water supply creeks at 4,100 af/yr .Table 2.2 shows the approximate average annual streamflow compared to the average water diverted by the District from these streams.

Table 2.2. Estimated average annual streamflow of District surface streams (northern system), amount and percentage diverted.

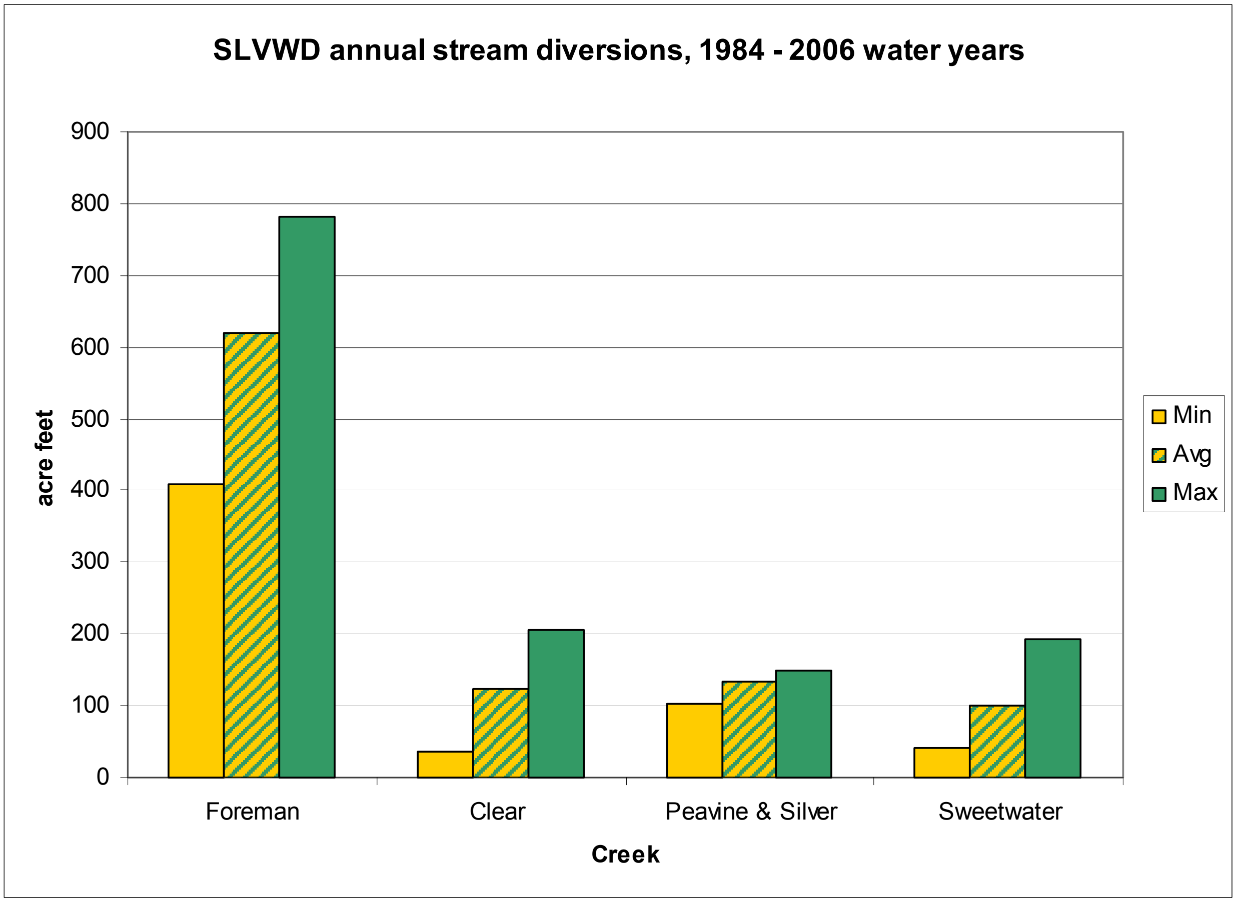
District supply creek (at diversion point)	**Total streamflow** (af/yr)	**Water diverted** (af/yr)	**% of total streamflow**
Foreman	1,400	621	44
Clear	1,300	124	10
Peavine & Silver	800	135	17
Sweetwater	600	101	17
Totals	4,100	981	24

Source: Johnson, 2008 (Table 4-3 and paragraph 4.1.3)

The total estimated annual streamflow (4,100 af/yr) of these District supply streams represents approximately 8 percent of the estimated average flow of the San Lorenzo River at Clear Creek (50,000 af/yr), and 4 percent of the estimated average flow of the San Lorenzo River at Big Trees (96,700 af/yr) (Johnson, 2008).

Figure 2.5 shows the annual minimum, maximum and average flows diverted by the District, from 1984-2006.

Figure 2.5. Annual minimum, maximum and average flows diverted from northern system creeks, water years 1984 – 2006.



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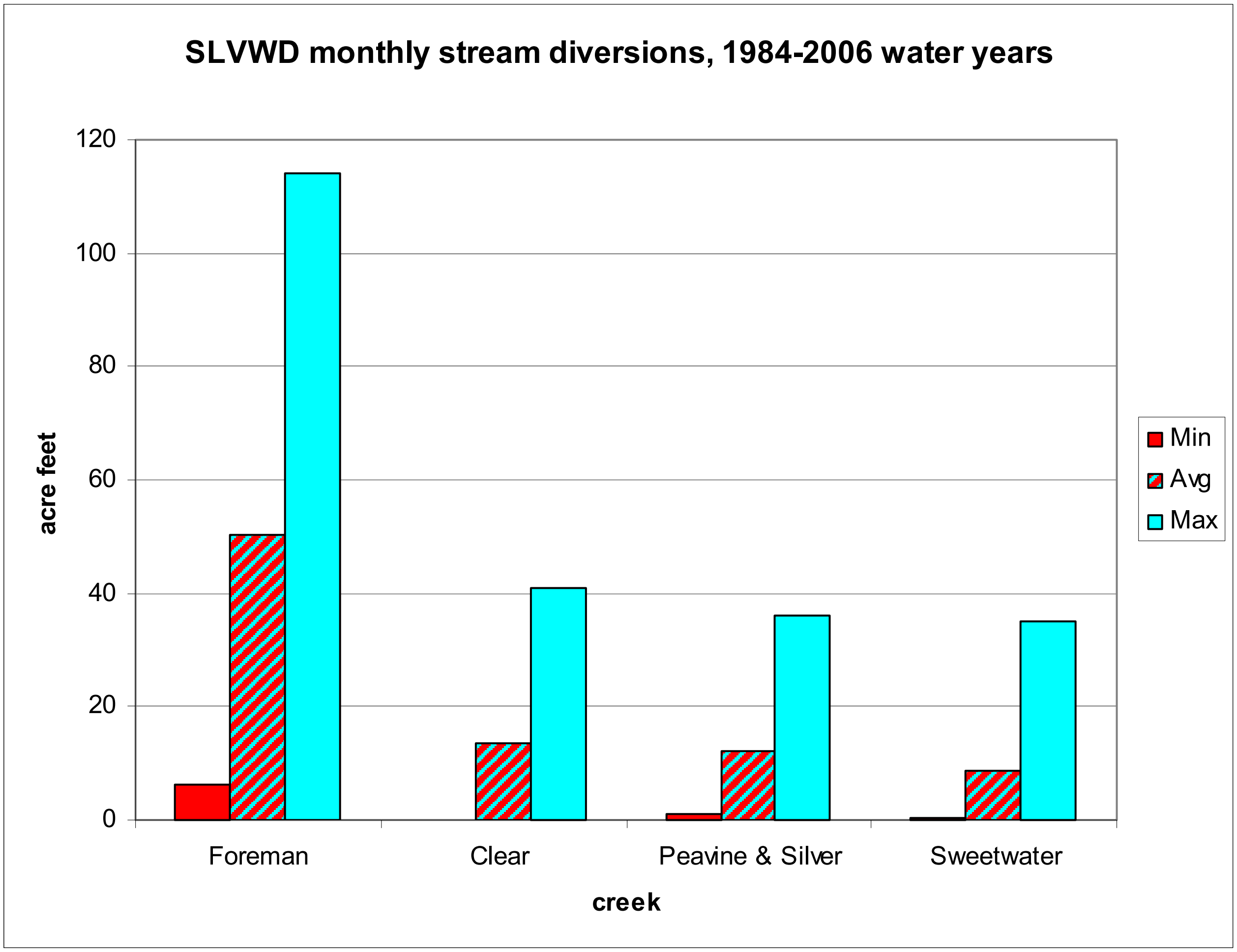
Source: Johnson, 2007 (data from Table 4-3)

Figure 2.6 shows the *monthly* minimum, maximum and average flows diverted from the same creeks. Total monthly stream diversions averaged about 74 acre feet, but have declined to as low as 13 acre feet in September 1988. The total maximum monthly rate of diversion during the period of record was 138 acre feet.

Figure 2.6. Monthly minimum, maximum and average flows diverted from the District's northern system creeks



Source: Johnson, 2007 (Table 4-13)

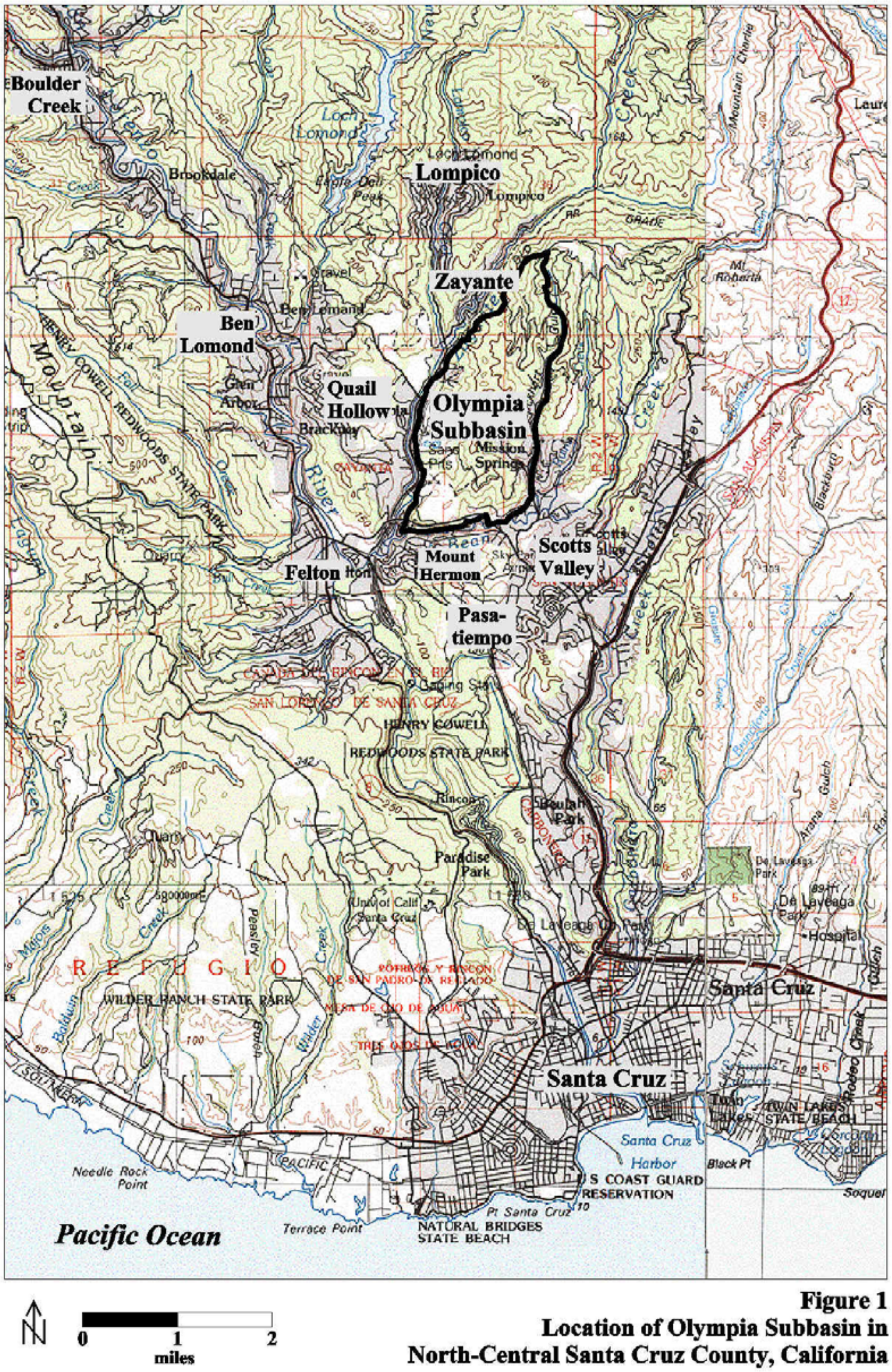
2.3.3 District wells and groundwater recharge lands

The District's wells are located in four different locations, and tap two different aquifers. The District owns approximately 167 acres of land that serve as protective buffers for its wells. For information about groundwater storage, recharge, and water quality issues that affect the District's groundwater sources, refer to "Chapter 3, Hydrology, Geomorphology, and Water Quality."

2.3.3.a The Olympia wellfield

The District's two Olympia wells draw from a three square mile area northeast of Felton and northwest of Scotts Valley, bounded by Zayante Creek to the west, Lockhart Gulch to the east, and Bean Creek to the south, as shown in Figure 2.7. The Santa Margarita Sandstone aquifer is the source of groundwater for the wells. The overall capture zone for the Olympia wells is approximately 1,200 acres, of which the District owns 163 acres. Groundwater recharge to the District's Olympia wells is derived primarily from percolating rainfall. Land use in the recharge area includes a closed sand quarry, undeveloped open space including timberland, and rural residential development (Johnson, 2002). For a more detailed discussion of potential impacts to groundwater recharge and water quality, refer to Chapter 3.

Figure 2.7. Location of the Olympia ground water basin



Source: Johnson, 2002.

2.3.3.b Quail Hollow wells

The Quail Hollow area is approximately three square miles, lying between Zayante and Newell creeks and the San Lorenzo River. The Santa Margarita Sandstone aquifer underlies the hillslope area of Quail Hollow. The District operates two wells in the Quail Hollow area. The primary recharge area for these wells is 200 acres or more, depending on water table conditions, of which the District owns approximately 4 acres. However, the entire square mile Santa Margarita exposure is important to the balance that contributes to the District wells.

Figure 2.8 shows the location of the Quail Hollow Basin.

Figure 2.8. Location of the Quail Hollow ground water basin

Figure 1
Location of Quail Hollow Area
in North-Central Santa Cruz County, California

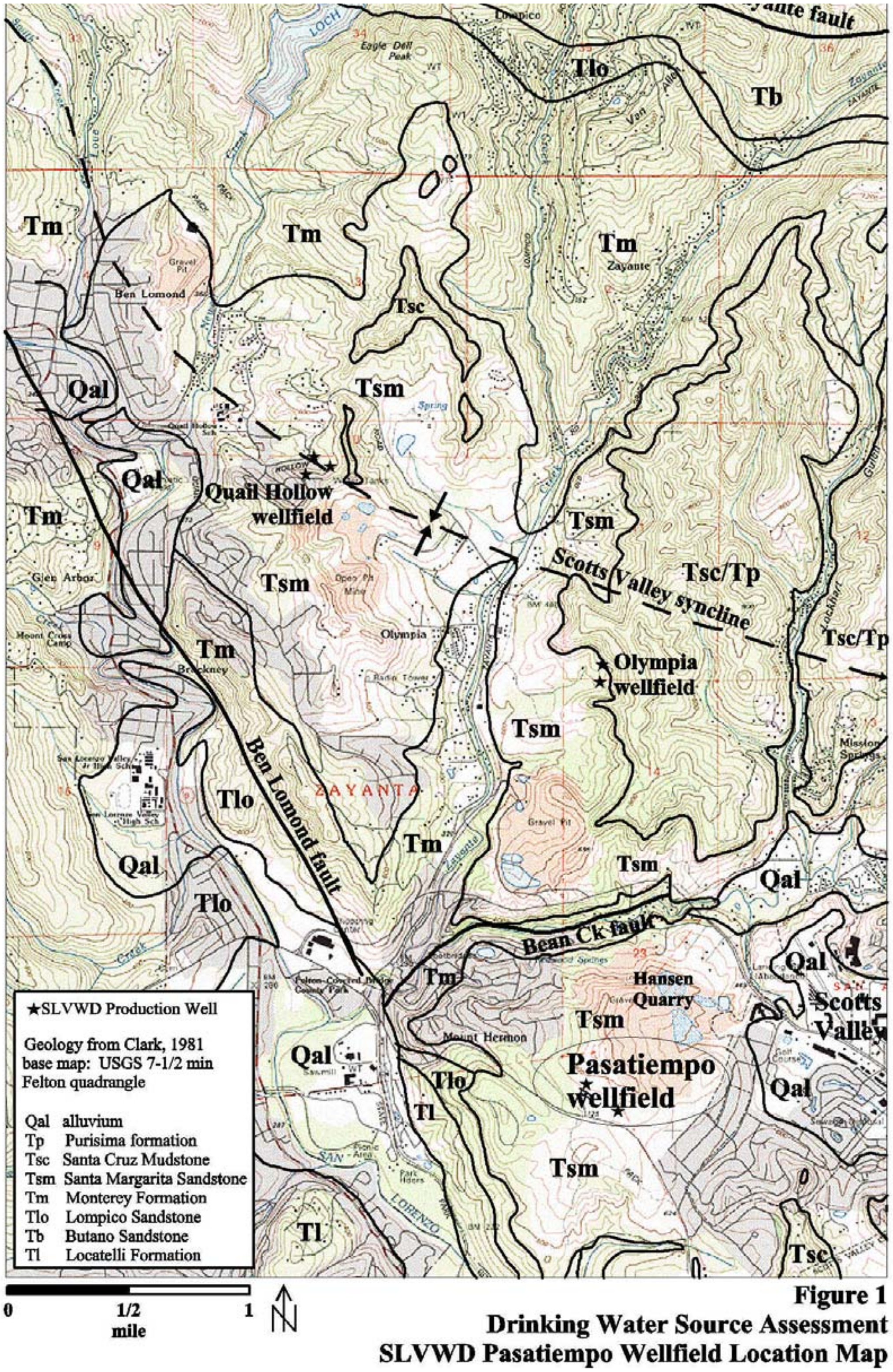
Source: Johnson, 2002.

2.3.3.c Pasatiempo wells

The District's two Pasatiempo wells are located near southwestern Scotts Valley, east of the San Lorenzo River, south of Bean Creek, west of Carbonera Creek, and north of Eagle Creek. The wells draw from the Lompico Sandstone aquifer, and have a recharge area of slightly more than 500 acres, of which the District owns 1.2 acres (well and tank sites).

Figure 2.9 shows the location of the Pasatiempo wellfield.

Figure 2.9. Location of the Pasatiempo wellfield



Source: Johnson, 2002.

2.3.3.c Mañana Woods well

The sole water source for the District's Mañana Woods service area in Scotts Valley is a well located on Kings Village Drive. The Mañana Woods well is located approximately ½ mile from the unincorporated Mañana Woods area south of Mt. Hermon Road in Scotts Valley. The water is treated at the site and pumped via mains to storage tanks within the service area. The District annexed the Mañana Woods water system in 2006.

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