Table of Contents

Upper Subbasin 1
Hydrology 1
Geology 4
Compositional Overview 4
Soils 5
Landslides 5
Earthquakes and Faults 6
Wildfires 6
Fluvial Geomorphology 6
Vegetation 7
Non-Native Plants 8
Land and Resource Use 10
Historic Land Use 10
Current Land Use 10
Fish Habitat Relationship 12
Fishery Resources 12
Habitat Overview 13
Historic Conditions 13
Current Conditions 14
Habitat Conclusions 15
Restoration Projects 15
Stream Habitat Improvement Recommendations 16
Refugia Areas 16
Key Subbasin Issues 16
Responses to Assessment Questions 17
Subbasin Conclusions 20

List of Figures

Figure 1. Lake Henshaw and surrounding area in the Upper Subbasin 2
Figure 2. Upper Subbasin locator map and CalWater Units. 3
Figure 3. Geology of the Upper Subbasin. 5
Figure 4. Vegetation of the Upper Subbasin. 8
Figure 5. Rainbow trout caught in W.F. SLR River (photo taken in April, 2008). 13

List of Tables

Table 1. Major streams in the Upper Subbasin. 2
Table 2. Rock types in the Upper Subbasin. 4
Table 3. Soil types in the Upper Subbasin. 5
Table 4. Vegetation of the Upper Subbasin. 9
Table 5. Habitat observations made in the Upper Subbasin from 1951-2008. 14
Table 6. SLR River and tributary salmonid refugia ratings in the Upper Subbasin. 16

Upper Subbasin

The Upper Subbasin is the largest of the subbasins, occupying two-hundred and six square miles or a little over one-third of the watershed. The watershed area comprises Lake Henshaw on its western boundary and all of the surrounding streams and their drainage areas that flow into the lake (Figure 1). Lake and stream elevations range from 2,727 feet at the spillway on Henshaw Dam (RM 50) to nearly 6,000 feet in the headwaters of a few tributaries on the southwestern portion of the subbasin. The SLR River flows into the lake at approximately 2,730 feet; however, the river's headwaters approach 5,000 feet in Anza Borrego State Park and exceed 5,000 feet in the headwaters of West Fork SLR River (W.F. SLR River). In general, precipitation increases in the higher elevations of the subbasin. Average yearly rainfall at Henshaw Dam is approximately 26 inches (based on data collected from 1948 to 2006) with higher rainfall totals in the surrounding Palomar, Aguanga, and Hot Springs Mountains.

This assessment area is mostly rural, containing only the small community of Warner Springs in the north-central part of the subbasin and Los Coyotes and Santa Isabel tribal members. It is predominantly composed of grasslands and native habitats consisting of mixed sagebrush/chaparral and hardwood forest/woodlands. The four mile stretch of riparian habitat along the SLR River below Lake Henshaw and the Warner Basin, which composes most of the Upper Subbasin, has been identified by The Southern Mountains and Foothills Assessment (Stephenson and Calcarone 1999) as an area of particularly high ecological significance. This designation describes areas that include critical habitats for rare and vulnerable species, those of high ecological integrity, and locations with unique ecological associations. The assessment describes how there are significant populations of arroyo toad and arroyo chub in the West Fork and North Fork of the SLR River and Agua Caliente Creek located within the subbasin. A self-sustaining native rainbow trout population is present in the West Fork SLR River. Extensive grasslands in the Warner Basin are occupied by federally listed Stephens' kangaroo rat (*Dipodomys stephensi*), and the subbasin is also one of the few areas in southern California where the red-sided garter snake (*Thamnophis sirtalis infernalis*) has recently been observed (Stephenson and Calcarone 1999). Moreover, the Upper Subbasin contains some of the most extensive remaining native grasslands in southern California, and the largest Engelmann oak woodland in the world (http://www.audubon.org /bird/iba05/2009).

The Vista Irrigation District (VID) is the largest landowner in the subbasin as well as in the SLR Basin. VID's property consists of Lake Henshaw and much of the surrounding grazing land around the lake and extending west of Highway 79. Indian reservations occupy the next largest segment of land with the Los Coyotes Indians and the Santa Ysabel Indians owning large tracts of land within their reservations. Cleveland National Forest and private landowners also occupy large portions of the subbasins.

Prior to the completion of the Henshaw Dam in 1922, the SLR River at the Henshaw Dam site was a perennially flowing river with minimum monthly summer flows of 1.4 cfs (see Middle Subbasin, Habitat Overview, pp. 11-12). The majority of these flows were most likely the result of the numerous tributaries flowing into the river in the western portion of the subbasin. Historically, the mainstem and most likely the West Fork SLR River, contained large areas of year round flows and supported trout populations of original ocean decent. Currently, native rainbow trout are only found in the W.F. SLR River.

To accommodate a popular demand for recreational sport fishing opportunities in inland lakes, warm water game fish, such as largemouth bass, bluegill, green sunfish, black crappie, and catfish were introduced into many lakes and reservoirs in southern California in the late 1940's. These fish may have been stocked into Lake Henshaw around this time as well. They are now common in the SLR River below the dam and are likely present in other streams within the basin.

Hydrology

The Upper Subbasin is composed of the Combs and Warner CalWater Units (Figure 2). There are eight named tributaries (Table 1) and 41.0 permanent and intermittent stream miles in this subbasin. The vast majority of these stream miles are intermittent. There are also a few named canyons containing intermittent and sections of permanent streams miles. The largest of the tributaries is W.F. SLR River. Although it is a blue-lined stream on USGS 7.5 quadrangles Palomar Observatory and Warner Springs, it is actually an intermittent stream with sections of perennial flow. This also applies to the SLR River and other named tributaries in the subbasin. Agua Caliente Creek and San Ysidro Creek are labeled as blue-lined streams, but only contain surface flows in portions of their channels. These streams and other tributaries play an important role in contributing to the overall volume of water in Lake Henshaw. Tributary drainage areas range from

less than 3.5 square miles to the 91.0 square mile SLR River in the Upper Subbasin. The subbasin also contains a large aquifer, which is located in the area surrounding Lake Henshaw. The aquifer's production is utilized by the settlement parties in the San Luis Rey Settlement Agreement (J. Membrino, personal communication 2009).

With the exception of the Northern Subbasin, the Upper Subbasin receives more precipitation than all the other subbasins. Lake Henshaw's mean annual precipitation total is 26 inches, based on the water years 1948-2005 (http://www.wrcc.dri.edu/). Water releases, controlled by VID, can vary year to year, but typically occur in the spring and continue through mid to late summer. The amount of the release usually depends on the rainfall totals and amount of water stored in Lake Henshaw. In 2007, 24 cfs was released on April 27 and water releases continued till late July.

Numerous wells, located throughout the subbasin, provide water for anthropogenic uses. These wells most likely reduce surface flow in the tributaries as well as in the mainstem and could lower the groundwater table.

Table 1. Major streams in the Upper Subbasin.

Stream	Tributary to	River Mile	Drainage Area (square miles) (in Subbasin)	Stream Order	Permanent (miles) (in Subbasin)	Intermittent (miles) (in Subbasin)
Mainstem SLR River*	Lake Henshaw	-	91.0	1	1.1	12.3 (10.6)
West Fork SLR River*	Lake Henshaw	50.0	30.6	1	2.1	9.3
Agua Caliente Creek*	SLR River	55.8	39.4	1	1.6	12.0 (1.6)
Cañada Verde	Agua Caliente Ck	3.9	6.4	INT	0.0	5.1
Ward Canyon	Agua Caliente Creek	0.5	4.8	INT	0.0	6.0
Buena Vista Creek*	Lake Henshaw	50.0	55.3	INT	0.3	11.3 (1.2)
San Ysidro Creek*	Buena Vista Creek	5.8	15.4	INT	0.8	7.3
Matagual Creek*	Buena Vista Creek	1.0	10.6	1	2.1	5.5
Carrista Creek	Lake Henshaw	50.0	10.4	INT	0.0	1.7
Carrizo Creek*	Carrista Creek	2.3	4.8	1	2.1	3.5

*A portion of these creeks retain perennial flows during normal rain years with WF SLR River generally containing the longest stream area with perennial flows.
INT = Intermittent stream

Figure 1. Lake Henshaw and surrounding area in the Upper Subbasin.

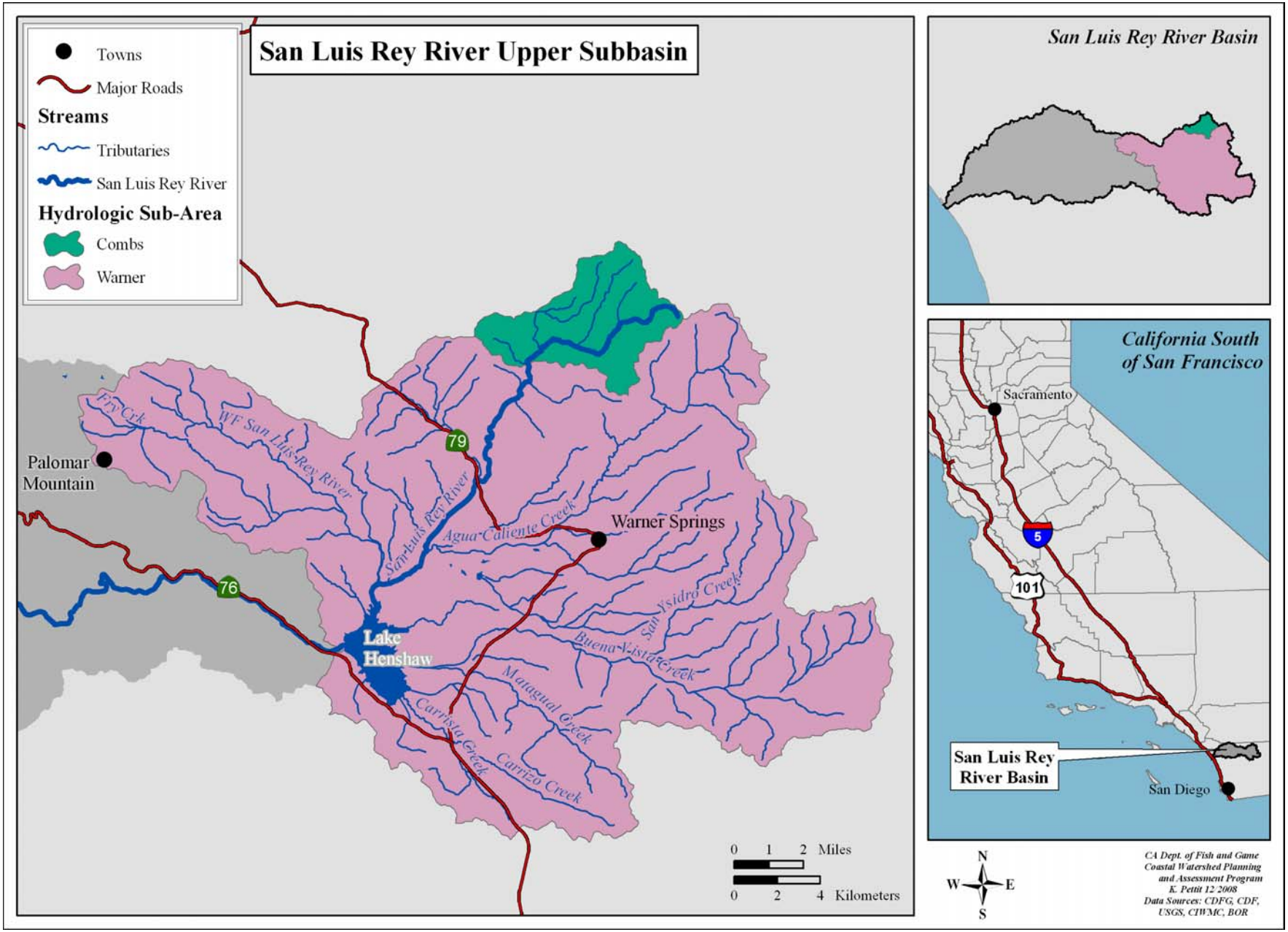

Figure 2. Upper Subbasin locator map and CalWater Units.

Geology

Like all of the subbasins within the San Luis Rey watershed, the Upper Subbasin is predominately underlain by granitic rock types of the Peninsular Range Batholith that intruded into older (Mesozoic) sedimentary, marine rock types between 90 and 140 million years ago and has subsequently been exposed by tectonic uplift and erosion (Figure 3). Intrusion of the Peninsular Range Batholith as well as regional tectonics has caused some of the marine, sedimentary rocks to undergo metamorphosis.

Erosion has exposed the batholith leaving behind mountains of granitic rock with remnants of the sedimentary rocks into which they intrude. Weathering of these rocks has created younger unconsolidated sediments that are very susceptible to erosion and mass movement such as landslides and debris-flows. These sediments have been deposited in a series of alluvial fans, marine and river terraces, as well as active channel deposits. These sedimentary deposits range from partially consolidated sandstone, siltstone, mudstone, and shale to unconsolidated sand and gravel (Table 2).

Compositional Overview

Rock Types

Mesozoic Granitic

Granitic rocks make up the majority of this subbasin. They occupy approximately 67% of its surface area. They are predominantly Cretaceous (65.5 million through 154.5 million years ago) in age. These rocks are very hard and resistant to erosion, however they do tend to exfoliate to some extent in exposed surfaces and preferentially weather at structural joints. Over long periods of time granitic rocks tend to weather and become “soft” reducing their density, increasing their porosity, and making them much less resistant to erosion, producing “decomposed granite.” In more advanced forms, the minerals within the granite disaggregate and form “Arkosic Sand” which is highly susceptible to erosion, sliding, and fluvial transport.

Quaternary Alluvium

Alluvium covers less than 15% of the basin. It consists of unconsolidated sediments that range from clay to streams and makes up most of the bed and banks of the streams. Units of alluvium delineated by the geology map include sediment currently being acted upon by boulders. Alluvium is transported and deposited by the streams, bank and flood-plain deposits occasionally acted upon by the streams, and sediment that has accumulated within Lake Henshaw. If the alluvium within the stream channel is of sufficient depth it can readily transport water via the subsurface pore-spaces allowing stretches of the stream to “run dry.”

Plio-Pleisticene Nonmarine

This unit occupies about 13% of the basin. It is composed of sedimentary rocks ranging in composition from siltstone through conglomerate. The sediments that make up these rock types were deposited on land between eleven thousand and five million years ago. The sediments of these rock types range from siltstone through conglomerate and from poorly consolidated to well indurated.

Mesozoic Sedimentary

Mesozoic sedimentary rocks make up around 5% of the subbasin and consist mostly of siltstone, sandstone, and conglomerate and were deposited some 65.5 to 225 million years ago. The original deposition of the sediments that make up these rock types occurred in environments ranging from marine to terrestrial. Some of these rock types have subsequently undergone metamorphism especially in areas in contact with granitic rock types. These sedimentary rock types are generally more susceptible to erosion than granitic rock types.

Quaternary Alluvial Fan Deposits

Fan deposits make up about 1% of the basin and consist of unconsolidated sediments ranging from clay to boulders. They wash out of canyons with steep slopes and are usually deposited where there is a significant change of slope. They are not usually transported far from their source and therefore consist of sediments made from the bedrock of the mountains from which they come.

Table 2. Rock types in the Upper Subbasin.

Lithologic Unit	Percent of Basin
Mesozoic Granitic	66.74
Quaternary Alluvium	14.73
Plio-Pleisticene Nonmarine	12.52
Mesozoic Sedimentary	4.56
Quaternary Alluvial Fan Deposits	1.32

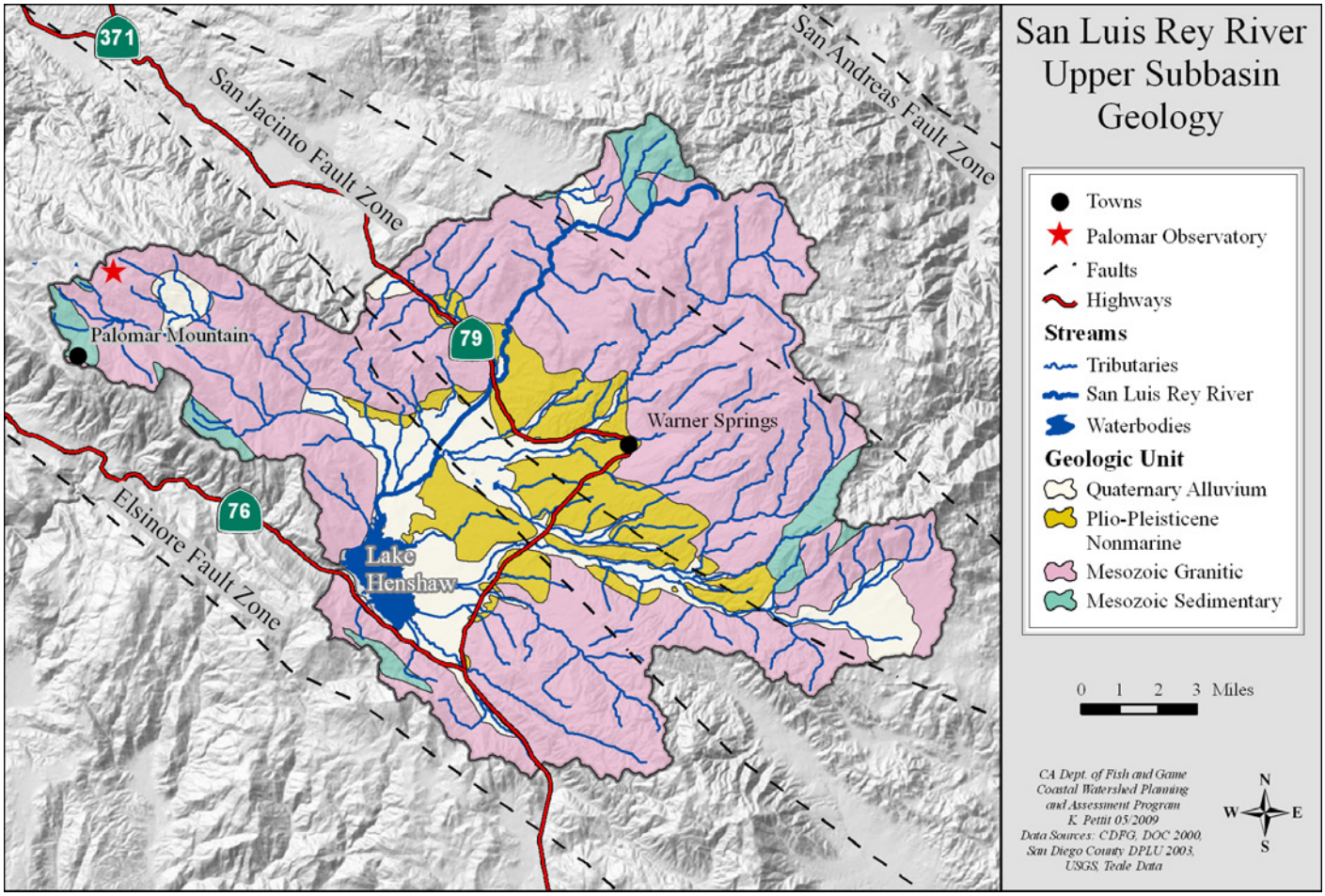

Figure 3. Geology of the Upper Subbasin.

Soils

The underlying bedrock is generally responsible for a soil's texture and erodability characteristics. The sediment contribution from soils found in the Upper Subbasin is dependent largely on slope, soil sediment size, consolidation, cohesion, compaction, the type and amount of vegetation cover, land use, and amount, intensity, and duration of local rainfall.

The majority of bedrock throughout the subbasin is composed of various granitic rock types (Table 3) producing associated soil types that are, in general, very well drained and are somewhat prone to erosion and transport by fluvial processes as well as wind. Soils with high sand and silt content are typically more susceptible to erosion than soils with high clay content which exhibit a greater degree of cohesion.

Table 3. Soil types in the Upper Subbasin.

Soil Type	Percent of Upper Subbasin	Composition
Tollhouse-Rock outcrop-La Posta	44.06	igneous/granitic
Oak Glen-Mottsville variant-Calpine	23.12	granitic
Sheephead-Rock outcrop-Bancas	15.76	gneissic/granitic
Hotaw-Crouch-Boomer (s1015)	12.68	granitic/metavolcanic

Percent area of basin represents a rough approximation based on GIS mapping.

Landslides

Like the other SLR River Subbasins, the Upper Subbasin is partially mantled with unstable soils. Alluvial material is generally confined to the mainstem while the hillsides are often composed of granite, weathered granite, and sedimentary rock. Except for fresh granite, these rock types are susceptible to surface erosion, headword erosion, gullying, stream bank

raveling, and landsliding. This area has undergone tectonic uplift leaving steep canyon walls above the streams. As tectonic forces push the land up, gravity tries to pull it down, and the result is usually landslides and rock falls. Landsliding is further exacerbated by seasonal rain storms. As the hillsides become saturated, pore pressure between grains becomes greater making them unstable and more prone to landsliding. These conditions can be exacerbated by moderate to extreme wildfires.

Earthquakes and Faults

The whole of the San Luis Rey River Basin is tectonically and seismically active, and the possibility of seismic activity occurring in this subbasin is similar to the entire southern California region. The Upper Subbasin lies between the active fault zones of the Elsinore Fault Zone on its southwest border and San Jacinto Fault Zone, which cuts through the northern portion of the subbasin (Figure 3). Many faults are found between these two major zones; moreover, the San Andreas Fault Zone lies just to the north of the subbasin. All of these faults are right-lateral, strike-slips faults that are related to translational plate boundary tectonics between the Pacific and North American plates. These faults all maintain the potential for strong seismic movement. The San Jacinto Fault Zone (currently established Alquist-Priolo Earthquake Fault Zone), for example, is capable of producing earthquakes in the range of magnitude (M) 6.5–7.5 and has an average recurrence interval of approximately 100–300 years. The most recent quake that occurred in the region was due to the San Jacinto Fault Zone, which produced a M 6.5 quake in 1968 (http://www.data.scec.org/index.html).

Strong ground shaking generated by earthquakes can trigger rock falls and landslides that deliver large amounts of sediment to the streams. For instance, the 1994, Northridge earthquake, whose epicenter was located 20 miles northwest of downtown Los Angeles, was a M 6.7 earthquake that triggered in excess of 11,000 landslides in a 6,200 square mile area (USGS) in similar terrain. In addition to potentially triggering landslides, strike-slip faults can weaken bedrock, offset streams, and truncate and oversteepen certain topographic landforms thus enhancing erosion and transport of sediment to the streams. If situated near or above artesian wells, these faults may also cause the natural upward migration of water, creating seeps, springs, and potentially surface flows. For example, water moving up the Agua Caliente Fault forms Warner Springs, demonstrating that the fault affects subsurface flow at this location. The Aguanga Fault, along with other unnamed faults that cut through this basin possess the potential to cause earthquakes, but have an unknown effect on groundwater (California Groundwater Bulletin 2004: 118).

In 1971, the California Division of Dam Safety declared the Henshaw facility prone to failure in the event of seismic activity VID was required to permanently reduce the lake's capacity from 200,000 acre-feet to 50,000 acre-feet (Babbitt 1993). Today, the dam functions at less than 10% of its original storage capacity because of the Division of Dam Safety's reduction requirement, the collection of sediment over the years, and the drought-like conditions that have been experienced this past decade. More recently, in the Carlsbad Watershed to the south of the SLR River Basin, a federal analysis in 2007 determined that a large earthquake could liquefy the earthen portions of the Lake Wohlford Dam and cause potential flooding in the central part of Escondido. Most of the water used to fill Lake Wohlford comes via the Escondido Canal from Lake Henshaw.

Wildfires

Wildfire can, and usually will enhance the erodability of a region by burning off the duff layer and organic matter that helps to bind the soil together, as well as intensively drying it leaving behind a loose, "hydrophobic" soil in its wake. During subsequent rain storms the soil's capacity to absorb water is greatly reduced and surface flows are proportionally increased. Sometimes this hydrophobic layer can persist for years, especially if it is relatively thick. Wildfires can destroy woody debris strewn on hill slopes allowing for less resistance to the erosive power of surface runoff transporting increased amounts of sediment downstream. The propensity for debris flows on steep slopes is also increased following a wildfire (Cannon et al. 2004). Relatively hot fires may cause thermal expansion of individual minerals within the rock resulting in fracturing of its surface layers and thus, enhanced erosion.

The 2007 wildfires did not occur within the Upper Subbasin; however, wildfires have occurred frequently in the subbasin within the past decade (2006, 2004, 2003, and 2002; Figure 21, Basin Profile). Considering the arid climate and the dominant vegetation types, mixed sagebrush/chaparral and grasslands, the area is certainly prone to future fires. Post-fire erosion potential has been estimated as moderate to low (Table 5, Basin Profile) for most of this subbasin (USGS).

Fluvial Geomorphology

On average, the Upper Subbasin should act as a

sediment source, transport, and deposition reach. Tributaries erode sediment from the steeper slopes and deliver them to the mainstem which in turn redistributes sediments within its floodplain and also transports sediments further downstream. When the mainstem enters Lake Henshaw, its flow regime drastically changes allowing sediment carried in bedload and by suspension to drop out and accumulate as lacustrine (lake) deposits. The slope of the mainstem was calculated to be 5% or less based on GIS mapping. However, many other streams in the Upper Subbasin, such as WF SLR River, Agua Caliente Creek, and Carrista Creek contain significant stream reaches where the slope is greater than 5%. Sediment erodes from the steeper hillsides and is brought by tributaries and deposited into Lake Henshaw.

The Upper Subbasin is underlain by a basement of granitic rock. Roughly 30% of this granitic rock is covered by sedimentary deposits along major drainages. These sediments consist of unconsolidated, alluvial fill and to locally cemented sediments deposited sometime within the last 5 million years. The coarse unconsolidated nature of these sedimentary deposits allows them to hold and transport water. The underlying (sometimes more than 100 feet in depth) granitic rock acts as an aquitard making the overlying sediments essentially aquifers. The large Lake Henshaw area aquifer extends outward from the lake to Highway 79 with further upstream extensions along the W.F. SLR River and Buena Vista Creek (See Figure 6, p.12 of the Basin Profile).

Numerous wells populate the Upper Subbasin, which are used for irrigation, human consumption, and water storage. The VID, for example, utilizes 24 wells within its holdings surrounding Lake Henshaw to supplement water supplies to the lake (VID 2008). Cumulatively, these wells have various effects on the groundwater levels in the subbasin. In the southeast part of the subbasin, the water level in one well declined only about three feet from 1912 through 1967; however, in the central part of the subbasin, groundwater levels in wells declined 30 to 138 feet during the 1950s and 1960s (DWR 1971).

Sediment budget studies have estimated that coastal rivers and streams supply, on average, 70 to 90% of beach sand in California (Bowen and Inman, 1966; Best and Griggs, 1991). In southern California rivers, most sediment transport occurs during infrequent floods (Brownlie and Taylor 1981), but it is these energetic events that flood control dams are constructed to prevent. In the San Luis Rey River, which is one of the principal sources of sediment for the Oceanside littoral cell, Henshaw Dam reduced suspended sediment yield by 6 million tons, total sand and gravel yield by 2 million tons (Brownlie and Taylor 1981).

Although Henshaw Dam is utilized for water storage, it also functions as a sediment trap. According to a 1951 survey of Lake Henshaw, the capacity of the reservoir was found to be 194,300 acre-feet as compared to 200,000 acre-feet when it was first completed in 1922 (Lettieri-McIntyre and Associates 1995). This 3% decrease in the lake's capacity occurred over a relatively short period, 29 years. In addition to trapping sediment, the dam reduces peak flows. While the hydrologic controls in the basin, Henshaw Dam and the Escondido Canal diversion dam diminish the potential for property damage along the river downstream, they in turn, contribute to property damage along the coast by eliminating sediment supply to the protective beaches (California Department of Boating and Waterways and State Coastal Conservancy 2002). For the rivers contributing sediment to the Oceanside littoral cell, sediment from about 40% of the catchment area is now cut off by dams. Because the rate of longshore transport (a function of wave energy striking the coast) is unchanged, the result has been a sediment deficit, loss of beach sand, and accelerated coastal erosion (Inman 1989).

Vegetation

The Upper Subbasin, while containing large areas utilized as cattle and livestock grazing, retains native habitats over the majority of the subbasin. The predominant vegetation cover type as described by the USFS CALVEG data is mixed sagebrush/chaparral, covering 54.59% of the Upper Subbasin (Figure 4 and Table 4). This cover type is divided between lower montane/mixed chaparral, red shanks chaparral, and chamise vegetation types. Herbaceous was the second most abundant cover type at 16.38%. While there is a separate agriculture cover type, a large portion of the herbaceous cover type is most likely used for the grazing of cattle and other livestock, but is not accounted for since land use is often difficult to remotely ascertain. For this reason, it can be assumed that areas mapped as annual grasslands may also be agricultural in nature.

The third most abundant vegetation cover type is hardwood forest/woodland (10% of the subbasin). Coast live oaks make up a little over half of this cover type. Canyon live oak, black oaks, and Engelmann oaks compose the remaining vegetation types in this category. The rest of the cover types compose a significantly less amount of land. Mixed conifer/woodland and barren/rock cover types each compose approximately 5% of the subbasin. Although

wetlands, mostly in the vicinity of Lake Henshaw, make up only 2.5% of the subbasin, they are an important ecological component of the subbasin as well as the basin as a whole. It is important to note the grasslands within the subbasin are some of the most extensive in southern California and the surrounding Engelmann oak woodland is the largest in the world (http://www.audubon.org/bird/iba 05/2009).

There is no significant urban/residential area in the Upper Subbasin. The majority of the residents are single family dwellings. About one third of the Upper Subbasin is under ownership of Native Americans, USFS, and other federal and state lands. Another quarter of the subbasin is owned by water districts, mostly the VID. In all likelihood, there seems little potential of rapid expansion of residential or commercial development in the near future.

Non-Native Plants

Non-native, invasive plants in the Upper Subbasin consist primarily of exotic grasses. The invasive species that are problematic in the Coastal and Southern subbasins are almost non-existent in the Upper Subbasin. Similar to many other areas of California, non-native annual grasses and forbs have displaced perennial native grasses within this subbasin. The deep roots of native grasses stabilize the soil, increase water filtration, and recycle nutrients (http://www.cnga.org/). Native grasslands also provide important habitat to numerous sensitive species, including, but not limited to: the northern harrier (*Circus cyaneus*), mountain plover (*Charadrius montanus*), burrowing owl (*Speotyto cunicularia hypugaea*), and the Stephens' kangaroo rat (*Dipodomys stephensi*) (Lettieri-McIntyre & Associates 1995).

Conversely, non-native grasses reduce the quality of forage and cover for wildlife. Once alien grasses become established it is difficult for native vegetation to recover. Non-native grasses germinate quickly, grow aggressive, and establish extensive fibrous root systems (Beyers et al. 1998). The faster aboveground growth rate of annuals (non-natives) results from their rapid uptake of available resources and results in a reduction in light for native seedlings. With their earlier development, exotic annuals may also effectively deplete soil resources before seedlings of native species have a chance to do so (D'Antonio et al. 2003). Oak regeneration is hampered by non-native grasses as they diminish the upper soil moisture

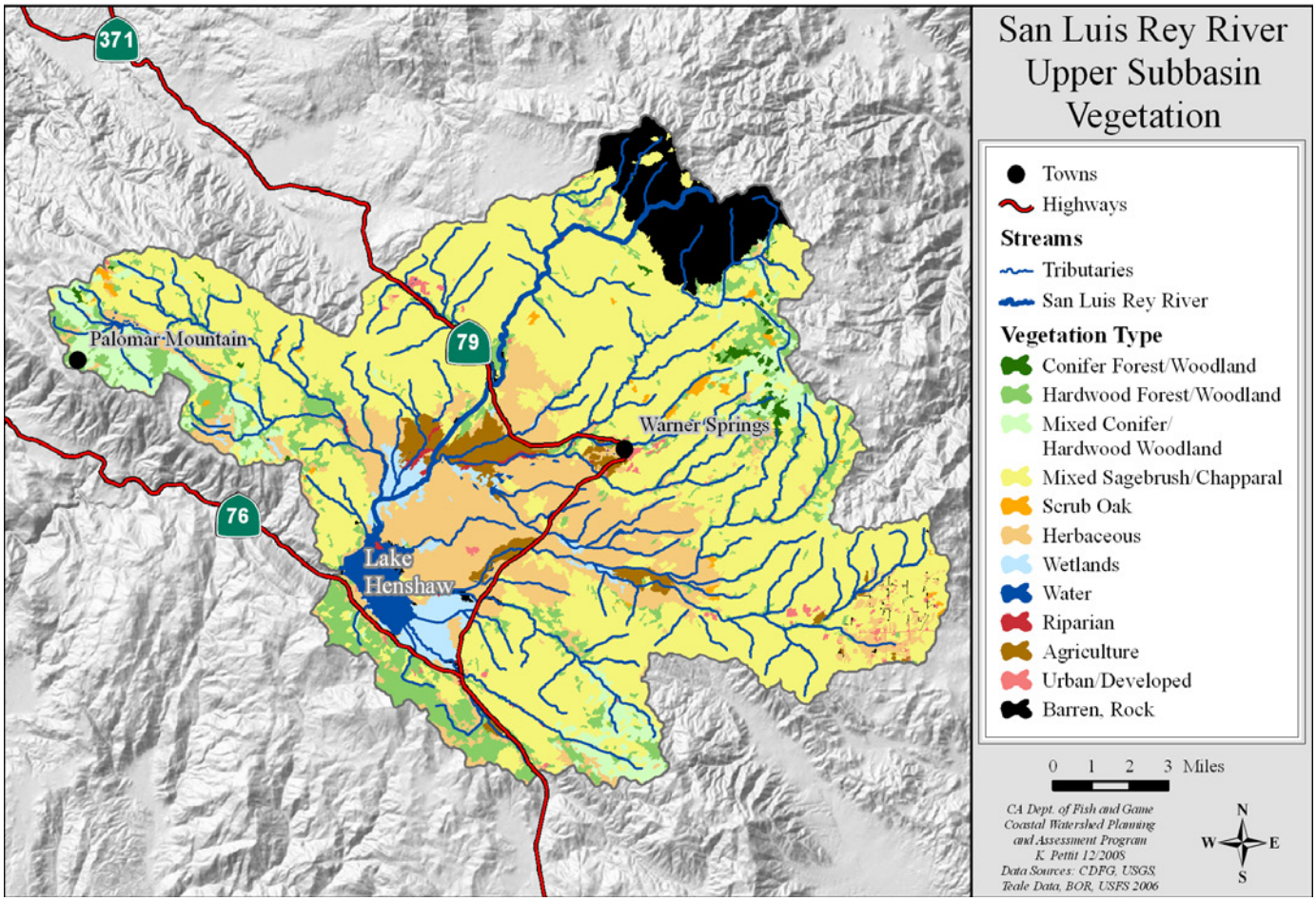

Figure 4. Vegetation of the Upper Subbasin.

Table 4. Vegetation of the Upper Subbasin.

Vegetative Cover Type	Percent of Basin	Primary Vegetation Type	Percent of Cover Type
Mixed Sagebrush/Chaparral	54.59	Basin Sagebrush	0.8
		Buckwheat	4.3
		California Sagebrush	0.6
		Ceanothus/Mixed Chaparral	0
		Chamise	25.2
		Lower Montane Mixed Chaparral	34.7
		Manzanita Chaparral	1.4
		Upper Montane Mixed Chaparral	1.9
		Red Shanks Chaparral	30.2
		Other	0.9
Herbaceous	16.38	Annual Grasses/Forb Alliance	22.8
		Non-Native/Ornamental Grass	0.7
		Perennial Grasses and Forbs	76.5
Hardwood Forest/Woodland	10.14	Black Oak	23.4
		California Sycamore	0
		Canyon Live Oak	10.2
		Coast Live Oak	52.0
		Interior Live Oak	0.5
		Engelmann Oak	1.5
		Eucalyptus	0
		Interior Mixed Hardwood	12.1
		Non-native/Ornamental Hardwood	0
Mixed Conifer/Woodland	5.37	Bigcone Douglas - Fir	9.5
		Coulter Pine	52.1
		Mixed Conifer - Fir	11.8
		White Fir	24.1
		Mixed Conifer - Pine	2.5
Barren, Rock	5.18	Barren	98.9
		Urban-related Soil	1.1
Wetlands	2.47	Wet Meadows	100
Agriculture	2.39	Agriculture	100
		Orchard Agriculture	0
		Pastures and Crop Agriculture	0
Water	1.44	Water	100
Urban/Developed	0.58	Urban/Developed	100
Scrub Oak	0.55	Scrub Oak	100
Conifer Forest Woodland	0.48	Bigcone Douglas-Fir	2.1
		Coulter Pine	43.3
		Mixed Conifer - Fir	53.3
		White Fir	1.3
		Fremont Cottonwood	0
		Riparian Mixed Hardwood	60.6
		Riparian Mixed Shrub	0
		Willow (Shrub)	39.4

These statistics exclude the classification of water. Data from CALVEG & USFS.

content, which decreases the likelihood of acorns successfully sprouting. Gophers, whose population numbers generally increase in non-native grasslands, can devastate oak seedling establishment (Apostol et al. 2006). Moreover, other studies have shown that the presence of exotic annual grasses negatively influences reproduction of native perennials in California grasslands by reducing inflorescence number and seed output (D' Antonio et al. 2003).

Land and Resource Use

Historic Land Use

Prior to the settlement of Europeans, the Upper Subbasin was inhabited by the local Native Americans comprised of the Cahuilla Indians and the Kuupangaxwichem Indians. The Spanish called the Kuupangaxwichem Indians the Cupeños, which has been adopted as the more commonly used name. The Cupeño and Cahuilla Indians of San Diego County belong to the Cupan subgroup of the Takic language family of Uto-Aztecan. This language is sometimes called Southern California Shoshonean (http://infodome.sdsu.edu/research/guides/calindians/insdcnty.shtml). The Cahuilla lived throughout Riverside County and in Northern San Diego County where they numbered from 6,000 to 10,000 people (http://www.kumeyaay.info/). Conversely, the Cupeños were one of the smallest tribes in California and lived primarily around what is now the Warner Springs area.

These Indian tribes had very little contact with the Spanish or any other outsiders until the early 1800s. The Cupeños lived in the Warner Springs area in two villages (Cupa was one of these villages), with each maintaining a clan leader, and were politically independent (Tetra Tech 2000). The Cupeño diet consisted of acorns, berries, seeds, cactus fruit, deer, quail, rabbits, and other small game. These villages were relatively undisturbed until the arrival of Spanish settlers in 1810, which soon established an inland outpost of coastal missions and began raising cattle on Cupeños land. As settler numbers increased in this region, the Indians began to work in serf-like relations to the newcomers. One of these newcomers was Juan Jose Warner, a naturalized Mexican citizen. Warner received a land grant from the Mexican Government on November 28, 1844, which encompassed much of the Cupeños land. A failed revolt attempt in 1948 against all foreign invaders to the region led to the burning of the village of Cupa (http://www.palatribe. com/). As the hot springs and other resources located on Cupa territories became more popular, the desire to expel the native people increased. Eventually, through a 1903 court case involving the former governor of California claiming rights to the Warner Springs area on Cupeños land, the Cupeños were forced to relocate to the Pala Indian Reservation. This reservation was a Luiseño Indian Reservation; thereby, forcing two distinct Indian tribes to gather on one reservation. The 40-mile journey from Cupa to Pala took three days (September 4-6, 1903), which the Cupeños refer to as their "Trail of Tears" (http://www.palatribe.com/).

The Cahuilla Indians were divided into roughly a dozen independent clans that contained 500 to 1200 people. Similar to the Cupeños, the Cahuilla became a part of the labor force for the Spanish and Mexican settlers. Europeans had damaging effects on the Cahuilla people; most noteworthy was the death of perhaps 80% of their population from European diseases. The Europeans also took over most of the Cahuilla land, which combined with the population decrease lead to the gradual loss of Cahuilla political autonomy (http://www.manataka.org/). Eventually, the Cahuilla in the Upper Subbasin formed the Los Coyotes Band of Mission Indians and currently maintain some of their culture and traditions on the reservation.

Agriculture

The grazing of cattle, sheep, and horses was the principle form of agriculture developed in the Upper Subbasin. Livestock was grazed in the valley bottoms before Lake Henshaw was created and, subsequently, around the lake. A few crops, such as grapes and various tree fruits, were grown near water sources.

Water Storage

From 1893 to 1895, the Escondido Irrigation District constructed the thirteen mile long Escondido Canal that brought SLR River water by gravity flow from the canal's intake (RM 40) on the La Jolla Indian Reservation into the adjacent Carlsbad Watershed to what is now Lake Wohlford. When built, the canal's carrying capacity was approximately 40cfs. If there were additional flows, such as following significant rain events, these flows were passed on downstream in the riverbed. The canal's carrying capacity has since been increased to its current carrying potential of 70cfs (http://www.vid-h2o.org/home/index.asp). Shortly after the canal was completed, Vista Irrigation District's predecessors, William Henshaw and San Diego County Water Company, obtained water rights along the SLR River and completed the construction of Henshaw Dam (1922), located approximately ten miles upstream from the intake of the Escondido Canal. The dam's primary purpose at the time of construction was to provide water for downstream agricultural needs (Hazel et. al 1975). The dam began the delivery of water to the City of Escondido in 1925 and the VID in 1926 (SLR Watershed Council 2000).

Current Land Use

Current land use in the Upper Subbasin is limited by ownership designation and general terrain. Cumulatively, the Los Coyotes Indian Reservation, state park lands, the Cleveland National Forest and Bureau of Land Management compose over one-third of the subbasin. The VID is the largest landowner in

the subbasin as well as in the entire SLR River basin.

Scattered dwellings occur within the subbasin; however, open space and rangeland are the predominant land uses. Human activities, such as water extraction and storage, agriculture, and to a lesser extent tourism/recreational opportunities associated with Warner Springs and Lake Henshaw, play a large role in shaping the landscape and the natural resources within the subbasin.

Agriculture

Agriculture in the Upper Subbasin is dominated by cattle grazing around Lake Henshaw and nearby surrounding areas. Fruit trees, grapes and other crops occupy a less significant amount of land in the subbasin. The steep, rugged, relatively dry terrain also limits the potential for crop production.

In a three-year study (1999-2002) on the Warner Ranch surrounding Lake Henshaw, Atwill and Tate (2003) examined the cattle ranching and its effects on the water resources of the area. Specifically, this study: 1) evaluated the risk that livestock poses to drinking water resources on the Warner Ranch (The Ranch); 2) evaluated current grazing management and stocking levels on The Ranch comparative to sustainable forage production and conservation of natural resources; and 3) developed recommendations for livestock and grazing management options to achieve a balance between viable livestock production and water quality and natural resources protection. Scientists determined a risk to source water due to the presence of *Cryptosporidium parvum*, a pathogen species found in livestock feces that causes parasitic diseases. The risk was greatest in the form of direct deposition of the cattle, particularly from calves, into Lake Henshaw and waterways leading to the lake. While the risk is off-set by significant thermal inactivation and the high infiltration capacity of The Ranch's soil, the risk is greatest during high rainfall years, under saturated soil conditions, with the potential for overland transport of the pathogen to waterways and the lake. Their study goes on to state the following:

> Forage resources are in a degraded condition. Of specific concern is inadequate residual forage cover contributing to a lack of plant diversity in the forage base, a diminished seed base, poor seedling establishment conditions, significant bare soil, and degraded riparian plant communities. This results from periods of grazing beyond the Ranch's carrying capacity, as well as a recent period of severe drought. Annual rangeland and riparian areas on The Ranch are resilient, and will recover with moderation of grazing pressure given average or above average rainfall conditions.

The report outlined management options to reduce or minimize the potential for source water contamination as well as improve natural resource protection/ restoration. Utilizing some of these management recommendations, the Ranch has implemented rotational grazing and constructed cattle fencing around Lake Henshaw to minimize source water contamination and protect biological resources. More management options could be applied, such as erecting cattle exclusionary fencing around more inlet streams and restoring riparian habitat.

In addition to these concerns associated with grazing around the lake, agriculture plays a role in diverting surface flows in streams in the subbasin and overall groundwater supplies. These water extractions place stress on the water demands of riparian plant species and most likely reduce stream surface flows in the subbasin.

Water Storage and Extraction

Henshaw Dam, which controls 206 square miles of the drainage basin, is the principle hydraulic control of the basin. The original storage capacity of the lake was 200,000 acre-feet, but due to dam safety concerns because of potential seismic activity, sediment accumulation, and recent drought conditions the lake's capacity has been greatly reduced and generally does not even approach it current storage capacity of 52,000 acre-feet. After a dry spring, the lake's capacity in July, 2008, had receded to 10,251 acre-feet, only 20% percent of its potential capacity (http://www.vid-h2o.org/home/index.asp). Presently, Lake Henshaw functions as an important source of water for human use. The VID owns Lake Henshaw and controls flow releases into the SLR River downstream, where most, if not all of the flows, are diverted into the Escondido Canal. The canal's current carrying capacity is approximately 70cfs. Only during periods of canal maintenance or extreme winter flows is some water allowed to continue down the SLR River below the Escondido Canal diversion dam.

Numerous wells, located primarily around the lake, continue to supplement the overall water supply in the lake. The VID is the primary water supplier to the Rincon Indian Reservation, the City of Escondido, and Vista. Approximately two-thirds of the water is used for residential use, with the remaining contributing to irrigation, agriculture, and commercial/industrial uses (http://www.vid-h2o.org/home/index.asp).

Tribal Indian Lands

Approximately 12% of the Upper Subbasin is in tribal reservation land. This area is made up of the Los Coyotes Band of Mission Indians and the Santa Ysabel Band of Mission (Diegueño) Indians reservations. The Los Coyotes Reservation is located between Anza Borrego State Park and the Cleveland National Forest in the headwaters of the Agua Caliente Creek, Cañada Verde Creek, and San Ysidro Creek. Situated in this remote region of southern California mountains, the nearly 25,000 acre reservation is the largest Native American reservation in San Diego County. The tribe has about 288 enrolled tribal members, of which only 74 live on the reservation (http://www.kumeyaay.info/); the tribal lands are sparsely populated with mostly single family dwellings.

The Santa Ysabel Reservation has approximately 700 members and is composed of three tracts of land that total 15,000 acres. These tracts are located east of Lake Henshaw, on the north and south sides of Highway 79 between the towns of Santa Ysabel and Warner Springs. The largest tract, which includes the tribal offices, most of the tribe's residents, and the tribe's new casino is situated on the slopes of the Volcan Mountains. The tribe's newly constructed casino opened in April, 2007 with the hope of providing much needed income for the poverty-stricken tribe (Sifuentes 2007).

Urbanization

Most of the Upper Subbasin remains rural in nature with low-density housing and small to large scale agricultural operations. The only incorporated community in the subbasin is the small, resort town of Warner Springs, located in the north-central part of the subbasin. Warner Springs got its namesake from the naturally occurring springs that are located within the vicinity of the resort. As described above, the subbasin is home to the small populations of the Los Coyotes Band of Mission Indians and the Santa Ysabel Band of Mission (Diegueño) Indians.

Recreational

Lake Henshaw remains a popular recreational spot for local and regional residents. The lake provides angling opportunities for a variety of warm water game fish, such as largemouth bass, bluegill, green sunfish, crappie, channel catfish, bullhead, and common carp. Hunting of waterfowl is very popular on the lake and its surrounding area. A campground and cabin rentals are located on the south side of the lake as well.

The Cleveland National Forest occupies a large portion of the northwestern corner of the subbasin. Most of this land is within the West Fork SLR River drainage. Hunting, hiking, fishing, picnicking, and other activities are available on these lands. The Pacific Crest Trail generally meanders from north to south through the Upper Subbasin, crossing near the town of Warner Springs and heading southeast around Lake Henshaw and continues southward out of the basin.

The Los Coyotes Indian Reservation has a campground and offers camping, hiking, horseback riding, and off-road activities on the reservation lands.

Fish Habitat Relationship

Fishery Resources

Currently, there is a self-sustaining, native rainbow trout population in the West Fork SLR River, which indicates suitable trout/steelhead habitat is present in the subbasin. While anecdotal and documented accounts of steelhead in the SLR River indicate a productive fishery in the lower to middle mainstem below the Middle Subbasin and in tributaries such as Pauma Creek, historical documentation of steelhead in the Upper Subbasin is somewhat limited. Nonetheless, the first written evidence of native trout in San Diego County comes from a note in an article by Dr. J.G. Cooper from a scientific collection expedition he conducted in 1862 in the Cuyamaca Mountains. He reported that: "trout and stickleback are found no nearer than Warner's Pass fifteen miles north of San Felipe at the head of the San Luis Rey river" (Cooper 1874). This indicates the mainstem and most likely the West Fork SLR River, at minimum, would be included in observed trout presence in the Upper Subbasin prior to any introduction of fish from outside the basin. Supporting evidence of a historical trout population in the Upper Subbasin includes a 1979 chromosome analysis and electrophoretic analysis of proteins from trout taken from the West Fork SLR. In this analysis, the U.C. Davis geneticist, concluded, "it seems likely that the West Fork population is composed predominately of fish native to the region" (Thorgaard 1979). Considering the SLR River had prior year-round connectivity (except low water years) to the Pacific Ocean and stream conditions would have been dramatically different prior to dam construction, it is certainly possible that ocean-run *O. mykiss* (steelhead) could have utilized the streams in the Upper Subbasin during normal to above average rainfall years.

Hatchery raised rainbow trout were once stocked in the West Fork SLR River and may have been stocked in other streams in the Upper Subbasin. The earliest records of stocking in the West Fork occurred in the

1893. These trout were the progeny of wild trout collected from the Pit River, raised in the Sisson hatchery, and then shipped by railroad car to many areas in Southern California for stocking purposes. These fish represented the original Shasta strain of rainbow trout (Bottroff and Deinstadt 1978, *draft*).

Arroyo chub, *Gila orcutti*, is the only other native fish that still inhabits the subbasin. Known populations are located in the West Fork SLR River and Agua Caliente Creek (Stephenson and Calcarone 1999). These are small populations in limited, perennial flowing reaches of these creeks.

Warm water game fish, were introduced into Southern California lakes in the 1940s and were most likely stocked in Lake Henshaw during this period or shortlythereafter. These non-native fish, described in the "Exotic Fish Species" section of the Basin Profile (pp.68-69), were intended to provide an additional recreational fishery to this inland reservoir. These fish continue to thrive in the lake and even in the SLR River downstream of the dam.

Figure 5. Rainbow trout caught in W.F. SLR River (photo taken in April, 2008).

Habitat Overview

Historic Conditions

Before the completion of the Henshaw Dam, the SLR River was a perennial flowing river. Based on historic SLR River stream flow data recorded during a ten-year period from 1912 to 1922, near the current dam location, the SLR River maintained minimum monthly flows above 1.4 cfs during the summer months and greater than 8 cfs during the winter and early spring (Jones and Stokes Associates, Inc. 1976). Mean monthly flows were much higher, especially during the precipitous portion of the year, December through mid-March were mean monthly flows ranged from 50 cfs up to 254 cfs (see Middle Subbasin, Figure 5, p. 12). These flows were aided by the numerous tributaries that flowed from the surrounding mountains into the SLR River in the present-day Lake Henshaw area.

Historic and more recent surveys in the Upper Subbasin have mostly occurred in the West Fork SLR River and in Agua Caliente Creek (Table 5). In the West Fork SLR River surveys, rainbow trout were identified through electro-fishing, rod and reel, and stream bank observations. Generally, the reports stated suitable spawning and rearing conditions were present for trout. However, the presence of exotic game fish (green sunfish and bullheads) was also noted. The two Agua Caliente Creek surveys performed in the early 1950s had somewhat conflicting accounts of habitat available for trout. One survey dismissed the stream as a potential trout stream, describing the stream as having poor substrate and most likely high summer water temperatures; the other report, while acknowledging the lack of ideal habitat, still concluded that the creek may be a viable option for developing a modest fishery. Conditions in Agua Caliente Creek may have been

representational of other streams in the Upper Subbasin, such as San Ysidro Creek and Mataqual Creek, which contained sections of perennial stream flow, potentially providing areas of rainbow trout habitat.

Table 5. Habitat observations made in the Upper Subbasin from 1862-2008.

Stream	Date Surveyed	Source	Habitat Comments	Barrier Comments
W.F. San Luis Rey River	06/09/1978	CDFG 1978	Surveyed between upper and lower falls, approximately 3 miles upstream its confluence w/ Lake Henshaw. Stream flow was high, with an above average cfs of 6-7. The water temperatures ranged from 52°F to 68°F. The surveyor reported a high canopy density and heavily oxygenated water with numerous falls. Substrate consists of numerous large boulders with sufficient spawning gravels. Stream supports "a large population of trout mostly in the 7-8" range with a fair number of 10-11" size group. The quantity of trout is surprising considering that the streams has undergone a three year drought period." Green sunfish were abundant the prior year, but only one was caught on this survey.	Rainbow trout are limited to the surveyed area. The upper falls is a barrier to upstream migration and the lower falls is a barrier to downstream out-migration and would prevent in-migration from downstream.
	7/21/1997	CDFG 1997	Surveyed area was 3 miles upstream of the "penal colony," which is just upstream the confluence with Lake Henshaw. Water temperature was 68°C at 13:30, pH was 8.3, and total alkalinity was 135 milligrams per liter. Riparian vegetation consisted of mature alder and canopy closure near 100%. Stream gradient was 4.8%. River flow was "limited to standing pools, sometimes connected by overland flow." Three pass sampling yielded 57 rainbow trout and one brown bullhead. Spot shocking confirmed the presence of young of the year (YOY) rainbow trout and green sunfish.	None described within sampled area.
Agua Caliente Creek	12/20/1951	CDFG 1951	Surveyed lower and middle sections of stream. Lower creek: Est. flow was 2-3 cfs, average width 8 ft, average depth 3-4 feet with a predominantly sandy bottom. Sparse canopy, poor habitat for fish, and this section of the creek likely dries up in spring. Upper creek (3 miles upstream): live alder and willow trees, steeper gradient, a few areas that had the "appearance of a permanent water area," but pools were only fair and stream substrate mostly sand. Overall, "no area observed could be considered good trout water and it is doubtful whether any section examined is worthy of any development primarily due to the unstable bottom and probably high summer water temperatures."	Approximately 3 1/2 miles upstream is an 8-10 foot waterfall that acts as an impassible barrier to fish life.
	10/31/1952	CDFG 1952	Survey began in Lost Meadows and went upstream. Stream flow was "10 miner's inches" (0.20cfs). Stream was well shaded with cedars and alders throughout its length. Streambed altered between sandy bottom, bedrock, and boulder dominated areas. The biologist concluded, "the valley and canyon, marginal as they may seem, could be developed and a modest fishery developed. It is a wilderness, never apt to attract many, but an effort should be made to improve it, for such primitive areas are not abundant."	No impassible barriers noted.
Upper Subbasin streams	1862	Dr. J.C. Cooper	Noted trout and stickleback in the stream(s) north of Warner Pass.	No impassible barriers noted.

Current Conditions

Due to the location of the Henshaw Dam blocking all fish passage into the Upper Subbasin, tributaries in the Upper Subbasin were not surveyed by the CDFG for the sake of this assessment. Located almost entirely within the Cleveland National Forest, the West Fork SLR River contains a self-sustaining, native residential rainbow trout population. In the West Fork SLR, rainbow trout are limited to a three-mile reach approximately three miles upstream its confluence with Lake Henshaw. This reach is defined by an upper and lower falls, maintaining perennial flows between these falls. A mature riparian with an extensive canopy, suitable spawning gravels, deep pools and other elements of complex habitat are found in this section. In the recent past (1997), bluegill and brown trout were present in this area. These exotic fish may predate on the early lifecycle stages of trout. Access is limited into the trout inhabited areas; hence, angler use is considered light.

In addition to the West Fork SLR River, other streams in the Upper Subbasin contain suitable trout habitat. The following brief descriptions of these tributaries are based almost entirely on information provided by members of the local San Diego Trout organization who have spent time surveying these creeks and/or know their historical fisheries background.

- Carrizo Creek: rainbow trout habitat located in upper mountainous areas, as lower creek goes dry;
- Mataqual Creek: always runs dry in its lower section as the flow goes subsurface, but abundant rainbow trout habitat is located upstream of the scout camp;
- San Ysidro Creek: small section of stream, in the valley contains perennial flows. Rainbow trout were first recorded near this section in 1863;
- Cañada Verde Creek: has rainbow trout habitat within the perennial section of Eagles Nest, as a spring is dammed with a small, but constant rainbow trout pond;
- Aqua Caliente Creek: contains small, perennial sections of creek utilized by arroyo chubs that overlaps potential rainbow trout habitat;
- Lost Valley Creek (an upper tributary of Agua Caliente Creek): also has a short, perennial section, which has rainbow trout habitat;
- Will Valley Creek (tributary to the W.F.): maintains a small, perennial section of creek providing rainbow trout habitat consisting of deep, rock-pools;
- Iron Springs Creek: also contains a perennial section of creek with rainbow trout habitat.

All of these tributaries are ephemeral streams that retain smaller sections with perennial flows and rainbow trout habitat. Aqua Caliente Creek also holds arroyo chub in its perennial areas.

While these tributaries are suitable for rainbow trout, significant basin challenges such as, downstream barriers and sufficient water flows would prevent steelhead from utilizing these streams anytime in the near future.

Habitat Conclusions

The SLR River and its tributaries in the Upper Subbasin are currently inaccessible to anadromous steelhead trout due to the presence of Henshaw Dam, Escondido Canal diversion dam, and multiple other fish passage barriers located downstream of the subbasin. Considering the Upper Subbasin is completely inaccessible to steelhead, streams were not surveyed in this subbasin. Relatively little historic and current information is available on many of the streams in the Upper Subbasin.

The occurrence of a self-sustaining, native rainbow trout population in the West Fork SLR River indicates suitable trout/steelhead habitat is present in the subbasin. Other streams such as Mataqual Creek, San Ysidro Creek, and Aqua Caliente Creek also have the potential to support small trout populations in perennial sections of their respective creeks. All of the streams in the Upper Subbasin, including the West Fork SLR River, are generally limited by low flow or complete absence of surface flows. High water temperatures and low dissolved oxygen levels could be a limiting factor in some of these streams as well. Barriers in the form of natural waterfalls limit fish passage on the West Fork SLR River to a roughly three mile stretch of creek, approximately three miles upstream of its confluence with Lake Henshaw. There is relatively little information available as to whether natural or man-made barriers exist on the other streams that may impede the movement of fish.

Warm water game fish are present in Lake Henshaw and have been found in the West Fork SLR River. Green sunfish and largemouth bass were observed in CDFG surveys in 1966 and 1997, and most recently bullhead were observed in an upper section of the West Fork SLR River. These warm water game fish will predate on all early life cycle stages of trout; however, removal of non-native species from a stream is very difficult and these fish may provide a threat to the trout for foreseeable future.

Restoration Projects

Restoration projects within the subbasin have been limited to those performed by local landowners, the Cleveland National Forest Service, and the Los Coyotes Indian Tribe. Even though trout exist in the subbasin, there is little evidence of any habitat improvement projects within the subbasin. The CalFish website did not list any agency or organization funded stream restoration projects in the subbasin (CalFish is a multi-agency program for collecting, standardizing, maintaining, and providing access to quality fisheries data and information for California.).

Projects that have occurred, or are currently underway, which have improved stream habitat conditions or contributed to the monitoring of stream habitat conditions include water quality control through monitoring and altering grazing practices around Lake Henshaw and streams to minimize animal waste transport into waterbodies.

Information on other watershed stream restoration projects can be found on CalFish (www.calfish.org) or on the Natural Resources Project Inventory online database (www.ice.ucdavis.edu/nrpi/).

Stream Habitat Improvement Recommendations

Stream habitat improvement recommendations are generally developed based on results from stream surveys conducted along potential salmonid bearing stream reaches. The Upper Subbasin streams are, however, inaccessible to steelhead and would require numerous fish passage/instream habitat improvement projects downstream to provide access into the Upper Subbasin. The mission of the CDFG's Coastal Watershed Assessment Program's is primarily to assess and develop recommendations for stream habitat that is available or could potentially be available for anadromous fish; therefore, because of the numerous obstacles for successful fish migration into the subbasin, CDFG chose not to survey the streams in the Upper Subbasin. Thus, stream habitat improvement recommendations are limited to general guidelines for improving riparian areas, water quality and quantity, and instream habitat for native trout populations in the subbasin. These are discussed in the Issues and Responses to Assessment Questions section below.

Refugia Areas

The interdisciplinary team identified and characterized refugia habitat in the Upper Subbasin by using professional judgment and criteria developed for southern coastal watersheds. The criteria included measures of watershed and stream ecosystem processes, the presence and status of fishery resources, stream flows, agriculture and other land uses, land ownership, potential risk from sediment delivery, water quality, and other factors that may affect refugia productivity.

The most complete data available in the Upper Subbasin were for the West Fork SLR River, which was last surveyed by CDFG during the summer of 1997. Trout habitat conditions in the Upper Subbasin on surveyed streams are generally rated as medium potential/low quality refugia.

A literature review did not contain any current references to trout in any of the other tributaries with the subbasin. While trout were historically noted in at least one other stream, San Ysidro Creek, further field studies are needed to determine the habitat suitability and limiting factors for trout production in these streams if fish passage/instream habitat improvement projects were to occur. The CDFG Wild Trout Program has plans to survey portions of the West Fork SLR River in 2008 to evaluate current habitat, general status of the trout population, and presence/absence of exotic game fish. The following refugia area rating table summarizes subbasin salmonid refugia conditions.

Table 6. SLR River and tributary salmonid refugia ratings in the Upper Subbasin.

Stream	Refugia Categories				Other Categories		
	High Quality	High Potential	Medium Potential	Low Quality/Low Potential	Passage Barrier Limited	Critical Contributing Area	Data Limited
SLR River							x Needs survey
W.F. SLR River			X		X		
Mataqual Creek							x Needs survey
San Ysidro Creek							x Needs survey
Cañada Verde Creek							x Needs survey
Aqua Caliente Creek							x Needs survey
Lost Valley Creek							x Needs survey

Key Subbasin Issues

- Southern California Coast Steelhead are currently blocked from accessing potentially suitable habitat in the Upper Subbasin due to the presence of Henshaw Dam, Escondido diversion dam and multiple other fish passage barriers located downstream of the subbasin;
- The West Fork SLR River is currently the only stream in the subbasin to maintain resident, native trout populations;

- Warm water game fish, present in the Lake Henshaw, West Fork SLR River, and potentially other streams in the subbasin pose a threat to trout successfully completing their early lifecycle stages;
- Without sufficient precipitation to sustain surface flows, many streams in the Upper Subbasin contain only small sections of perennial flows.

Responses to Assessment Questions

What are the history and trends of the sizes, distribution, and relative health and diversity of salmonid populations in the Subbasin?

Findings and Conclusions

- Prior to any introduction of hatchery raised fish, trout were observed in the Upper Subbasin streams north of Warner's Pass (Cooper 1874). At minimum, this includes the mainstem and the West Fork SLR River;
- A native, self-sustaining rainbow trout population is present in the West Fork SLR River;
- Due to downstream barriers, ocean-run steelhead do not have access into the subbasin;
- In order to accommodate a strong demand for a recreational fishery, exotic game fish were most likely stocked in Lake Henshaw, beginning in the late 1940s, and are abundant today in the lake and have been observed in the West Fork SLR River.

What are the current salmonid habitat conditions in the Upper Subbasin? How do these conditions compare to desired conditions?

Findings and Conclusions:

Flow and Water Quality:

- Stream flows are seasonal in all streams in the Upper Subbasin with some streams maintaining areas with year round water. Low water flow most likely influences water quality and instream water temperatures;
- During these low-flow conditions, water quality and instream water temperatures may be unfavorable to trout;
- Periods of grazing cattle beyond the Warner Ranch's carrying capacity and severe drought have degraded water quality and riparian plant communities in streams and in Lake Henshaw (water quality);
- The numerous wells located on the Warner Ranch may reduce the amount of water available for riparian species and reduce overall surface flows in the SLR River or its tributaries;
- In general, there is a lack of water quality data on the streams in the Upper Subbasin.

Erosion/Sediment:

- There is a lack of data concerning erosion/sediment in the streams of the Upper Subbasin.

Riparian Condition/Water Temperature:

- Generally, streamside canopy appeared to be lacking in many of the subbasin's streams lower reaches near their terminus into Lake Henshaw. These streams' canopy cover may increase further upstream;
- According to a 1978 West Fork SLR River survey report, the three mile section that maintains a trout population contained a mature riparian with nearly 100% canopy closure. More recent surveys on the West Fork have noted the existence a suitable riparian canopy;
- Water temperature data is lacking in the streams in the subbasin. Without an extensive canopy and coldwater seeps, it seems likely that instream water temperatures during the summer and early fall extreme period would be unfavorable for trout.

Instream Habitat:

- None of the streams in the Upper Subbasin were surveyed as a part of the watershed assessment; therefore, the condition of instream habitat in the subbasin's streams is relatively unknown;
- Previous surveys on the West Fork SLR River have noted suitable habitat conditions for trout such as, suitable spawning gravels, presence of moderate to deep pools, and mature canopy cover;
- Warm water game fish are present in the West Fork SLR River and could inhabit other streams in the subbasin. These fish would predate on the various lifecycle stages of trout.

Gravel/Substrate:

- Based on the self-sustaining, resident trout population in the West Fork SLR River, suitable salmonid spawning areas are available in this stream. Other streams with similar geology may possess spawning gravels as well.

Refugia Areas:

- Salmonid habitat conditions in the Upper Subbasin are generally considered unknown as far as potential refugia due to the lack of recent surveys. The West Fork SLR River was considered medium potential because of its current trout population and its watershed boundaries located almost entirely within the Cleveland National Forest;
- The subbasin is currently inaccessible to steelhead. Numerous downstream fish passage barriers would need to be modified in order to allow trout to have access to the area. The limited sections of permanent stream flow would be a limiting factor for potential refugia areas for trout.

Barriers:

- In the West Fork SLR, rainbow trout are limited to a three mile reach at approximately three miles upstream of the confluence with Lake Henshaw, where they are confined by an upper and lower falls;
- Fish passage barriers may be present on some of the streams that drain into Lake Henshaw. Stream surveys are needed to determine the presence/absence of any potential barriers.

What are the impacts of geologic, vegetative, fluvial, and other natural processes on watershed and stream conditions?

Findings and Conclusions:

- Weathering of the granitic rocks has created younger unconsolidated sediments that are very susceptible to enhanced erosion and mass movement such as landslides and debris-flows;
- The Upper Subbasin is in a potentially seismically active area as the basin is bordered by the San Andreas Fault Zone to the north and the Elsinore Fault Zone to the south. While the San Jacinto Fault Zone cuts through the middle of the subbasin;
- Large seismic events, especially when coupled with large storm events, can trigger large landslides and mudflows increasing sediment delivery to the streams and altering their hydrologic condition;
- If situated near or above artesian wells, these faults may also cause the natural upward migration of water, creating seeps, springs, and potentially surface flows. For example, water moving up the Agua Caliente Fault forms Warner Springs, demonstrating that the fault affects subsurface flow at this location.
- Due to sediment accumulations and recent drought conditions Henshaw Dam functions well below its current potential capacity. It the summer of 2008, the dam's water storage was less than 20% of its potential capacity;
- The 2007 Poomacha Fire did not burn within the Upper Subbasin, but several wildfires have occurred within the subbasin since 2002 and future wildfires are likely to occur. Post-fire erosion potential has been estimated as moderate to low for most of this subbasin (USGS).

How has land use affected these natural processes?

Findings and Conclusions:

- Cattle's grazing on the Warner Ranch has previously degraded water quality in subbasin streams and in Lake Henshaw; however, recent implementation of seasonally appropriate grazing rotation on Warner Ranch has minimized the potential for water quality contamination:
- Prior over-grazing has negatively affected riparian communities on many inlet streams to Lake Henshaw;
- Water extraction by numerous wells in the subbasin may reduce water available to riparian species and overall surface flows in streams;
- Various land uses have caused the spread of non-native plant species, particularly non-native grass species, throughout the subbasin altering the landscape and vegetation communities.

Based upon these conditions, trends, and relationships, are there elements that could be considered to be limiting factors for steelhead/trout production?

Findings and Conclusions:

Based on available information for this subbasin, it appears that salmonid populations are limited by:

- Steelhead trout currently do not have access into the subbasin due to Henshaw Dam, the Escondido Canal diversion dam, and numerous downstream fish passage barriers;
- Available instream habitat is limited to isolated sections of streams containing perennial flows;
- Water quality and water temperatures may be unfavorable for trout in many streams in the subbasin;
- Reduced riparian habitat on many subbasin streams' lower reaches;
- Presence of predatory warm water gamefish.

What watershed and habitat improvement activities would most likely lead toward more desirable conditions in a timely, cost effective manner?

Barriers to Fish Passage:

- Information on potential fish passage barriers is mostly limited to the West Fork SLR River. CDFG is not aware of barriers on the other streams in the subbasin, but this is mostly due to the lack of surveys performed on these creeks. General surveys of these streams would be necessary to identify and determine if efforts are needed to alleviate fish passage impediments at culverts or other public or private road crossings.

Flow and Water Quality:

- Insure that water diversions used for domestic or irrigation purposes bypass sufficient flows to maintain all needs of fishery resources;
- Recommendations to improve water quality and riparian areas on the Warner Ranch are derived from Atwill and Tate (2003), whose three-year study outlined management options to reduce the risk to source water and establish sustainable forage production to grazing pressure ratios:
  - Minimize grazing of dairy heifers in pastures with direct access to Lake Henshaw to reduce direct fecal deposition to the lake;
  - Minimize contact between calf manure and inlet streams from March through July, the period of high calf infection rates;
  - Minimize contact between dairy heifer manure and inlet stream channels from October through April (rainfall-runoff season) and during months when surface flows are present.

Erosion and Sediment Reduction:

- Continue to identify and reduce sources of sediment delivery to stream channels from road systems;

- Re-vegetate exposed stream banks and/or install structures to increase bank stability.

Riparian and Instream Habitat:

- Perennial wetlands and riparian areas should maintain livestock exclusionary fencing so that prescribed grazing management can be applied to these sensitive areas. Create offsite watering areas;
- Consider planting barren nearstream areas with willow, cottonwood, or sycamore trees to increase streamside shade canopy and allow for woody recruitment.

Education, Research, and Monitoring:

- Continue, expand, or develop education programs concerning water conservation, water quality, and the importance of watershed/riverine ecosystems;
- Conduct habitat surveys to determine habitat suitability and the presence/absence of fish species on: Carrizo Creek, Mataqual Creek, San Ysidro Creek, Cañada Verde Creek, and Aqua Caliente Creek;
- Perform habitat survey and trout population estimate on the West Fork SLR River;
- Research the possibilities of removing exotic, warm water game fish from the West Fork SLR River;
- Conduct water quality and temperature monitoring on the West Fork SLR River over several years to characterize instream conditions and potentially provide reference values for basin and the regional wild trout fishery.

Subbasin Conclusions

While the Upper Subbasin still retains large areas of native habitats, various land uses has altered the overall function of the upper watershed. Similar to the Middle Subbasin, steelhead once utilized the mainstem and its tributaries within the subbasin; however, it is currently not accessible to steelhead trout. Numerous fish passage barriers downstream prevent steelhead from accessing the Middle and Upper Subbasins and would require mitigation in order for steelhead to access these subbasins.

The West Fork SLR River is inhabited by native rainbow trout and arroyo chub; chub are also found in Aqua Caliente Creek. While instream habitat conditions are suitable for trout in these streams, there is little information available concerning the overall amount of suitable habitat in the streams of the subbasin. Further surveys are needed to determine general habitat suitability and the presence/absence of potential fish passage barriers. Much of the land surrounding Lake Henshaw is utilized for livestock grazing and there appears to be very little habitat associated with this area as riparian areas along the inlet streams have been severely reduced or in many cases, completely eliminated. Generally, these streams retain perennial surface flows only in smaller reaches that are limited to the mid to upper portions of their drainages. Numerous wells that are used to help supplement overall water supplies in Lake Henshaw may reduce water availability in lower stream reaches.

Warm water game fish provide an important recreational opportunity in Lake Henshaw. A few of these game fish may be present in some of the streams in the subbasin, such as West Fork SLR River. These fish would present a predatory problem for the early to mid-lifecycle stages of juvenile trout.

While some suitable habitat is available for steelhead/trout in the Upper Subbasin within the West Fork SLR and potentially other streams (e.g., Agua Caliente Creek, Mataqual Creek and San Ysidro Creek), utilizing restoration opportunities in the lower watershed and the Northern Subbasin tributaries would be more beneficial to re-establishing steelhead populations in the watershed. Overall length of migration, numerous fish passage barriers, varying, unreliable flow rates, and Lake Henshaw containing large populations of exotic predatory fish are all detrimental to the likelihood/feasibility of sustaining steelhead runs in the Upper Subbasin. Nonetheless, efforts should be made to preserve water quantities and water quality in streams and waterbodies as well as restoring/improving riparian areas in the subbasin.