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Coastal Subbasin

The Coastal Subbasin includes the watershed area along the SLR River from its mouth at the Pacific Ocean to RM 19 at Rice Canyon, approximately one mile east of Interstate 15 (Figure 2). Stream elevations range from sea level at the mouth of the SLR River to approximately 1,600 feet in the headwaters of the tributaries. While it is the third largest subbasin of the SLR Basin at 102 square miles, 18% of the total watershed, it is easily the most populated. This assessment area encompasses the dominant population centers in the basin area with the cities of Oceanside, Vista, Bonsall, and portions of Fallbrook residing within its boundaries. The lower and southern portions of the subbasin are mostly urban/residential, commercial, and light industrial areas. The northern portions of the basin are held in larger private parcels managed for agricultural crop production. California Highway 76 runs parallel to the river throughout the subbasin.

As a result of population growth in the subbasin the river, its stream channel and the surrounding riparian have been the most altered and managed area in the basin. The channelization of the river, manipulation of riparian vegetation, draining and downsizing the estuary, and utilizing numerous wells throughout the subbasin have cumulatively changed the form, function, and habitat of the river and its estuary.

An adult steelhead was observed in the SLR River on two separate occasions during the CDFG 2007 habitat typing surveys. This fish was observed on May 2nd and May 8th, 2007, at RM 7, approximately ½ mile downstream of College Avenue in Oceanside. Due to the lack of coordinated survey efforts and the fact that CDFG has not surveyed the lower SLR River since the 1940s, there is minimal information available on the presence of steelhead in the Coastal Subbasin. Only a few sightings have been reported within the subbasin since the mid-1940s.

Hydrology

The Coastal Subbasin is made up of one complete CalWater Unit, Mission, and the majority of the Bonsall CalWater Unit (Figure 2). There are four named tributaries (Table 1) and 133 permanent and intermittent stream miles in this subbasin. A majority of these stream miles are intermittent. The mainstem SLR River is a second order stream, using the Strahler (1964) classification. During typical rainfall years, the mainstem in the Coastal Subbasin will retain surface flows until the late summer with portions of the river flowing year round (Basin Profile, Figure 6). The tributaries are intermittent or first order streams. Flows in tributaries are affected by agricultural, landscaping, and urban runoff. Drainage areas in smaller, unnamed tributaries range from less than three square miles to the 102.5 square mile SLR River within the Coastal Subbasin.

Figure 1. The SLR River in Oceanside, Interstate 5 is in the background.

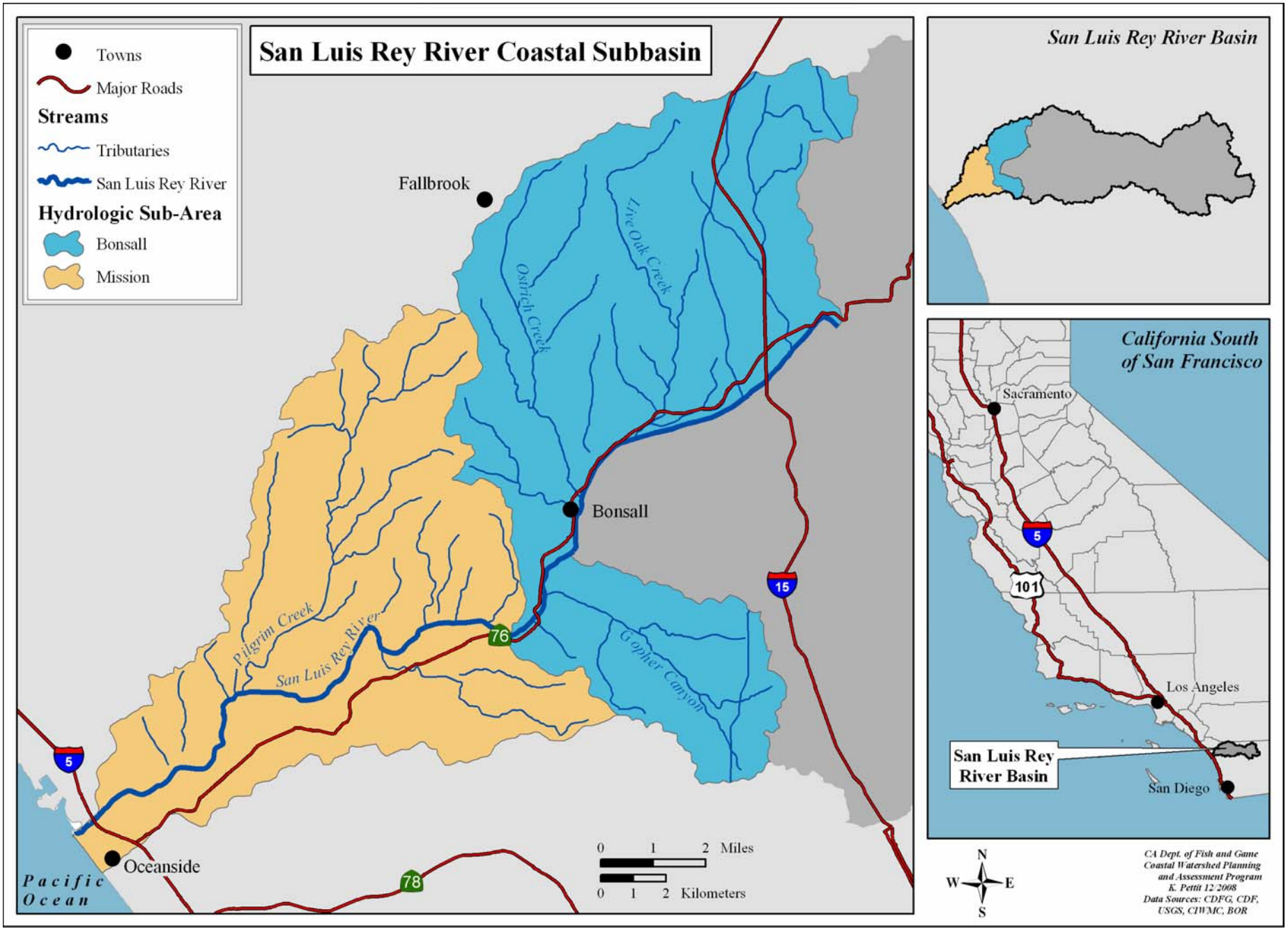

Figure 2. Coastal Subbasin locator map and CalWater Units.

Table 1. Major streams in the Coastal Subbasin.

Stream	Tributary to	River Mile	Drainage Area (square miles)	Stream Order	Permanent (miles, in Subbasin)	Intermittent (miles)
San Luis Rey River	Pacific Ocean	--	102.5	2	19.0	2.1
Pilgrim Creek	SLR River	4.9	19.5	1	7.1	2.5
Gopher Canyon	SLR River	12.5	11.5	n/a	0.0	5.5
Ostrich Creek	SLR River	14.8	11.6	1	3.2	4.1
Live Oak Creek	SLR River	16.3	12.5	n/a	0.0	7.8

Geology

This basin is predominately underlain by plutonic rock types, "granitic rock" of the Peninsular Range Batholith that intruded into older marine sediments between 90 and 140 million years ago (Figure 3). The plutonic rocks have subsequently been exposed by tectonic uplift and erosion, and only remnants of the older sediments remain atop the granitic rock in the upper portion of this basin. At the lower end of this subbasin sediments from the eroding upper portion of the basin have been deposited in a series of marine and river terraces as well as alluvial fans and valley fill material (Kennedy and Tan 2005).

Table 2. Geologic composition of the Coastal Subbasin.

Lithologic Unit	Percent of Basin
Mesozoic Granitic	63.47
Eocene Sedimentary	17.25
Quaternary Alluvium	10.3
Mesozoic Sedimentary	6.64
Miocene Sedimentary	1.19
Quaternary Terraces	.81
Tertiary Volcanic	.19
Mio-Pliocene Marine	.03

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

Compositional Overview

Rock Types

Mesozoic Granitic

Granitic rocks compose the majority of the Coastal Subbasin. They occupy approximately 63.5% of its surface area. They are predominantly Cretaceous (154.5 million through 65.5 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 decompose, become "soft," and much less resistant to erosion producing "decomposed granite." In more advanced forms, the minerals within the granite disaggregate and form "Arkosic Sand" which is made of individual mineral grains disaggregated from the granitic parent rock. These sands are predominantly comprised of quartz and feldspar. This material is highly susceptible to erosion, sliding, and fluvial transport.

Eocene Sedimentary

This rock type makes up about 17.2% of the subbasin. It contains sedimentary rocks ranging in composition from siltstone through conglomerate. The sediments that make up these rock types were deposited on land between 56 and 34 million years ago. The sediments of these rock types range from siltstone through conglomerate and from poorly consolidated to well indurated.

Quaternary Alluvium

Alluvium covers about 10.3% of the subbasin. It consists of unconsolidated sediments that range from clay to boulders and is generally deposited in low lying areas and in floodplains producing a relatively flat landscape. Alluvium is transported and deposited by the streams and makes up most of the bed and banks of the streams. Units of alluvium delineated by the geology map (Figure 3) include sediment currently being acted upon by the streams and bank and flood-plain deposits occasionally acted upon by the streams. 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 have subsurface flow.

Mesozoic Sedimentary

Mesozoic sedimentary rocks compose around 6.6% 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.

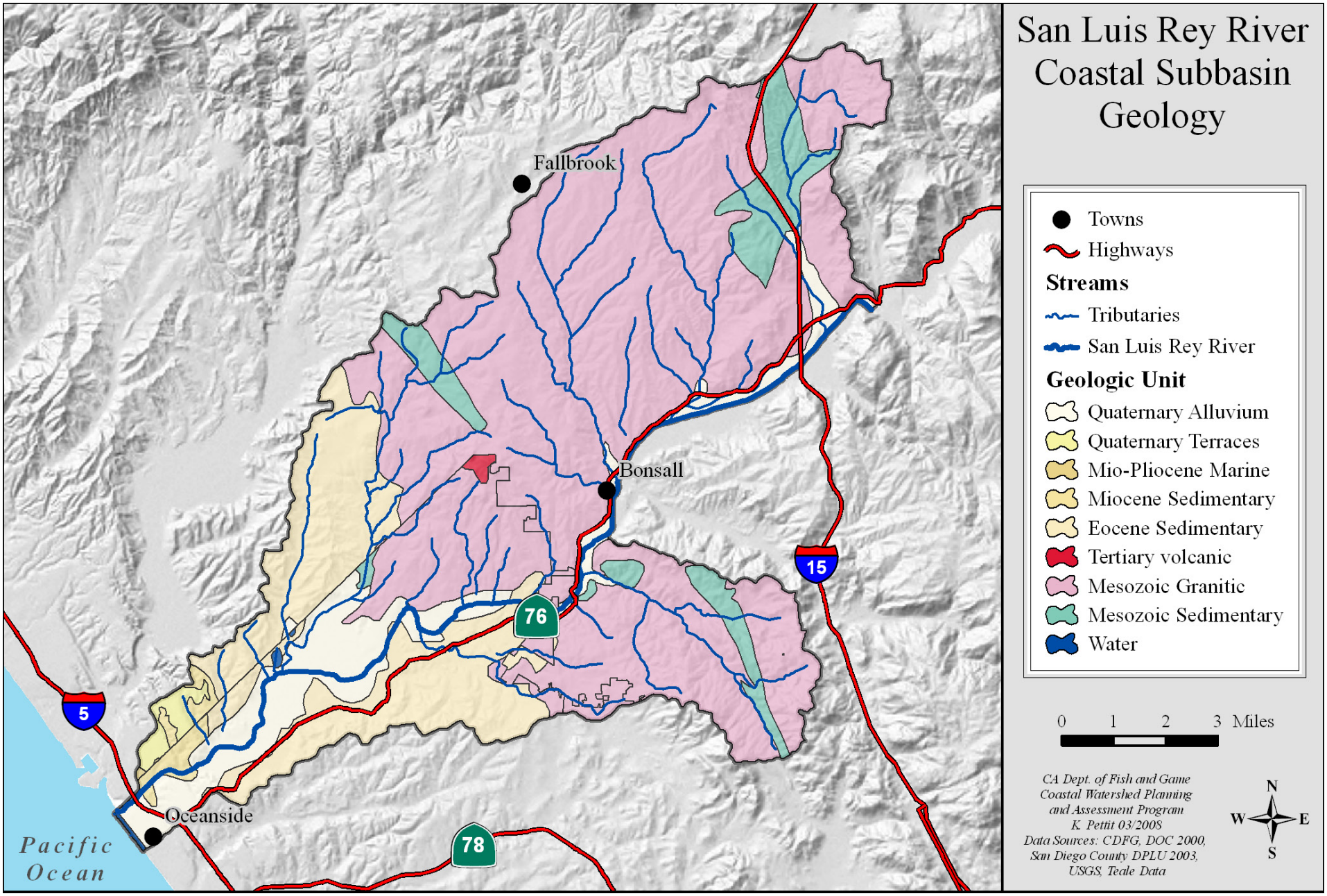

Figure 3. Geology of the Coastal Subbasin.

Miocene Sedimentary

This rock type makes up 1.2% of the subbasin. It consists of sedimentary rocks ranging in composition from siltstone through conglomerate. The sediments that make up these rock types were deposited on land between 23 and 5 million years ago. The sediments of these rock types range from siltstone through conglomerate and from poorly consolidated to well indurated.

Tertiary Volcanic

Tertiary volcanic rocks compose less than 1% of the subbasin. This unit consists of volcanic flows of dacitic composition that were deposited between roughly 65 through 2 million years ago.

Quaternary Terraces

Terrace deposits occupy less than 1% of the subbasin. They consist mainly of marine terraces with minor amounts of river terrace deposits. The marine terraces are made of near-shore and shoreline sediments and wave-cut platforms that have been uplifted above current sea level by tectonic forces associated with the transform plate boundary between the North American and Pacific Plates. The river terraces consist of unconsolidated flood-plain sediments that have been uplifted above the active stream channel. These terrace deposits are prone to dry ravel and slumping when perched steeply above the stream channel.

Mio-Pliocene Marine

This rock type makes up less than 1% of the subbasin. It is made out of sedimentary rocks ranging in composition from siltstone through conglomerate. The sediments that make up these rock types were deposited on land between roughly 23 and 2 million years ago. The sediments of these rock types range from siltstone through conglomerate and from poorly consolidated to well indurated.

Soils

The underlying bedrock is generally responsible for a soil's texture and erodability characteristics. The sediment contribution from soils found in the Coastal 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, and finally time.

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 is 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 Coastal Subbasin.

Soil Type	% of Upper Subbasin	Composition Ranges
Vista-Fallbrook-Cieneba (s1011)	49.32	granitic
Las Flores-Antioch (s1019)	16.9	sandstone
Tujunga-Salinas-Elder (s1001)	14.28	granitic/sandstone-shale
Rock outcrop-Las Posas (s1012)	7.02	granitic/igneous
Sesame-Rock outcrop-Cieneba (s1010)	4.03	granitic
Ramona-Placentia-Linne-Greenfield (s999)	3.74	mixed rock/shale-sandstone/granitic
San Miguel-Friant-Exchequer (s1013)	2.86	metavolcanic/schist-gneiss
Urban land-Marina-Chesterson (s1002)	1.35	marine terrace deposits
Rock outcrop-Lithic Torriorthents (s1021)	.49	granitic/mixed rock

% area of Basin represents a rough approximation based on GIS mapping.

Landslides

Like the other SLR River subbasins, the Coastal Subbasin is mantled with unstable soils. The floodplain in the Coastal Subbasin consists of alluvial material, while the hillsides are often composed of sandstones and other sedimentary materials. Both of these rock composition are susceptible to surface erosion, headwater erosion, gullying, stream bank raveling, and landsliding. This area has undergone tectonic uplift leaving poorly consolidated sediments in the form of marine terraces perched above the stream channels, as well as creating steep canyon walls further up the subbasin (Kennedy and Tan 2005). 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.

Earthquakes and Faults

Although no currently established Fault Zone cuts through the Coastal Subbasin, it is still considered tectonically and seismically active. This subbasin is nestled between the Lake Elsinore Fault Zone to the northeast and the Inglewood/Rose Canyon Fault Zone offshore to the southwest. Both of these faults are right-lateral strike-slip faults that are related to the transform plate boundary between the Pacific Plate and the North American Plate (S/an Andreas Fault System). The Lake Elsinore fault zone is capable of generating earthquakes in the range of M = 6.0 – 7.2 and has an average recurrence interval of 250 years. The Inglewood/Rose Canyon Fault Zone is capable of generating earthquakes in the range of M = 6.5 – 7.5 (SCEDC). Ground shaking generated by earthquakes can trigger rock falls and landslides that deliver large amounts of sediment to the streams. The 1994, Northridge Earthquake, whose epicenter was located 20 miles northwest of downtown Los Angeles (M = 6.7), triggered in excess of 11,000 landslides in a 6,200 square mile area (USGS) in similar terrain.

Fluvial Geomorphology

The Coastal Subbasin is considered a depositional reach because the mainstem has less than a 4% slope. Sediment erodes from the steeper hillsides and is brought by tributaries entering the mainstem in this subbasin as well as from the mainstem that transports the sediment from upper subbasins.

The most recent stream surveys of four reaches in the Coastal Subbasin found Rosgen channel types DA and F (Table 4). These reaches were on the mainstem of the SLR River. Type DA reaches have multiple channels that typically are narrow and deep with expansive, well vegetated floodplain and generally have associated wetlands. They have very gentle relief with highly variable sinuosities and stable stream banks. Type F stream reaches are wide, shallow, single thread channels. They are deeply entrenched, low gradient reaches and often have high rates of bank erosion. Type F reaches flow through low-relief valleys and gorges, are typically working to create new floodplains, and have frequent meanders (Rosgen 1994).

Nearly half of the 19 mainstem miles in the subbasin have been artificially confined with the channelization of the lower river. This has effectively converted this reach of the river from a distributary, meandering flow regime into a channelized flow regime to accommodate for agriculture and residential growth. Channelization creates a change in both the sediment budget and hydrologic flow regime since the river is disconnected from its floodplain. Typically, rivers are described by their diversity of meanders, pools, riffles and runs; but when a river or stream is channelized, the diversity of habitats and channel roughness is reduced. Roughness can be described as channel features that slow water velocity, create a diversity of habitat types, and form and maintain a channel that is appropriate for the amount of discharge, suspended sediment, and bedload. The reduction in roughness in the channelized portion of the SLR River explains the lack of pools and relative uniformity in habitat types (see current conditions, p. 18).

Table 4. Channel types in surveyed streams of the Coastal Subbasin

Stream	Reach	Length (feet)	Channel Type
SLR River	1	31,325	DA5
	2	17,952	F5
	3	19,702	F5

Vegetation

The predominant vegetation cover type as described by the USFS CALVEG data is urban/development, covering approximately 28.5% of the subbasin (Table 5). This is due to the large urban/residential areas occupied by the cities of Oceanside, Vista, Fallbrook, and Bonsall. With the exception of Valley Center in the Southern Subbasin, none of the other subbasins contain any significant urban/residential areas. Mixed sagebrush/chaparral is the second most abundant vegetation cover type at 21.5 %, followed closely by herbaceous with 20.5%.

While agriculture is listed as the fourth most prevalent vegetation cover type at 19%, this figure does not reflect the overall percentage of acres dedicated to the growing of crops for livestock. Within the Coastal Subbasin, pastures used for grazing for livestock may not be included in this vegetation designation 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; therefore, the agriculture vegetation cover type may compose similar or even a greater number of total acres than the urban/development type. Although, urban and residential areas continue to expand, decreasing the amount of farm land in the subbasin. The impact of agriculture and urban/residential areas in the subbasin are described further in the Land Use Section.

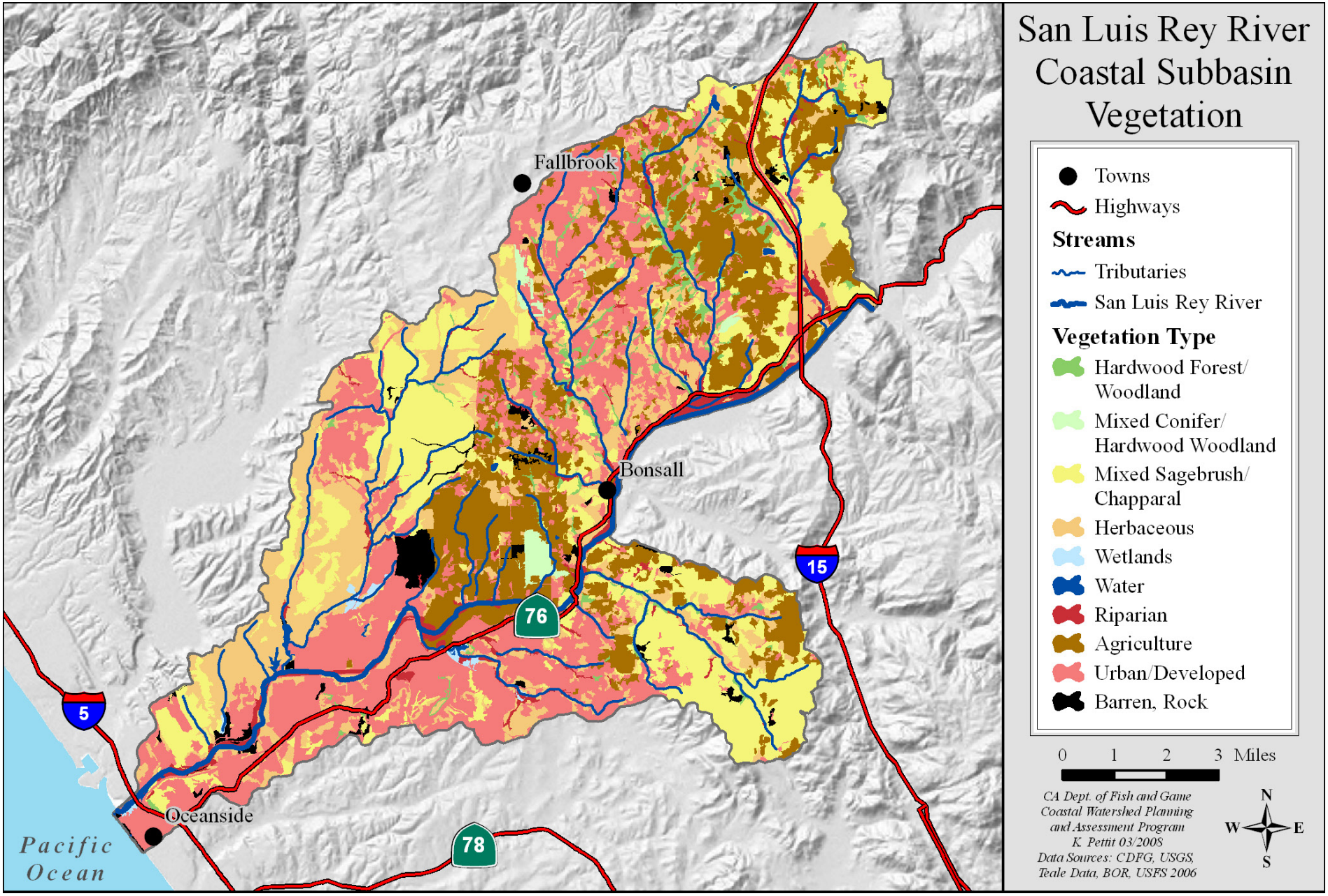

Figure 4. Vegetation of the Coastal Subbasin.

Table 5. Vegetation of the Coastal Subbasin. These statistics exclude the classification of water.

Vegetative Cover Type	Percent of Basin	Primary Vegetation Type	Percent of Cover Type
Urban/Development	28.5	Urban/Development	100
Chaparral/Scrub	21.5	Basin Sagebrush	0
		Buckwheat	0
		California Sagebrush	72.0
		Ceanothus Mixed Chaparral	0
		Chamise	0
		Lower Montane Mixed Chaparral	27.5
		Manzanita Chaparral	0
		Red Shanks Chaparral	0
		Upper Montane Mixed Chaparral	0
		Other	0.5
Herbaceous	20.5	Annual Grasses/Forb Alliance	90.7
		Non-Native/Ornamental Grass	7.6
		Perennial Grasses and Forbs	1.7
Agriculture	18.9	Agriculture	0
		Orchard Agriculture	77.0
		Pastures and Crop Agriculture	23.0
Riparian	4.3	Baccharis (Riparian)	2.3
		Fremont Cottonwood	0.2
		Riparian Mixed Hardwood	23.3
		Riparian Mixed Shrub	23.8
		Willow (Tree and Shrub)	49.8
Hardwood Forest/Woodland	3.0	Black Oak	0
		California Sycamore	2.8
		Canyon Live Oak	0
		Coast Live Oak	80.0
		Engelmann Oak	0
		Eucalyptus	11.7
		Interior Mixed Hardwood	0
		Non-native/Ornamental Hardwood	5.4
Barren/Rock	1.8	Barren	6.3
		Tilled Earth	22.7
		Urban related bare soil	71.0
Mixed Conifer/Woodland	0.77	Bigcone Douglas - Fir	0
		Coulter Pine	0
		Mixed Conifer – Fir	0
		Mixed Conifir - Pine	0
		White Fir	0
		Nurseries	100
Water	0.34	Water	100
Wetlands	.33	Tule – Cattails	100
		Wet Meadows	0

Data from CALVEG,USFS

Non-Native Plants

Probably because many non-native plants first become established in the coastal areas of California, their numbers tend to decline with increasing elevation and distance from the coast (Stephenson and Calcarone 1999). This is evident in the SLR River Basin as exotic plant species are most dominant in lower elevation areas within the western portion of the watershed (Figure 4). Currently, there are two plant species that represent the greatest threat to the Coastal Subbasin in terms of area occupied, potential to spread, impact to the quality and quantity of native habitat, and problems they pose to land managers: giant reed

(*Arundo donax*) and salt cedar (*Tamarisk spp*.). Among the many detrimental impacts, these invasive plants occupy habitat that normally has little vegetation, such as the SLR River's sandy channel bed in the Coastal Subbasin. Their presence changes the habitat in a manner that is potentially detrimental to the native fauna, such as the endangered Arroyo southwestern toad that utilizes open areas. See Invasive Species Management section in the Basin Profile (p. 33) for a more detail discussion.

The Mission Resource District, working with the SLR Weed Management Area, as of August 1, 2007, had treated approximately 292 of 507 acres of *Arundo* in the watershed, mainly in the mainstem and some tributaries (http://smslrwma.org/). Although, due to the Corps long-term Operation and Maintenance Plan in Oceanside along the concrete-lined channel, a much larger area of exotic and native plant species will be treated and added to these totals. In late February 2008, the Corps began removing the majority of native and non-native vegetation inhabiting the banks of the SLR River just upstream of the Oceanside Harbor. The vegetation removal, as planned, will continue eastward, depending on weather and stream flow conditions. This first phase of a multiple phase plan concluded on March 15th 2008, the commencement of the breeding season for federally endangered birds, such as the least Bell's vireo and the southwestern willow flycatcher. Vegetation removal resumed in the fall (end of the breeding season) of 2008 and continued to remove the majority of the vegetation, native and non-native, located between the leveed river banks.

Land and Resource Use

Historic Land Use

Prior to European settlement, the basin was inhabited by the Shoshonean Indians which comprised the Luiseño people. As described in the Basin Profile, the SLR River was a prominent natural feature of the Luiseño territory providing the residents with subsistent food sources that included ocean and freshwater fish and shellfish, a wide variety of plants and seeds, birds and small to large mammals available in the riparian habitat and from surrounding areas (Lettieri-McIntyre Associates 1995). The Spaniards arrived in the late 1760s and shortly afterwards established missions, including the Mission de San Luis Rey de Francia located just east of Oceanside. History and politics were to see the decline of the mission in the 1840s, but the area's advantages were common knowledge by this date as a greater number of homesteaders continued to populate the area.

With the completion of the Southern California Railway in the 1880s and the Highway connecting Los Angeles with San Diego in the 1920s the area continued to expand. World War II saw the transformation of Oceanside from a small town to a modern city with the establishment of Camp Pendleton, the nation's largest Marine Corps Base, on its border (http://www.ci.oceanside.ca.us/).

Agriculture became a prominent feature of much of the area outside the developing cities of Oceanside and to a lesser extent, Vista. Aside from Oceanside, the rest of the basin experienced rather moderate growth from World War II till the 1990s when the region, including San Diego County, experienced a housing boom that continued until the recent economic downturn.

Agriculture

Agriculture was the most significant historic land and resource use in the basin. Beginning with the grazing of cattle, sheep and horses around the San Luis Rey Mission, agriculture grew throughout the basin. As annual grasses became established, replacing perennial native grasses, livestock numbers declined dramatically. Before water was made widely available in the l950s (through imported Colorado River water), most agriculture was limited to dryland crops. Farming of grain and grain hay developed and expanded on homestead lands around Fallbrook, Bonsall, and Oceanside (SLR Watershed Council 2000). Extensive planting of olives in the 1880s around Fallbrook and Bonsall eventually gave way to the establishment of citrus orchards in the 1920s. Imported water supplies provided the needed resources for many intensive agricultural enterprises in the coastal basin and throughout the watershed such as truck crops, flowers, and nurseries.

Gravel Mining

Gravel mining operations have been an important industry in the basin. The SLR River has provided the San Diego region with a major source of sand, gravel, and aggregate. The river contains particularly valuable deposits of quality sand that requires little processing because the river's fluvial process have ground and sorted the material (Micheli 1994). This sand has been used by the construction industry for a variety of concrete and asphalt applications. Sand mining has long caused major disagreements in the watershed and was a dominant factor in the initiation of a general resource plan for this area.

During the past several decades multiple sand mining operations have been active on the river, almost exclusively in the Southern and Northern subbasins.

Beginning with the H.G. Felton Materials Company, which in 1969 was issued the first Major Use Permit for a sand mining operation on the SLR River, multiple sand mining operations have been active on the river, from just east of Bonsall to Pala. As development in San Diego County increased, including the housing construction boom during the 1980s, sand and gravel mining became the most economically important industry in the watershed (SLR Watershed Council 2000). At one time, there were thirteen operations. Of more recent significance was the termination of the Felton Mine site operated by Hansen Aggregates. This was an in-stream mine that encompassed 225 acres and mined an average of 600,000 tons of sand per year during the late 1990s and early 2000s. This sand accounted for about 20% of all the concrete use in San Diego County (Chester 2000). Their Major Use Permit expired in 2005 and the site was dedicated as open space.

The current condition of the SLR River, particularly in the Coastal Subbasin, demonstrates that the previous traditional approaches to regulating in-stream mining have failed to adequately protect river resources over the long term. The extraction of sand and aggregates has contributed to a range of significant environmental impacts. The cumulative effect of the mining operations has been to lower the overall bed elevation of the river (Micheli 1994). The process of channel degradation was accelerated by upstream and downstream erosion due to excavation of deep pits, some 80 feet in depth, in the active river channel. The mining contributed to a shift in channel morphology from a shallow and braided channel, sinuating back and forth across the broader portions of the floodplain as it deposits sand and creates scrub-shrub habitat, to a channel that is now in some places deeply incised with steep erodible walls (Micheli 1994). This channel degradation and streambed erosion has compromised bridge supports and exposed buried water and natural gas lines. Biologically, the degraded streambed causes the following impacts: lowering of groundwater levels, loss of riparian vegetation due to erosion and die-offs from the lack of water, a minimal low-flow channel that implicates a loss of deep holding pools for adult and juvenile steelhead migration, loss of cover and complex habitat for juvenile steelhead.

In addition to effecting riverine ecosystems, sand mining also contributes to a reduced supply of sand transported through the mouth to replenish the beaches of Oceanside (Kondolf 1993). Combining the effects of the Henshaw Dam impounding sediment, the mining produced an even larger sediment deficit. According to Kondolf (1997), the five gravel mines that were in operation in the 1990s, within 8km of the Highway 395 Bridge, they extracted a permitted volume of approximately 300,000 m^3/yr. This was about 50 times greater than the estimated post-dam bedload sediment yield, further exacerbating the coastal sediment deficit.

The SLR River is one of several key locations in the county that can provide the sand and gravel resource. However, sand mining has been shown to have a costly effect through infrastructure degradation, loss of environmental resources in the watershed, and a large reduction in beach sand. If future sand mining operations were to occur in the basin some of these impacts could be minimized by stricter monitoring and compliance of permit requirements by governmental enforcement agencies and the mining operations themselves.

Current Land Use

Agriculture

Agriculture is the fourth largest industry in San Diego County (SLR Watershed Council 2000). The SLR watershed is a major agricultural area in San Diego County. The warm coastal climate of the Coastal Subbasin makes it ideal for the growing of tomatoes, avocados, citrus fruit, herbs, nursery stock, and flowers. Numerous small and large-scale farms populate the subbasin, including land adjacent to the river.

The large agricultural production in the basin may contribute to reduced water quantity and quality. Although many agricultural producers use water from imported sources (the Colorado River and State Water Project) (SLR Watershed Council 2000), water pumps were observed during CDFG 2007 field surveys in or near the flood plain within the Coastal Subbasin. These pumps may divert groundwater, which normally contributes to SLR River flows, to assist crop production.

The use of pesticides in San Diego County is closely scrutinized by the local Agricultural Commissioner's office, and growers must be concerned with issues involving use of pesticides. Growers are increasingly required to reduce and capture runoff water, re-use tailwater and utilize other best management practice to minimize the effects of agriculture on water quality and water bodies in the areas where they farm. See Agriculture section in the Basin Profile (p.42) for further details of the impacts of agriculture.

Urbanization

The major population centers in the watershed are located in the Coastal Subbasin, where over two-thirds

of the watershed population resides. The City of Oceanside, Vista (near the coast), and the community of Fallbrook, located in the north central portion of the Coastal Subbasin contain a majority of the population in this subbasin. By the year 2020, the City of Oceanside is expected to add 41,000 people, Vista 13,000 people, Bonsall 8,000 people, and Fallbrook 10,500 people. These substantial increases in populations will put additional stress on the natural resources and further encroach on native habitats as additional developments will occur to provide the necessary services and infrastructure to accommodate the enlarged population in the subbasin.

The increase in urbanization and impervious surfaces, as well as the removal of riparian vegetation has significantly affected the watershed's ability to respond to precipitation, which can increase urban flooding. Consequently, urbanization alters the rates of infiltration, evaporation (the conversion of water from a liquid into a gas), and transpiration (transfer of water from plants to the atmosphere) that would otherwise occur in a natural setting. The replenishing of groundwater aquifers is also effected and does not occur, or occurs at a slower rate (SANDAG 2004). Together, these various effects determine the amount of water in the system and can result in extremely negative consequences for river watersheds, aquifers, and the environment as a whole.

Streams in urban areas often belong to the category of most degraded. Urban planning must consider where water flows and the impacts of development on the water resources, including drinking water. In a natural setting, runoff water flows through vegetated land areas and other pervious services, which filter water before entering reservoirs. Interruption of this process can affect the quality and quantity of drinking water. Additionally, too much infiltration of urban runoff can cause pollutant build up in underground aquifers, which can negatively impact groundwater supplies (SANDAG 2004). Large sums of money could be spent restoring urban streams. However, the proper management of storm water is a prerequisite for successful restoration of urban streams. Urban stream restoration should not be undertaken unless integrated with broader catchment management strategies, and when design options are so constrained that significantly improving ecological conditions in streams is unrealistic (Bernhardt & Palmer 2007). In the case of the SLR River, the SLR River Watershed Urban Runoff Management Program (SLR River Watershed URMP), contains collaborative plans and efforts to reduce the impacts of urban activities on receiving waters within the SLR River Watershed to the maximum extent practical (PBSJ 2003). Utilizing this plan in conjunction with urban restoration projects could provide the most effective means of restoring and maintaining stream habitat in the lower SLR River.

Currently, there are numerous on-going or proposed projects associated with urbanization and land-use developments that will have potentially significant impacts on the subbasin's natural resources and habitats.

Housing Projects: While there are numerous housing development plans, a proposed 1,244-home development, north of California Highway 76 just east of Interstate 15, is the largest potential development near the river. A housing project of this size in addition to other developments would require additional water supplies that may be taken from wells near the river, potentially lowering the groundwater table. Moreover, increased housing would most likely require a new wastewater facility or an expansion of the current facilities, which would require more water and potentially affect the water quality of the river or tributaries.

Highway Widening: Caltrans has a project to widen, improve, and realign Highway 76 as part of the high-priority, Early Action Program of the TransNet transportation improvements funding program. Highway 76 from west of East Vista Way to I-15 is scheduled for widening to a four-lane roadway by 2012. As proposed, Caltrans' planning and design of Highway 76 improvements would affect riparian areas and potential water quality and sediment delivery along the SLR River.

Gregory Canyon Landfill: The proposed Gregory Canyon Landfill is located primarily in the Southern Subbasin, three miles east of Interstate 15 and south of Highway 76 (a portion of the project site extends into the Rice Canyon and Gomez Creeks watersheds, north of the highway). This 1,770-acre landfill would most likely have significant impacts not only in Southern and Northern subbasins but also downstream in the Coastal Subbasin. Proponents of the landfill, primarily the project proponent and the County, have argued for over a decade that San Diego County could run out of space in the near future to accommodate its solid waste. This proposed landfill has caused a considerable amount of community concern, from a broad range of interest groups. Organizations that have opposed the landfill include but are not limited to: The Pala Band of Mission Indians, the Federal Bureau of Indian Affairs, the City of Carlsbad, The City of Oceanside, the San Diego Water Authority Board of Directors, San Diego Baykeeper, Riverwatch, the Natural Resources Defense Council, and the SLR

Watershed Council. The SLR Watershed Council has voiced its concerns on the landfills impacts to air quality, water quality, transportation, wildlife, cultural and historical resources (SLR Watershed Council 2000). The Council was particularly concerned with the location of the landfill with respect to the aquifer of the San Luis Rey River (SLR Watershed Council 2000). The potential exists for the landfill to leak, causing contamination of one of San Diego County's few reliable sources of groundwater (see Local Water Supply Development below).

A lawsuit was filed in January of 2009 against the County of San Diego and Gregory Canyon Ltd. in which the plaintiffs (Riverwatch and the Pala Band of Mission Indians) asserted that the Solid Waste Facility Permit for the landfill has been rescinded and therefore cannot be modified. The case was consolidated with a CEQA case involving the same facility and litigants. A hearing on a planned demurrer by Gregory Canyon, Ltd. and the County of San Diego Department of Environmental Health has been scheduled for June 26, 2009 (http://www.sdcounty.ca.gov/deh/waste/chdgregory.html.).

Currently, approval of the proposed landfill depends largely on whether the court decides if water supply for the landfill has been properly addressed. In order to operate the landfill, nearly 200 acre-feet of water per year is needed to help control dust and odor (Pfingsten 2008). Any agreement would require the water supplier to continuous deliver large amounts of water over a 60-year period, regardless of drought conditions or increased demand from other users. Most recently (May, 2009), the Olivenhain Municipal Water District board voted to not supply recycled water to Gregory Canyon. The operator will therefore have to identify another source or sources of water in order to obtain a modified solid waste facility permit, and the County will have to complete any necessary CEQA analysis concerning those sources (http://www.sdcounty.ca.gov/deh/waste/chdgregory.html.).

Local Water Supply Development: With the intent on diversifying their water supply, the San Diego County Water Authority and the City of Oceanside agreed to drill two new wells to help supply the City of Oceanside. Currently the city receives about 7% of the city's need from wells in the basin. Once these new wells are up and running as well as other wells that awaiting proper filtration installation, this figure will increase to about 20% of the city's needs (Burge 2007). This increase equates to pumping 2.4 million gallons per day to 8.4 million gallons per day once the proper carbon filters are installed and public health permits are granted (City of Oceanside 2007). The new wells are located a significant distance from the current riverbed and it seems unlikely that these new wells with affect surface flows of the SLR. On-going monitoring of these wells is necessary to minimize any impact to the groundwater table. Any lowering of the groundwater table and diminished surface flows could, in turn, impact wetlands and riparian areas and may lead to a saltwater intrusion in the lower river. The City of Oceanside monitors the production wells weekly and the monitoring wells monthly using a sounding device that measures the distance in feet from the surface to the top of the water in the well. This ongoing monitoring will be essential in determining alterations in water quantity in the lower portion of the SLR River. See Water Use section in the Basin Profile (p. 50) for further discussion.

Mining

Although there are no current mining operations within the subbasin, the Rosemary's Mountain Quarry site is set to begin operations in 2009/2010 and is projected to sell one million tons of sand and gravel a year for 20 years (Pfingsten 2008). This 94-acre mine, of which 38-acres will be mined, is located on the boundary of the Coastal and Northern Subbasins, 1.5 miles east of Interstate 15 and Highway 76. The mine will increase vehicle traffic on Highway 76 with a projected 452 daily truck trips added to the already busy highway (Pfingsten 2008). To compensate for the additional traffic the mining company, Granite Construction, will be widening and straightening 1.3 miles of the highway. While the quarry will provide the area with what some state officials say are needed aggregate supplies within areas of nearby development (Jones 2007), the quarry is located adjacent to the SLR River and there is a concern of its operations affecting the air quality, sediment input and water quality of the river. Strong site specific permit compliance is needed to minimize the impacts of the operations on the environmental quality of the river and local habitat.

Waste Water Facilities

The Rainbow MWD's sewage treatment system has very nearly reached capacity, with less than 50 remaining EDU available for new connections (Rainbow MWD 2006b). The Rainbow MWD has identified three possible solutions to the sewer capacity limits: (1) do not allow future projects/development rights to the sewer system, (2) construct a wastewater treatment plant for treatment of sewage, or (3) upgrade the existing Oceanside Wastewater Treatment Plant to allow for more treatment capacity (Rainbow MWD 2006a).

The San Luis Rey Wastewater Treatment Plant, at

3950 N. River Road, provides wastewater treatment and disposal for 80% of the City of Oceanside's water, essentially covering all areas east of Interstate 5. The La Salina Wastewater Treatment Plant serves all areas west of Interstate 5, downtown, and along the coast.

Recreational

Numerous recreational opportunities exist in the Coastal Subbasin along and near the river. A multi-use path for runners, hikers, bikers, etc. extends 7.2 miles from near the Interstate 5 river crossing to the east end of College Avenue. This path receives moderate to heavy use all year round. Current plans are underway to extend the bike path a couple of miles further east. Horseback riding trails are available east of the Bonsall area to Interstate 15 on both sides of the river. Several parks, Guajome and Live Oak, which provide camping, fishing, and habitat protection are found within the subbasin. There are an increasing number of golf courses being developed as a part of new housing developments. These golf courses can contribute to water quality problems with the large amount of pesticide and fertilizers that go into the management of these large turf areas. Golf courses tend to use large amounts of water and can exacerbate erosion or water quality problems with runoff from these courses.

A San Luis Rey River Park is currently in the planning stages. This proposed regional park would span 8.5 miles along the SLR River corridor between Interstate 15, west to the old Bonsall Bridge. The creation of this park aims to incorporate a balance of recreation preservation/restoration/interpretation of the SLR River's sensitive resources to serve the Fallbrook and Bonsall Community Planning Areas (CPAs) and the larger North County region (Held, 2008 Draft). The County plans to develop the Park with a goal of designating about 40 acres of San Luis Rey River Park as active use areas and with passive use sites, multi-use trails, and about 1,600 acres of natural preserve. Some land acquisitions have occurred, but additional private lands need to be purchased. These private lands for the Park would be acquired from willing sellers only.

Fish Habitat Relationship

Fishery Resources

Prior to the 1940s, steelhead trout were found in the SLR River in sufficient numbers to provide the local region with recreational fishing opportunities. This fishery included areas of the Coastal Subbasin, such as the estuary. In addition to anecdotal accounts, fish presence (steelhead) in the Coastal Subbasin was also documented by field observations (See Basin Profile, Fishing and Historic Accounts of Steelhead Runs p. 51, for more detailed information). It is unknown if steelhead used any of the tributaries in the subbasin; academic research did not reveal any historical observations and historical stream surveys were very limited. Since the mid 1940s there have been very few reports of steelhead sightings in the lower river or any of the tributaries in the Coastal Subbasin; however, no annual, or even periodic, systematic surveys have been conducted within the Coastal Subbasin.

During the 2007 CDFG stream habitat surveys, an adult steelhead was observed in the mainstem, approximately 7 miles upstream from the estuary. While the winter and spring of 2007 was considered a low water year, this adult steelhead (estimated at 20-24 inches in length) managed to enter the SLR River from the Pacific Ocean and swam upstream approximately seven miles. At the time of observation, the river's low flow conditions would have prevented it from continuing upstream over the boulder rip-rap configuration at the College Avenue Bridge and similarly downstream at the Douglas Bridge. Prior to this sighting, the last report of a steelhead (adult) in the Coastal Subbasin was in 1997 by a consultant working in the mainstem. Its location in the river is unknown. Other than limited, one-day seining surveys in the estuary in 2000 and 2003, no other focused surveys for steelhead have occurred in the Coastal Subbasin since the 1940's. In recent years, steelhead have not been detected in any of the Coastal Subbasin tributaries. Even though there has been a lack of focused surveys in these tributaries, it seems unlikely that steelhead/trout would utilize the majority of these streams due to insufficient stream flows, the lack of suitable habitat, fish passage barriers, and water quality issues. However, field surveys utilizing appropriate protocols are necessary to confirm the presence or absence of steelhead/trout.

In addition to steelhead, the Coastal Subbasin, specifically the estuary, is host to numerous other marine or estuarine dependent fish species, such as deepbody anchovy, topsmelt, arrow goby, and cheekspot goby to name a few (see Table 10, in the Basin Profile for a complete list). Many of these fish species depend on the estuarine environment to complete one of more stages of their lifecycles. The federally endangered, tidewater goby (*Eucyclogobius newberryi*), was once present in the SLR estuary and in the Santa Margarita estuary to the north. The last museum collection of the tidewater goby in the San Luis Rey River occurred on 11 January 1958 (MBC Applied Environmental Sciences 2000). Although the river has been surveyed for tidewater goby on several occasions in the 1970s and more recently in 2000 and

2003, no tidewater gobies have been noted. However, tidewater gobies are known to recolonize sites that are in close proximity to other sites, particularly during winter high flows (Lafferty et al. 1999a,b). Thus, the presence of tidewater gobies in the Santa Margarita River (last detected in 2000) and in San Mateo Creek, just north of the Santa Margarita River (identified in 2003), coupled with the Pacific Street bridge replacement at the river's mouth, could allow them to access the SLR River during a wet year (MBC Applied Environmental Sciences 2003).

Estuary

The SLR estuary, which once sprawled more than 2,258 acres, has been significantly altered by agriculture and urban development within the floodplain and watershed and mineral and aggregate extraction in the channel (http://ceres.ca.gov/wetlands/geo_info/so_cal/san_luis.html). According to an 1893 USGS map of the lower portion of the river, 2200 acres were designated as high marsh and the remaining 58 acres were labeled as low marsh. Prior to human intervention, there were seasonal breakthroughs of the sand berm in the winter, followed by closures of the river mouth by accumulating sand in the late spring and throughout the summer. Winter flows would often scour out much of the lagoon and bring in fresh sediments and nutrients. When the sand bar closed in the spring, the lagoon would be relatively low in salinity due to sufficient freshwater inflow to keep the salinity down. In addition to the natural hydrologic regime, intermittent connections during wet winters existed with the lagoon of the Santa Margarita River in the early 1900s (MBC Applied Environmental Sciences 2000).

The estuary and its surrounding floodplains have been utilized by humans for the past hundred years, altering the size and function of its associated ecosystems. Probably the most significant anthropogenic related impact to the estuary was the development of the Oceanside Harbor in early 1960s. In order to create the harbor, the estuary and river was re-contoured, dredged, levies were built, and vegetation was removed. Filling in of the north and south shores and construction of the Pacific Street berm inland of the original barrier sand bar made the lagoon long and narrow rather than wide and parallel to the barrier beach as it was historically (MBC Applied Environmental Sciences 2003). Extensive agricultural activities in the lower watershed, including the former floodplains, coupled with groundwater extraction to supply Carlsbad and Oceanside drinking water, altered the water quality and water chemistry of the lagoon. The overall water chemistry and water quality was further changed when the City of Oceanside discharged treated wastewater directly into the river from 1958 to 1974.

Presently, the estuary has been downsized to an approximately 164 acre floodplain (Figure 5) with very little native habitat. The vast majority of the surrounding floodplain is now privately owned. The Oceanside Harbor and lower eight miles of the river is owned by the City of Oceanside. Most of the native vegetation has either been removed or displaced by exotic, non-native vegetation. Boulders line portions of the southern banks of the lower estuary, leaving that area devoid of vegetation. Interstate 5 and the railroad dissect the estuary. Constriction of the estuary/lagoon increased scouring with flood events and severely decreased the amount of lateral shallow or emergent habitat necessary for some fishes and other lower vertebrates. Due to these changes the vulnerability of some populations of fishes amphibians, and reptiles is increased and can lead to extirpation of local populations (MBC Applied Environmental Sciences 2003).

Prior to its removal in October, 2008, the Pacific Street Crossing located at the river's confluence, contained two, large corrugated metal culverts that allowed the exchange of freshwater with the ocean water. While allowing for a year-round tidal influence, these culverts changed the function and habitat quality of the estuary. This continuous exchange often created a saline lens at the bottom of the lagoon; whereas prior conditions, discussed above, kept the salinity at lower concentrations (MBC Applied Environmental Science 2003).

Despite the modification of the mouth of the lagoon with the former Pacific Street Bridge configuration allowing this continuous exchange between saline water with freshwater and the decrease in the lagoon size and overall quality of habitat, biological sampling conducted in the spring (April 21) of 2000 and summer (July 24) of 2003 demonstrated a typical subset of estuarine fishes that have marine adult or larval stages (MBC Applied Environmental Sciences 2003). These surveys employed various size beach seines at eight locations from west of the Pacific Street bridge, upstream to just east of the Interstate 5 bridge. The surveys were initiated to determine any potential impacts to the area that might be affected by the bridge replacement project, and to determine the presence of any endangered species or species of special concern within the river, with particular emphasis on the presence or absence of tidewater goby (*Eucyclogobius newberryi*) and steelhead. No tidewater gobies or steelhead smolts were observed during these surveys;

the timing of one of the surveys (atypical period for smolt migration) and presence of exotic predatory species may partially explain the lack of young steelhead. The exotic predatory species, such as largemouth bass, black bullhead, and blue gill, likely contribute to a loss of available habitat in the estuary.

Role of estuaries/lagoons for steelhead

The use of estuaries by southern steelhead has been documented for central California coast streams, but not necessarily for streams further south (USFWS 1998). There are several factors that may explain this lack of documentation. Southern California Coast Steelhead populations are a small fraction of Central Coast populations, making it more difficult to potentially study/identify them in southern California estuaries. Overall, greater development and loss of habitat has occurred in southern California estuaries than in estuaries to the north. It is also important to note that a key factor affecting steelhead use of lagoons is the ability of adults and juveniles to migrate between the freshwater spawning habitat and the lagoon. Due to watershed management practices, which affect the migration corridor, this can be a significant constraint of estuary/lagoon use if there is a considerable distance between the estuary/lagoon and upstream habitats. The effects of droughts would only exacerbate these conditions as fewer smolts may emigrate.

In similar streams in central California, Smith (1994) described lagoon/estuary usage by juvenile steelhead as infrequent due to restrictive up and downstream migration opportunities and that the contribution of an estuary to smolt production probably varies from year to year. Most of steelhead smolt production would benefit from estuary rearing during good water years but receive little to no benefit in periods of drought (USFWS 1998). Previous estuarine studies have shown that growth rates are greater in juveniles utilizing the estuarine environment (Shapovalov and Taft 1954, Smith 1994; cited in USFWS 1998; Bond 2006), but if access is not available, then rearing will occur in the river. A recent study of steelhead in a small central California watershed (Hayes et al. 2008) states that southern coastal estuaries that form lagoons provide the opportunity for trout to achieve the necessary size for marine survival, which heavily influences adult escapement and possibly defines adult production from the watershed. Given the historical cyclic wet to dry weather patterns, it is plausible that steelhead reared in the SLR River lagoon in wet years and in the river or other Basin streams in dry years. In addition to steelhead, tidewater gobies, red-legged frogs, arroyo toads, two-striped and southwest garter snakes, and southwestern pond turtles (all federally endangered, threatened or state species of special concern) all depend on lowland river floodplains and lagoons and were historically present in the lower SLR River (MBC Applied Environmental Sciences 2003).

Figure 5. SLR River Estuary following the removal of the Pacific Street Bridge, December, 2008.

The removal of the Pacific Street Crossing could restore more normal conditions in the lagoon and increase the potential for recovery or reintroduction of a variety of species of fish, amphibians, and reptiles. The return of somewhat natural flows may perhaps serve to enhance a potentially significant halibut nursery and make the area more suitable to tidewater gobies (MBC Applied Environmental Sciences 2003). Although, other factors must be addressed to further enhance the potential for the species to recolonize the SLR lagoon and river. These include the restoration of lateral habitat lost by the filling in of the northern and southern margins, the elimination of predatory exotics, and the reduction of the scouring and other habitat alterations as a result of the river's channelization. A hydrologic/biological study should be developed to study the ongoing effects of the bridge replacement on sediment transport, water quality, lagoon habitat, and include monitoring of estuarine dependent fish species.

Habitat Overview

Historic Conditions

As with most of the basin, there has been a limited amount of stream surveys done in the Coastal Subbasin. Stream surveys were conducted by CDFG as early 1946; however, stream survey efforts were neither specific nor standardized until the 1990s when the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 1998) was published. Most early observations in the historic stream surveys are not quantitative and have limited use in comparative analysis with current habitat inventories. However, data from these stream surveys provide a snapshot of conditions at the time of survey (Table 6).

The earliest stream survey in this subbasin was a 1946 field survey of the SLR River. This survey generally indicated that the river within the Coastal Subbasin was unsuitable for trout. Much of the river in this section was dry, as numerous pumps in or near the riverbed were noted.

The lack of information on the habitat and presence of steelhead within the Coastal Subbasin, particularly before the completion of water diversions, most notably the Escondido Canal diversion in 1895, and the Henshaw Dam in 1922 makes it difficult to speculate on historical use of the subbasin for steelhead spawning and rearing. Considering the river was located in what was once a large, alluvial floodplain, it seems likely that steelhead used this portion of the river as a migration corridor to more suitable spawning habitat upstream. With perennial river flows prior to the completion of the Escondido Canal diversion, the mainstem would have been more conducive to upstream adult migration and smolt emigration to the ocean. Additional water extractions in tributaries, groundwater pumping, and an extended drought (1940s to mid 1970s) compounded the problem of having insufficient river flows to maintain high quality habitat and allow for fish passage. Considering the documented presence of an extensive riparian area, potentially providing diverse, complex habitat and the occurrence of cooler coastal air temperatures, moderating stream temperatures, the lowland reaches of the Coastal Subbasin may have been utilized as juvenile rearing habitat during emigration to the ocean.

It is unknown whether steelhead utilized any of the tributaries for spawning or rearing within the subbasin. While several large tributaries exist, such as Pilgrim Creek and Gopher Canyon, no annual, or even period, systematic surveys were conducted in these tributaries to detect the presence or absence of steelhead/trout. Whether any of these streams retained perennial flows is also unclear.

Estuary conditions, as described in the Estuary section, were far more suitable for steelhead prior to human intervention as the estuary once encompassed over 2,200 acres and had intermittent connectivity with the Santa Margarita River lagoon to the north. There are anecdotal accounts of steelhead/trout being caught in the Santa Margarita lagoon as well as in the SLR lagoon and it seems more than likely that the area provided excellent rearing habitat for juvenile trout. Figure 6, an aerial photo taken in 1932, displays the former estuary conditions. While the estuary had already been altered, it is evident that far more side channel habitat with abundant vegetation was present, providing excellent nursery habitat for a variety of marine and estuary dependent species.

Figure 6. SLR River estuary in 1932 (Photo courtesy of the City of Oceanside Archives).

Table 6. Habitat observations made in the Coastal Subbasin from 1946-2003.

Stream	Date Surveyed	Source	Habitat Comments	Barrier Comments
San Luis Rey River	09/04/1946	CDFG 1946	Surveyed east of Oceanside to Pala Indian Reservation (approximately RM 7 to RM 23). Stream flow was low with an average depth of 8-10 inches and an average width of 4-5 feet. The water temperature was 68°F. The surveyor reported of numerous pumps in the river and much of the river was dry except for the upper 4-6 miles. Rainbow trout, mosquito fish, and small cyprinids were present; however the trout were most likely observed in the vicinity of the Pala Indian Reservation. The 1946 survey indicated the area within the Coastal subbasin was not supportive for trout.	Escondido Canal diversion, RM 40, and Henshaw Dam, RM 50, were described as complete barriers to fish passage.
	6/20/1975	Swift 1975	"The streambed mainly is sand in the lower reaches. The river is intermittent (from the Escondido Canal) to the vicinity of Bonsall where the flow appears to be permanent. Mosquito fish and a few green sunfish were caught near the Oceanside Airport. Water temp at 3:30 pm was 20°C; dissolved oxygen (ppm) was 5; pH was 7.5; and turbidity (J.U.) was 51.	None described in the lower river
	11/8/1978	CDFG 1978	Fisheries personnel netted and seined approx. 1½ miles of SLR river near Oceanside. The following fish were collected: 8 largemouth bass, 228 bluegill, 37 green sunfish, 11 black bullhead, 1 channel catfish, 327 golden shiners, and "numerous" mosquitofish. Bullfrogs and adult pacific pond turtles (*Clemmys marmorata pallida*) were observed as well as an abundant number of snails (*Physa sp.*) in the river and backwater areas.	No impassible barriers
	04/21/2000	MBC Applied Environmental Sciences (2000)	Survey collection of lagoon from mouth to just upstream of I 5 bridge. Collections demonstrated a typical subset of estuarine fishes that have marine adult or larval stages that can easily enter the lagoon despite culverts at mouth. "Presence of exotic predatory species may partially explain the lack of some native species like killifish, tidewater gobies, and young steelhead. Culverts allow frequent exchange with the ocean, and a saline lens is present in the bottom of the lagoon."	No impassible barriers
	06/24/2003	MBC Applied Environmental Sciences (2003)	Method of survey, collections, and report conclusions coincides with those of 2000 report. Report noted timing of survey occurred most likely after the main-movement of steelhead.	No impassible barriers

Current Conditions

In the Coastal Subbasin, CDFG/PSMFC fisheries crews conducted stream habitat inventories on the entire length of the SLR River with the subbasin, 18.3 stream miles in May, June, and July of 2007 (Table 7 and Figure 7). During the mainstem survey, three tributaries, Gopher Canyon, Ostrich Creek, and Horse Ranch Creek, contained flowing water and were examined for general habitat suitability. Based on the stream habitat conditions at the time of the survey, it seemed unlikely that these streams would be utilized by steelhead; therefore, full habitat inventory protocols were not performed. Other tributaries in the subbasin were not surveyed due to the absence of surface flows or denied landowner access permission.

Gopher Canyon had an approximate flow of 0.5cfs in July of 2007. This low gradient (less than 1% slope) stream was surrounded by agricultural fields and low density housing. Stream flows were most likely attributed to agriculture and residential runoff. Canopy was approximately 50% and provided mostly by deciduous trees and to a lesser extent shrubs. Aquatic plants were prevalent in much of the streambed. Stream substrate consisted almost entirely of sand and was devoid of potential spawning gravels. The stream lacked complexity with only a few, short, and shallow pools. Numerous tree frogs were observed in the lower section, near the confluence of the SLR River.

Ostrich Creek was a low gradient stream whose very low flows were also most likely supplied by agricultural and residential runoff. This creek was very difficult to access and evaluate due to the overgrown vegetation in the stream on its banks. Very little water was present in the creek, streambed substrate was predominantly sand, no spawning gravels were observed, and the creek offered little in the way of habitat diversity.

Stream habitat inventory methods were conducted on the SLR River according to methods determined in the *California Salmonid Stream Habitat Restoration Manual* (Flosi, et al. 1998). Analysis of the SLR River water quality and instream habitat conditions includes the following:

- Canopy Density;
- Habitat Type Categories;
- Pool Characteristics:
- Pools by maximum depth;
- Pool shelter;
- Cobble Embeddedness;
- Water Quality;
- Water Chemistry;
- Waste Water Treatment Facilities.

Table 7. Coastal Subbasin streams surveyed by CDFG, spring 2007.

Stream	Year of Survey	Survey Length (miles)	Percent of Permanent Stream Surveyed	Number of Reaches
San Luis Rey River	2007	18.3	100	4
Gopher Canyon*	2007	0.8	>13	1
Ostrich Creek*	2007	0.3	>5	1
Horse Ranch Creek*	2007	0.1	>2	1

* Full habitat inventories were not performed on these tributaries

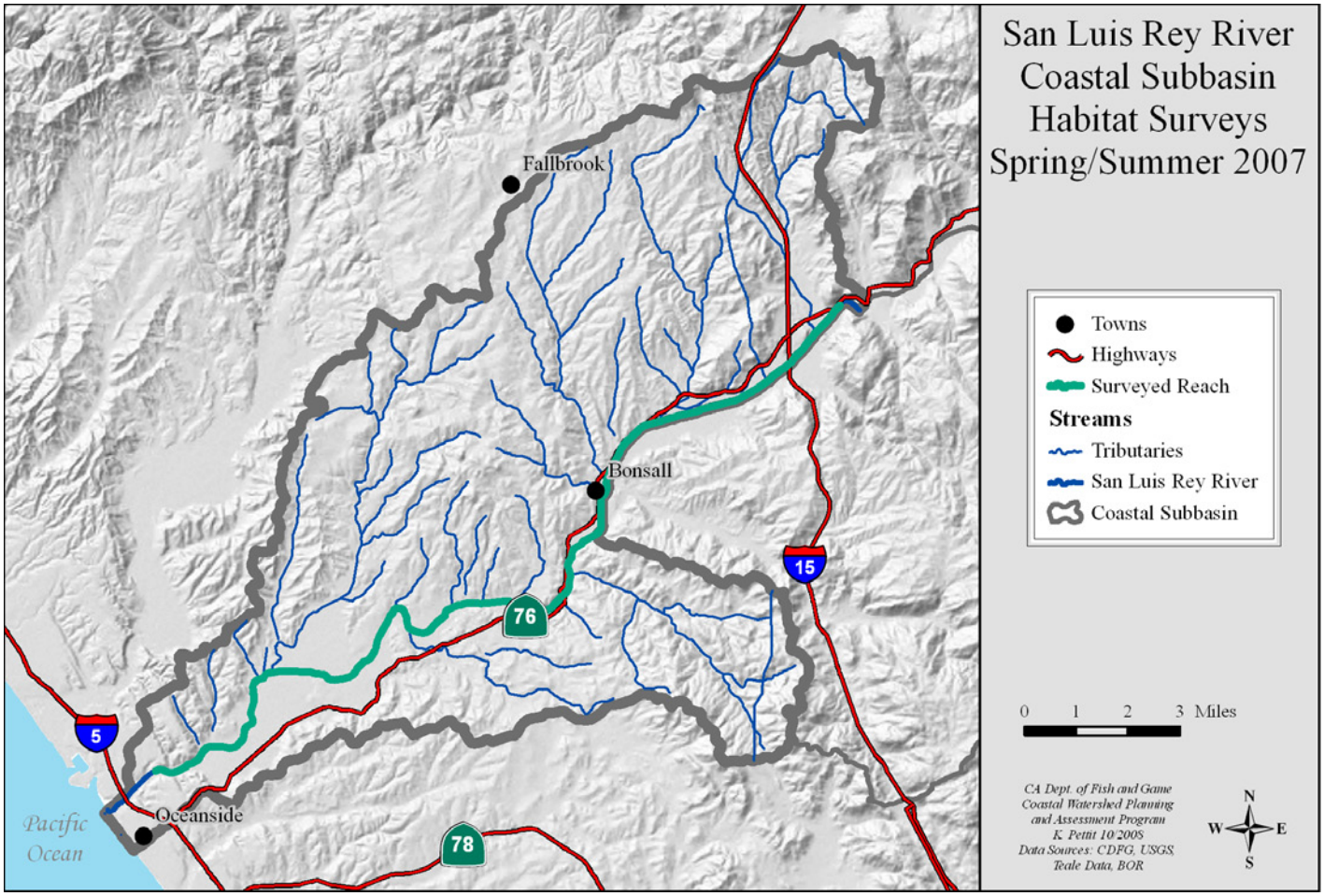

Figure 7. Habitat surveys conducted by CDFG on the SLR River in the Coastal Subbasin.

Canopy Density

Significance: Streamside canopy density is a measure of the percentage of wetted stream that is shaded by riparian tree canopy. Stream water temperature can be an important limiting factor of salmonids, and tree canopy provides shade to reduce direct sun light from increasing water temperatures. Moreover, near-stream forest density and composition contribute to microclimate conditions that help regulate air temperature, which in turn, influence stream water temperature. Riparian vegetation also bind the stream bank soil and provide resistance to the erosive forces of water, functions as the base of the food chain for biological stream life, helps store water along the stream corridor during the raining season for slow release to the stream in drier seasons, and creates desired complex instream habitat by providing woody debris to streams (Riley 1998). Generally, canopy density less than 50% by survey length is below target values and greater than 80% fully meets target values.

Findings: Canopy density measurements on the SLR obtained suitable values on three of the four reaches (Figure 8 & Figure 10). The overall Coastal Subbasin EMDS canopy density condition truth score is moderately suitable. The canopy coverage was provided by the invasive plant, giant reed (*Arundo donax*), and deciduous trees, mostly in the form of large willows and to a lesser extent, cottonwoods. The uppermost reach had the highest canopy density as river channel width decreased and riparian trees provided cover over the majority of the river. The poor rating in the lower reach can be attributed to the naturally broad stream channel as the actual riparian remained relatively unchanged from other reaches; however, the Corps long-term Operation and Maintenance Plan project in Oceanside has removed and will continue to remove large amounts of vegetation over the next couple of years near the river's wetted channel. This will adversely affect the canopy cover in this area.

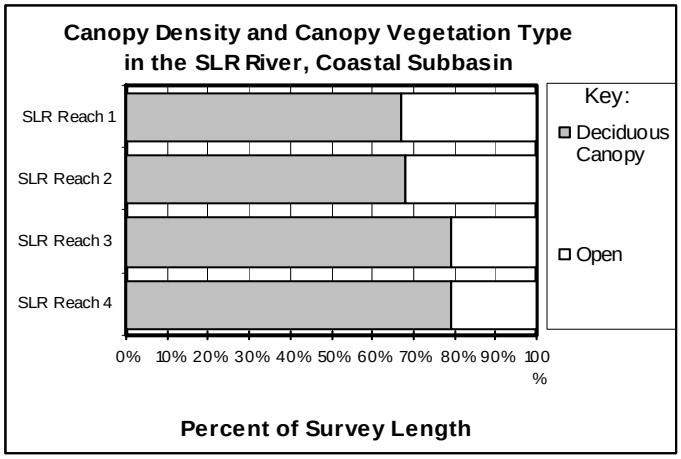

Figure 8. The relative percentage of deciduous canopy vs. open canopy in surveyed reaches of the SLR River, Coastal Subbasin.

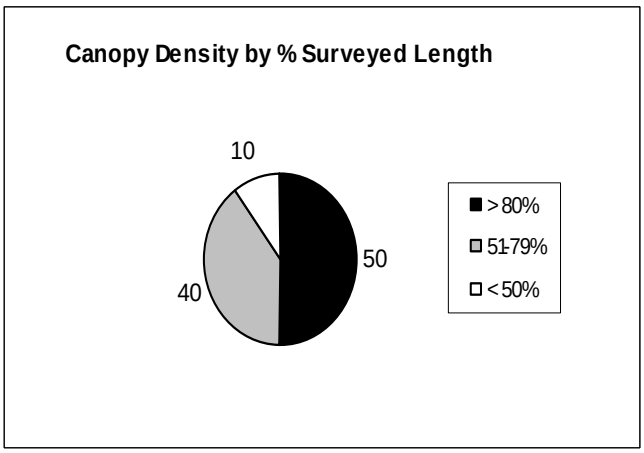

Figure 9. Canopy density of SLR River, Coastal Subbasin.

Averages are weighted by unit length to give the most accurate representation of the percent of a stream under each type of canopy. SLR reaches are listed from west to east within the Subbasin.

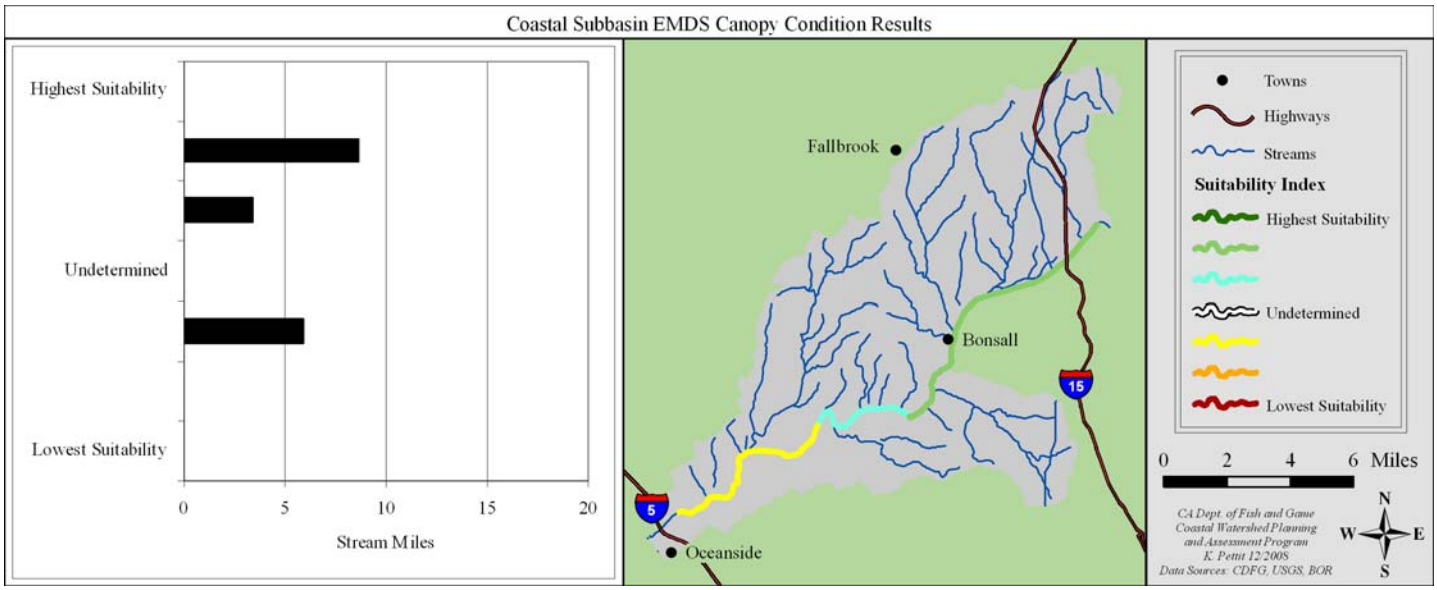

Figure 10. EMDS canopy results for SLR River, Coastal Subbasin, by surveyed stream miles.

Habitat Categories

Significance: Productive anadromous streams are composed of a balance of pool, riffle and run habitat and each plays an important role as salmonid habitat. Pools are the preferred habitat for yearling and older juvenile steelhead, but also provide important resting areas during adult winter/spring migration. Looking cumulatively at pool, riffle, and run relationships helps characterize the status of these habitat types and also provides a measure of stream habitat diversity and suitability for fish. A pool:riffle ratio of approximately 1:1 is suggested as a desirable condition for most wadeable, anadromous, fish bearing streams, but it is not applicable for evaluating salmonid suitability of all stream reaches and channel types (Rosgen 1994). However, pool:riffle:run relationships showing an over abundance of riffles or runs may indicate aggraded channel conditions or lack of scour objects needed for pool formation. Additionally, pool frequency by percent length is preferable to pool frequency by occurrence because the latter may give a false impression of health if there are numerous, shallow, short pools as a result of aggradation (NMFS and Kier 2008).

Findings: While pool habitats in the Coastal Subbasin comprised over 45% of the instream habitat types by occurrence, the overall percentage of pool habitat by survey length was only 16%. All of the reaches in the SLR River comprised less than 25% of their total survey length in pool habitat and two of the reaches contained less than 16% pool habitat (Table 8). In part, the lack of pools can be attributed to the natural hydrology of the lower river, which consists of a low gradient, depositional area. However, the low percentage of pool habitat is also the result of the significantly reduced stream flows, which hinders pool-forming processes from occurring in the lower watershed. The overall low number of riffles and the low percentage of total stream length in riffle habitat may also be attributed to natural hydrology of the lower river; however, anthropogenic activities that have occurred in the subbasin and throughout the entire basin have also played a significant role in altering instream habitat types. These activities have reduced gravel recruitment necessary for riffle formation and increased the fine sediment transport, which would bury existing or potential riffles.

Table 8. Coastal Subbasin percent occurrence and percent by length of pool, run, riffle, and dry habitats.

Stream	Stream Order	Survey Length (miles)	Pool, Riffle, Run Percent Occurrence	Pool:Riffle:Run Percent Total Length	Dry Percent Total Length	No Survey Percent Total Length
SLR River Reach 1	2	5.93	47:2:45	15:1:59	0	25
SLR River Reach 2	2	3.40	48:3:49	23:3:72	0	2
SLR River Reach 3	2	3.73	49:2:49	19:3:72	0	6
SLR River Reach 4	2	4.88	41:2:57	9:4:60	0	27

Pool Depth

Significance: Pool depth and frequency are fundamental attributes of channel morphology and are largely dependent on the presence of large roughness elements such as boulders, bedrock, rootwads, and small and large woody debris in addition to channel type, stream gradient, sinuosity, and channel width. Evaluating the amount of deep pool habitat in a stream reach helps assessment of important channel characteristics for steelhead. Deep pools provide escape cover from high velocity flows, hiding areas from predators, and ambush sites for taking prey. Greater pool depth provides more cover and rearing space for older age (1+ and 2+) steelhead juveniles and creates better shelter for migrating and spawning adults. Generally, a stream reach should have 35–50% of its length in primary pools to be suitable for salmonids. SLR River, due to the lack of hydrologic connectivity to the middle and upper watershed, was evaluated as a second order stream. The EMDS pool depth model based it suitability ratings on the overall survey reach length containing pools greater than 2.49 feet, with a slight consideration (weight) given to pools greater than 2 feet deep.

Findings: Only 17% of overall survey length in the Coastal Subbasin (SLR River) was comprised of primary pools (Figure 11), which is well below the target values of 35-50%. Subsequently, none of the reaches surveyed in the mainstem met EMDS pool depth target values (Figure 12). While the river was inventoried during one of the driest years on record, the percentage of suitable pool habitat most likely would have only slightly increased during wetter years. It is important to note that the majority of the pools in all of the surveyed reaches were greater than the target depth of 2.49 feet even during this dry survey year. This subbasin is located in a naturally, low-gradient, alluvial streambed; therefore, a high percentage of deep pools would not be typically expected. The lack of hydrologic connectivity from the Middle and Upper subbasins also greatly decreases the amount of stream flow into the Coastal Subbasin, thus hindering the potential for new pool formation and scouring of existing pools. Reach 2 had the most primary pools by survey length, with 22.6% (Table 9).

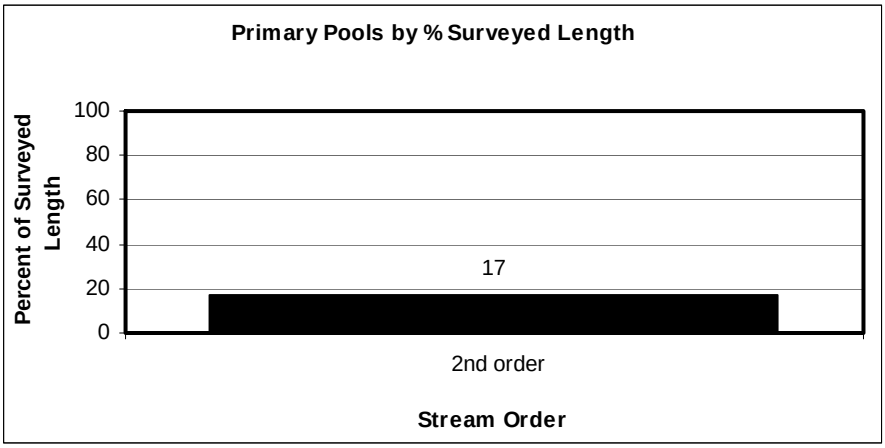

Figure 11. Primary Pools in the SLR River, Coastal Subbasin.
Primary pools are pools greater than 2 feet deep in 1st and 2nd order streams

Table 9. Percent length of the survey area composed of pools and percentage of pool habitat lengths by pool depths in the SLR River,Coastal Subbasin.

Stream	Stream Order	Percent all measured Pools by Survey Length	Percent Pools of Depth 2.0–2.49' by Survey Length	Percent Pools of Depth 2.5'–2.9' by Survey Length	Percent Pools of Depth 3'–4' by Survey Length	Percent Pools of Depth >4' by Survey Length	Percent Pools Within Target Range (>2.49') by Survey Length
SLR River Reach 1	2	19.8	1.7	1.8	4.9	10.4	18.1
SLR River Reach 2	2	22.6	1.5	7.6	7.1	6.4	21.1
SLR River Reach 3	2	18.5	2.5	2.9	7.2	5.9	16.0
SLR River Reach 4	2	7.6	1.2	1.5	1.5	3.4	6.4

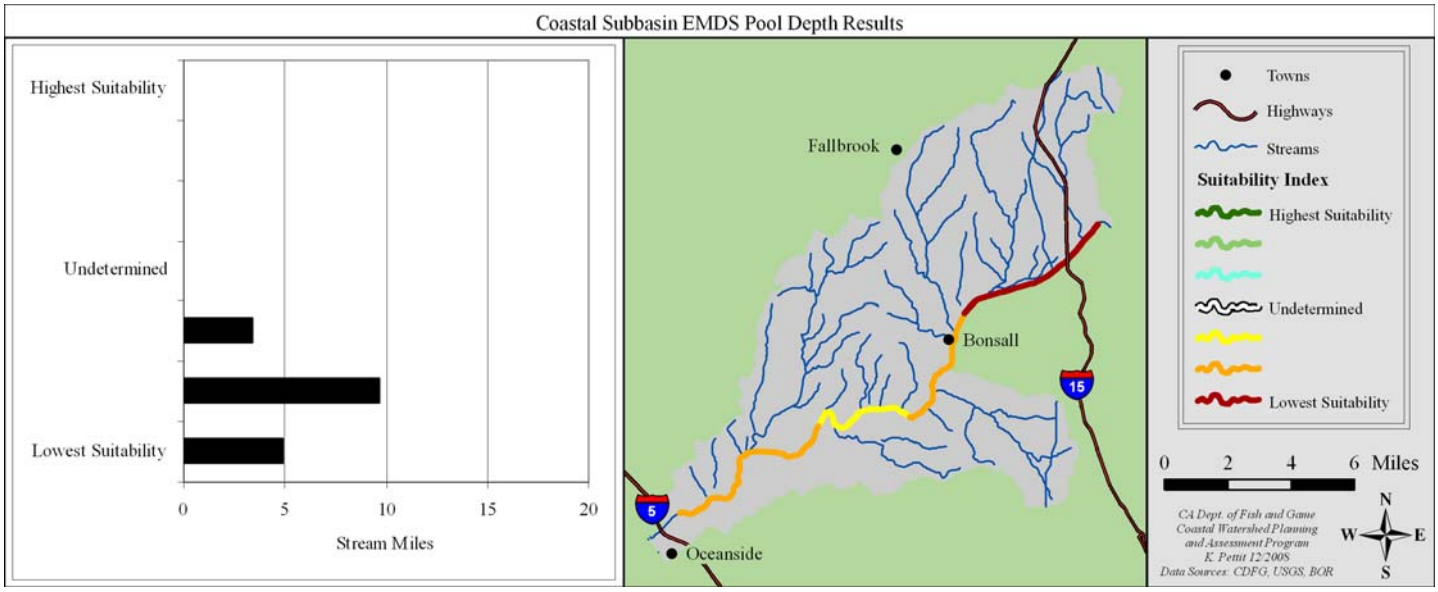

Figure 12. EMDS pool depth results for SLR River, Coastal Subbasin, by surveyed stream miles.

Pool Shelter

Significance: The pool shelter rating is a relative measure of the quantity and percent composition of small woody debris, root wads, boulders, undercut banks, bubble curtains, and submersed or overhanging vegetation in pool habitats. These elements serve as complex instream habitat with protection from predation, rest areas from high velocity flows, and separate territorial units to reduce density related competition. Shelter ratings of 100 or less indicate that shelter/cover enhancement should be considered. Large woody debris generally does not play a significant role in the habitat functions concerning steelhead/trout in southern California rivers and streams; therefore its presence/absence is not relevant in this assessment.

Findings: While pool shelter ratings for surveyed reaches of the SLR River in the Coastal Subbasin were all below the target value of 100% (fully suitable rating) (Figure 13), only reach 3 did not achieve a suitable EMDS rating (Figure 16). Each reach contained pools that met or exceeded the shelter rating of 100 or greater (Figure 14). As described further below, shelter complexity is composed considerably of the invasive species, giant reed (*Arundo donax*), and could be improved throughout much of the subbasin with invasive species eradication efforts and revegetation projects coupled with natural riparian succession.

In addition to shelter complexity rating, instream shelter composition, divided into eight cover types, was also collected during habitat inventories (Figure 15). Due to the widespread presence of *Arundo* within the river channel and along the stream banks, aquatic vegetation (39.7%) followed by terrestrial vegetation (31.7%) were the dominate cover types in the subbasin. *Arundo* has displaced large areas of native riparian vegetation along the SLR River in the Coastal Subbasin. The most significant negative impacts of *Arundo* on the riparian and stream habitat are as follows: *Arundo* increases sediment input by having a weak root system that is susceptible to under-cutting by stream flows; it creates a monoculture that is difficult to penetrate and excludes native plant species; in areas of heavy *Arundo* concentrations, it reduces all forms of wildlife, including the federally endangered species of the least Bell's vireo, southwestern willow flycatcher, and arroyo southwestern toad; and when grown along main stream channels, it provides less shade than native riparian trees because it grows vertically instead of arching over the water channel.

Small woody debris composed the third most common cover type, representing over 21% of the cover in pools. Root mass and undercut banks played a less significant role in providing potential shelter cover in pools. Bedrock ledges, boulders, and bubble curtains were absent or nearly absent from the surveyed reaches and are not included in Figure 15.

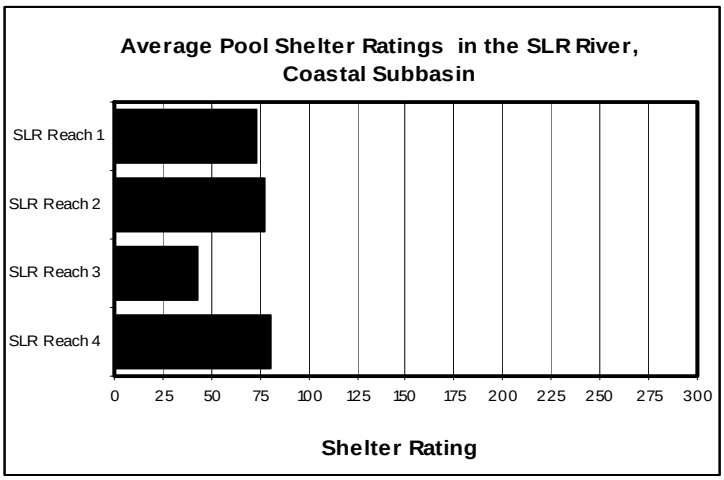

Figure 13. Average pool shelter ratings in the SLR River, Coastal Subbasin.

Stream reaches are listed from west to east.

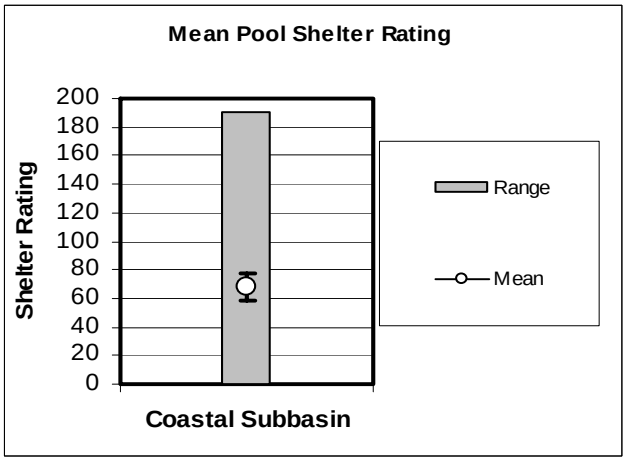

Figure 14. Pool shelter in the SLR River, Coastal Subbasin.

Error bars represent the standard deviation. The percentage of shelter provided by various structures (i.e. undercut banks, woody debris, root masses, terrestrial vegetation, aquatic vegetation, bubble curtains, boulders, or bedrock ledges) is described and rated in CDFG surveys.

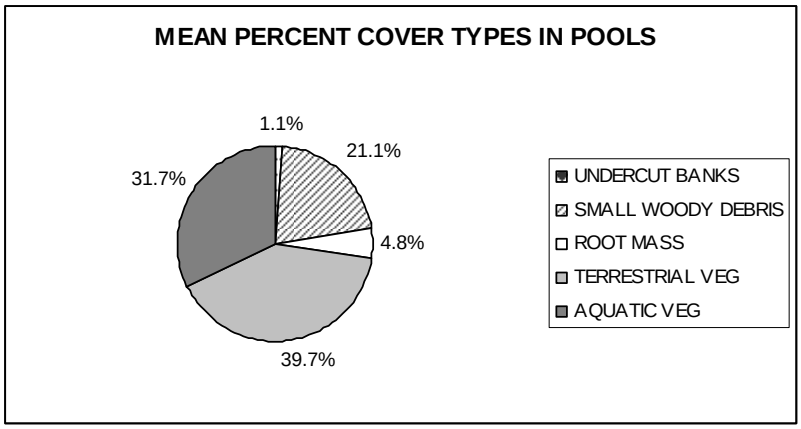

Figure 15. Mean percent of shelter cover types in pools for surveyed reaches of the SLR River in the Coastal Subbasin.

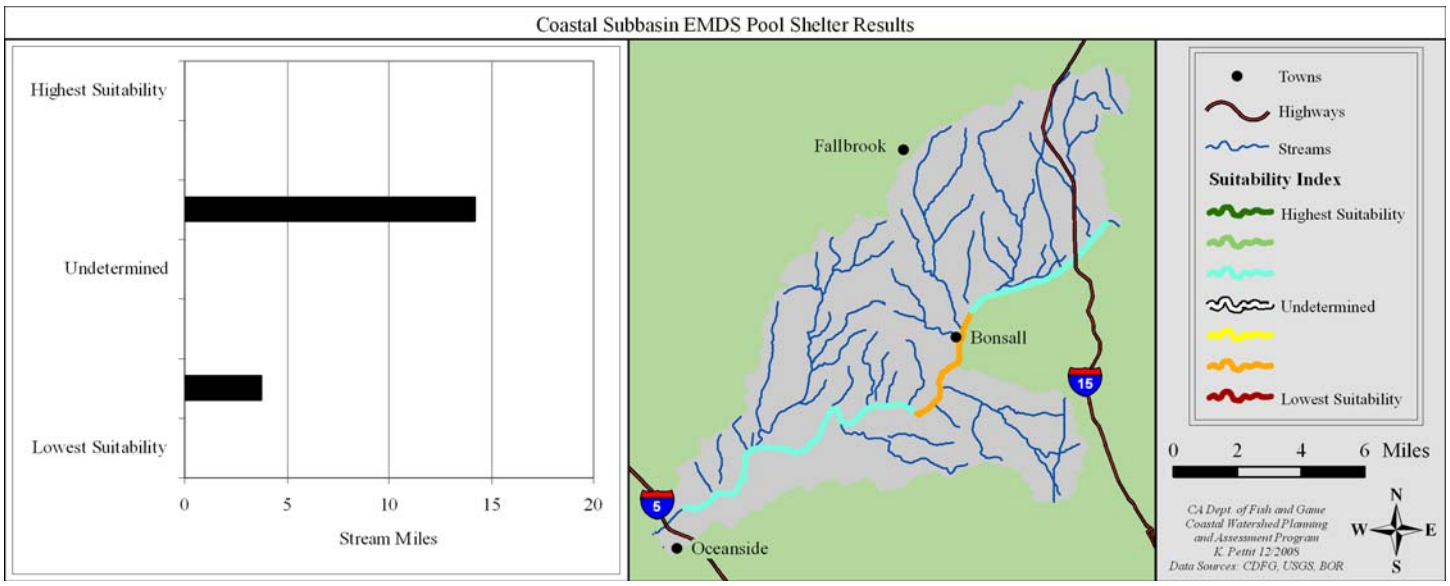

Figure 16. EMDS pool shelter results for the SLR River, Coastal Subbasin, by surveyed stream miles.

Cobble Embeddedness

Significance: Salmonid spawning depends heavily on the suitability of spawning gravel; fine sediments decrease successful spawning and incubation. Cobble embeddedness is the percentage of an average sized cobble piece at a pool tail out that is embedded in fine substrate. Category one is 0-25% embedded, category two is 26-50% embedded, category three is 51-75% embedded, and category four is 76-100% embedded. Generally, cobble embeddedness of 0-25% is considered good quality for spawning (Flosi et al. 1998). Excessive accumulations of fine sediment (>50%) reduce water flow (permeability) through gravels in redds which may suffocate eggs or developing embryos. Excessive levels of fine sediment accumulations over gravel and cobble substrate also may alter insect species composition and food availability for growing fish. Consequently, cobble embeddedness categories three and four are not within the fully supported range for successful use by salmonids. Category five was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like sand, bedrock, log sills, boulders or other considerations.

Findings: The entire stretch of the Coastal Subbasin received the lowest EMDS suitability rating for cobble embeddedness (Figure 19). Approximately 99% of the pool tail-out cobble embeddedness measurements were classified as categories four and five (Figure 18). This poor suitability rating can be primarily attributed to two factors. One, the natural stream morphology of the basin, which consists of a low gradient, alluvial streambed, combined with reduced stream flows into the subbasin hinder natural watershed processes of transporting new gravels. Moreover, severely reduced flows limit the river's scouring potential, leaving an abundance of fine sediments on the riverbed's surface. Two, medium sand is the naturally occurring, dominant substrate throughout the subbasin. The other determining factor involves the sampling method, which only measures potential spawning areas in the pool-tails. Southern California steelhead also utilize riffles as potential spawning grounds. This survey methodology did not take this into account and thus did not record/evaluate these areas. Bear in mind, riffle habitat only occupied approximately 2.5% of the subbasin's stream length. Although few in overall numbers, potential spawning areas were observed in pool tail-outs and at the top of riffles in the Coastal Subbasin. However, the on-going, abundant fine sediment transportation, especially in the lower reaches of the subbasin, may hinder the success of fry emergence from the gravels.

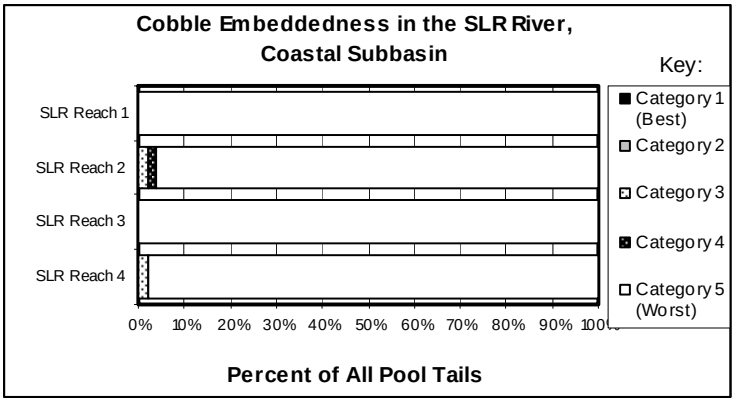

Figure 17. Cobble embeddedness categories as measured at every pool tail crest in SLR River, Coastal Subbasin.

SLR River stream reaches are listed in from west to east in the subbasin.

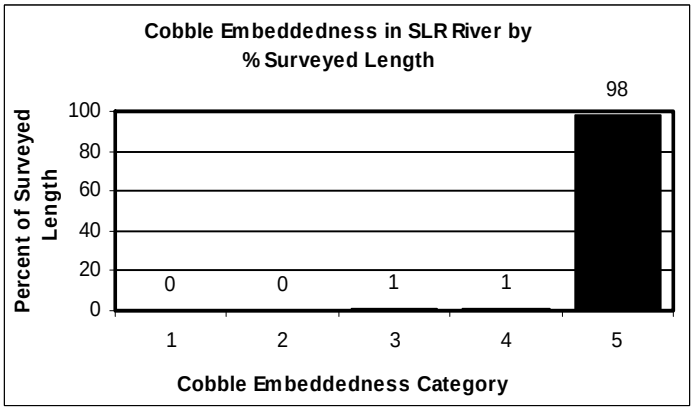

Figure 18. Cobble embeddedness in the SLR River, Coastal Subbasin.

Cobble embeddedness was measured only in pool tail-outs and did not take into account the steelhead may spawn in riffle habitat.

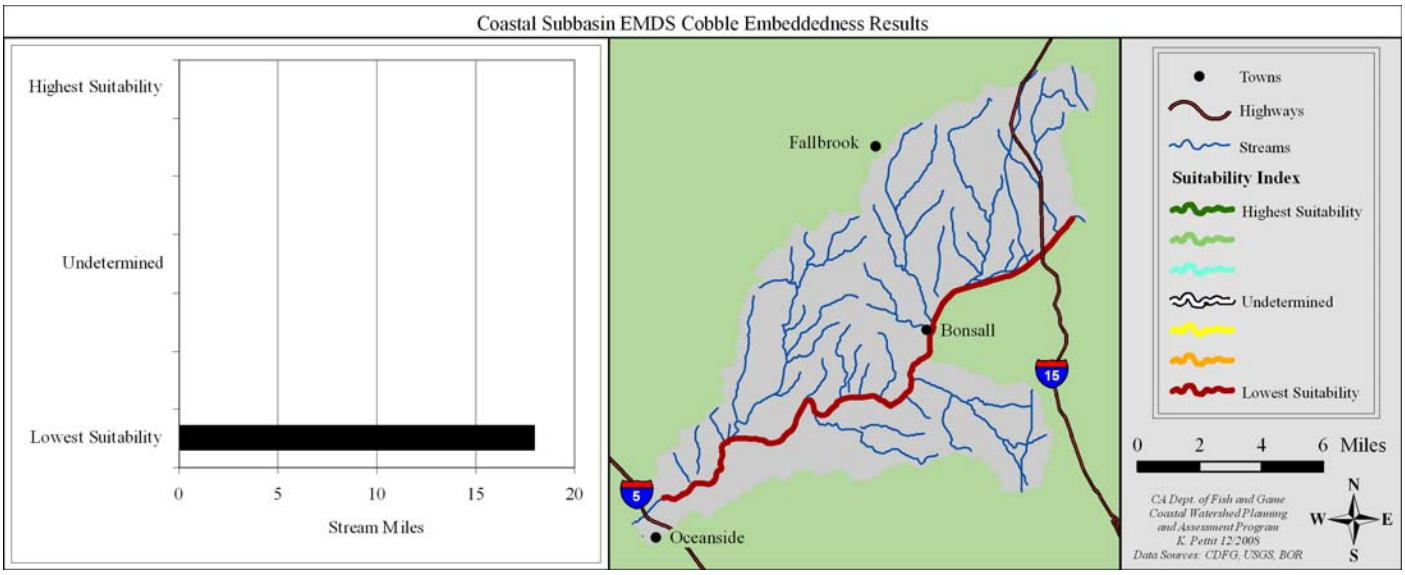

Figure 19. EMDS cobble embeddedness results for the SLR River, Coastal Subbasin, by surveyed stream miles.

Water Quality

The San Diego Regional Water Quality Control Board (SDRWQCB) has set water quality objectives for the following parameters on the San Diego streams and rivers:

- Maximum pH standard of 8.5 to maintain beneficial uses, including cold water fish species;
- Total Dissolved Solids [below 500 mg/L 90% of the time];
- Dissolved Oxygen (above 6.0 mg/L for COLD beneficial use (SDRWQCB 1998).

Nutrient concentrations: "a desire goal in order to prevent plant nuisance in streams and other flowing waters appears to be 0.1 mg/l total P. These values are not to be exceeded more that 10% of the time unless studies of the specific water body in question clearly show water quality objective changes are permissible and approved by the Regional Board. Nitrogen to Phosphorus ratio (if data lacking) of N:P = 10:1 on a weight to weight basis.

Water Chemistry

Significance: Water chemistry interacts with basic trophic levels affecting the production and availability of food for aquatic organisms. Nutrients are often limiting factors in the biological capacity of a stream yet a proper balance is needed to prevent eutrophication. Pollutants are a concern where they interfere with the biological function of aquatic organisms, or can be a threat to those that consume them. Large sources of nutrients and pollutants are commonly municipal and industrial wastewater facilities, storm runoff, and agricultural operations. Naturally occurring nutrients and heavy metals are often found in much smaller concentrations. The SLR River is currently listed impaired by the SDRWQCB for Total Dissolved Solids (TDS), chloride, and bacteria at the mouth, i.e. Pacific shoreline).

Steelhead are an important indicator of the health of the aquatic environment because they require clear, clean water, and they utilize all portions of a river system (McEwan and Jackson 1996).

Findings: Water Chemistry Studies:

The County of San Diego in conjunction with the City of Oceanside, private contractors, and public community organizations have studied water quality conditions in the lower SLR River from 2001 to the present, including water chemistry and macro-invertebrate surveys.

As a part of the regional monitoring effort as required by the 2001 San Diego Storm Water Permit, a mass loading station testing site was constructed in the fall of 2001, under the Benet Road Bridge (RM 2.7), North of Highway 76 to assess flow and to test for water toxicity and chemistry during three wet weather events each year beginning in 2001 through 2007 (A. Witheridge, personal communication 2009). The City of Oceanside also began a Dry Weather Analytical Monitoring and Field Screening Program in the spring of 2002 designed to test the water quality of urban runoff going into the City of Oceanside's rivers and creeks during the "dry season" (May through September), months when little to no rainfall occurs. By understanding how urban runoff discharges affect the local waterbodies, it provides more information about the quantity and seriousness of certain pollutant problems and where they might originate.

Overall results of the mass loading station and dry weather analytical monitoring and field screening program, survey period of 2001 to 2006, indicated that Total Dissolved Solids (TDS) continue to be the primary water quality concern in the watershed. The report also notes an increasing trend in indicator bacteria concentration, specifically in fecal coliform at levels above the water quality objective (WQO). While nitrate and dissolved phosphorus were at levels below the WQO both showed significantly increasing trends which may become an issue in the future. Other constituents monitored that were occasionally detected at levels above the WQO include: total suspended solids, turbidity, biochemical oxygen demand, pH, and diazinon (compound in pesticides). The report concluded that there was no clear link between dry weather results and mass loading station data; however, the cause of occasional, infrequent toxicity during mass loading station monitoring was unknown (Weston Solutions 2007). It is important to note, in 2007, a new San Diego Storm Water Permit was

Findings: Water Chemistry Studies Continued:

issued with different monitoring requirements. Beginning with monitoring year 2007-2008, an MLS and temporary watershed assessment station, placed under Camino del Rey near the intersection with Hwy 76, assessed flow, chemistry, and toxicity of the SLR River during two wet and two dry weather events. This testing will not be continued annually, but will instead be completed every other year starting with monitoring year 2008-2009, per the new permit requirements (A. Witheridge, personal communication 2009).

An Ambient Bay and Lagoon monitoring program (ABLM) began in June of 2003, investigating chemistry, toxicity, and benthic community structure in the SLR River estuary. Chemistry (sediment chemistry) used sediments from 12 coastal embayments, analyzed in four categories of constituents: metals, Polychlorinated Biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and pesticides. Of these, six metals were detected above the detection limit in the SLR River estuary: arsenic, chromium, copper, lead, nickel, and zinc. However, concentrations of metals were low and none exceeded their respective effects range low (ERL) or effects range medium (ERM – upper guideline value) sediment quality value during the 2003-2005 ABLM program. There were no PAHs found above the detection limit. The pesticide, 4,4'-DDE were detected at this site above the ERL value of 2.2 ug/kg (6.91ug/kg, the level detected), but this is below the respective ERM value of 27 ug/kg.

Toxicity results were determined by mean percent survival of the estuarine burrowing amphipod, *Eohaustorius estuaries*, exposed to the SLR River estuary sediments in a 10-day acute toxicity test compared to a control sample. No toxicity was observed during the 2005 testing year in the 10-day solid phase toxicity test using *E. estuaries*. Survival of *E. estuaries* was not significantly different in the SLR sediment (90%) as compared to in control sediment (97%), indicating that bioavailable metals found in the SLR River estuary sediment were not toxic to the amphipod *E. estuaries* (Weston Solutions, 2007). Overall, for the 2003 to 2005 monitoring years the estuary scored "good" for toxicology and chemistry. The benthic community health in the SLR River estuary was assessed as "poor to fair" (Weston Solutions 2007).

Lastly, in conjunction with the water quality/urban runoff monitoring, Weston Solutions performed a stream bioassessment in the SLR River Basin in October of 2005 and May of 2006 at two urban locations in the Coastal Subbasin as well as in the SLR River estuary and a reference site in Doane Creek in Mt. Palomar State Park. Although these bioassessments were not done in concurrence with the stream habitat surveys, they still provide a useful tool in determining overall stream water quality and habitat, which frequently is a limiting factor in steelhead/trout production due to the extensive land use modifications within many Southern California watersheds (NMFS & Kier Associates 2008). In summary, the SLR River urban sites had Index of Biotic Ratings of very poor during both surveys. The in-stream physical habitat of these sites was qualified as marginal, which could have limited macroinvertebrate colonization. These ratings are typical of a stream that receives a considerable amount of urban runoff and the ratings are comparable to all other urban streams in the County (A. Witheridge, personal communication 2009). Nonetheless, it should be noted that the sites were quite similar to those surveyed at the Santa Margarita site on Camp Pendleton, which had a substantially higher IBI scores. The results indicate that there is evidence of benthic alteration (Weston Solutions 2007).

Habitat Discussion and Conclusions

The SLR River has undergone dramatic changes since European settlers first moved into the basin. Prior to the 2007 CDFG habitat inventory, very few surveys had been completed on the river, detailing the habitat conditions. Data from older stream surveys provide only a snapshot of the conditions at the time of the survey. Terms such as excellent, good, fair, and poor were based on the judgment of the biologist who conducted the survey. The results of historic stream surveys are qualitative and cannot be used in comparative analyses with quantitative data provided by habitat inventory surveys with any degree of accuracy. However, the two data sets can be compared and may indicate general trends.

Very little habitat data is available to compare historic stream conditions to present conditions (Table 11). The spread of invasive, exotic plant species has certainly changed the composition of the riparian and canopy cover, shifting from native trees and shrubs to the invasive *Arundo donax* and *Tamarisk sp*. species. Moreover, the channelization of the lower river altered natural hydrologic processes and most likely changed the river's course from a meandering stream channel to a confined transport reach. This channelization has influenced the ratio of pool to riffle to run instream habitat types as runs dominate the lower reaches and riffles are almost completely absent.

Instream habitat conditions were generally poor in this subbasin at the time of the 2007 CDFG surveys. Surveyed reaches fell below target values and were evaluated as unsuitable for steelhead by EMDS for habitat characteristics except canopy density and pool shelter in portions of river (Table 10). However, the survey was performed during one of the driest years on record and some habitat factors such as pool depth and pool shelter may receive higher scores under normal flow conditions in the river.

The U.S. Army Corps of Engineers (Corps) Long-term Operation and Maintenance Plan along the lower seven miles of the river (between the levees) in Oceanside will most likely impact canopy density, pool shelter, pool depth and overall habitat complexity as native riparian trees as well as the large areas overgrown with *Arundo* are scheduled to be removed. While the removal of *Arundo* will help improve habitat conditions for numerous flora and fauna species, near-stream native tree removal will most likely have an adverse effect on steelhead habitat. During periods of high flows, steelhead survival may depend on access to areas of lower velocity on terraces adjacent to the stream. Riparian forests, large downed trees or other structural elements on the flood plain historically formed areas with slow backwaters where steelhead juveniles and adults could find refuge until flows receded. Levee construction and diking have been used for more than a century to confine stream courses and protect agricultural and housing developments on historic floodplains. Velocities inside dikes and levees increase during high flow events and juvenile steelhead may be flushed into the ocean prematurely, minimizing their chance of survival (NMFS and Kier Associates 2008).

The reduction in riparian along the river may also affect water temperatures, which would be a limiting factor for steelhead in the subbasin. Limited data were available on water temperatures, but CDFG in cooperation with Trout Unlimited and Golden State Flycasters have deployed data loggers to record river temperatures during the temperature extreme period from April to the end of October. This collection will take place over the next several years (2008-2009) in at least three locations in the subbasin where year-round flow is present: estuary, downstream of Douglas Avenue (RM 6), and downstream of Keys Creek confluence with the SLR River (RM 18).

Cobble embeddedness and pool depth were unsuitable on all surveyed reaches–thus these habitat factors are likely limiting to potential steelhead recovery. Cobble embeddedness and pool depth are affected by the natural geology of the area as well as the subbasin's lack of hydraulic connectivity to the Middle and Upper subbasins.

Macroinvertebrate data indicate that the SLR River is a highly impacted system, as it scored very poor in Index of Biotic Ratings during a 2005 and 2006 survey. The estuary scored only slightly higher during the 2003 to 2005 Ambient Bay and Lagoon Monitoring Program, were benthic community health was rated as "poor to moderate." Results of the mass loading station and dry weather analytical monitoring and field screening program, survey period of 2001 to 2006, indicated that total dissolved solids continue to be the primary water quality concern in the watershed. The report also notes an increasing trend in indicator bacteria concentration, specifically in fecal coliform at levels above the water quality objective (WQO). While nitrate and dissolved phosphorus were at levels below the WQO both showed significantly increasing trends which may become an issue in the future.

Table 10. EMDS reach condition results for the SLR River, Coastal Subbasin

Stream	Year	Canopy	Pool Quality	Pool Depth	Pool Shelter	Embeddedness
SLR River Reach 1	2007	-	-	--	+	---
SLR River Reach 2	2007	+	+	-	+	---
SLR River Reach 3	2007	++	--	---	--	---
SLR River Reach 4	2007	++	-	---	+	---
Coastal Subbasin		+	-	--	+	---

Table 11. Comparison between historic habitat conditions with current habitat inventory surveys in the SLR River, Coastal Subbasin

Stream	Canopy Cover		Spawning Conditions		Pool Depth/Frequency		Shelter/Cover		Summary of Changes from Historic to Current
	Historic	Current	Historic	Current	Historic	Current	Historic	Current	
SLR River	ND	Fully suitable	Poor	Fully unsuitable	ND	Fully unsuitable	ND	Fully unsuitable	Lower river channelized; Pool habitat most likely decreased; large areas of the riparian and canopy cover now consists of *Arundo donax*

*ND is no data available
Where multiple years of historic streams surveys were available, the oldest surveys were used.

Stream Habitat Improvement Recommendations

In addition to presenting habitat condition data, all CDFG stream inventories provide a list of recommendations that address those conditions that did not reach target values presented in CDFG's *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 1998) and in *NMFS's Guide to reference values used in south-central/southern California coast steelhead conservation action planning workbooks* (2008) (see the Current Conditions pp. 20-27). Stream habitat improvement recommendations were developed based on results from stream surveys conducted along potential salmonid bearing stream reaches in 2007. Full habitat inventories were performed only in the SLR River. Other tributaries in the subbasin were either not accessible to steelhead/trout, did not appear suitable for these fish, or could not be surveyed due to landowner access issues; therefore, full habitat inventories were not conducted and are not included in stream habitat improvement recommendations.

In order to compare SLR River reach recommendations within the subbasin, the recommendations of each reach were collapsed into five target issue categories: Surface Stream Flow; Fish Passage; Riparian/Water Temperatures; Instream Habitat; and Sediment Delivery (Table 12). These target issues were then paired with the appropriate recommendation category. For example, the target issue "Instream Habitat" was divided into the recommendation categories of: pool, cover, and spawning gravels. CDFG/PSMFC biologists selected and ranked habitat improvement recommendations based on survey inventory results collected in SLR River within the Coastal Subbasin (Table 13). The top three recommendations of each reach are considered to be the most important, and are useful as a standard example of the stream. When examining recommendation categories by number of stream reaches in the SLR River, the most important target issue in the Coastal Subbasin is maintaining sufficient stream flows.

In general, there was little difference in ranking of inventory recommendations throughout the four reaches in the SLR River (Table 13). Reach one and Reach two differed slightly from the other reaches because the instream habitat in Reach one is going to be altered by the Army Corps vegetation removal project and Reach two did not contain any passage barriers. Overall, following stream flow, the next most common rankings were fish passage and instream habitat – spawning gravel, pool habitat, and cover were all lacking in these reaches. Because of the high number of recommendations dealing with these target issues, high priority should be given to restoration projects that emphasize improved seasonally appropriate flows, removal of passage barriers, riparian vegetation planting, and water temperature monitoring, improving spawning gravels, pools formation, and cover.

Table 12. Recommendation categories based on basin target issues.

Basin Target Issue	Related Table Categories
Surface Stream Flow	Stream Flow
Fish Passage Barriers	Fish Passage
Riparian / Water Temp	Canopy / Temp
Instream Habitat	Pool / Cover / Spawning Gravels
Sediment Delivery	Bank / Roads / Livestock

Table 13. Occurrence of stream habitat inventory recommendations for different reaches of the SLR River of the Coastal Subbasin.

Stream	Survey Length (mile)	Stream Flows	Fish Passage	Riparian/Water Temps		Instream Habitat			Sediment Delivery		
				Temp	Canopy	Pool	Cover	Spawning Gravel	Bank	Livestock	Roads
SLR Reach 1	5.93	1	2	unk	3		5	4			
SLR Reach 2	3.40	1	5	unk		4	3	2			
SLR Reach 3	3.73	1	2	unk		4	5	3			
SLR Reach 4	4.88	1	2	unk		4	5	3			

Restoration Projects

With the few number of steelhead observed in the basin in the recent past, few projects have been initiated to improve or restore steelhead habitat in the SLR River or its tributaries. The CalFish website (http://www.calfish.org/) 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.).

A couple of significant projects currently underway in the basin that were not conceived as fisheries restoration projects, nonetheless, have and/or will improve the overall habitat conditions for steelhead in the SLR River. While intending to prevent wash-outs of the road and reduce maintenance costs, the Pacific Street realignment and bridge replacement should provide a more natural tidal flow exchange between the ocean and SLR River and thus improve overall estuary conditions. The project replaces two large culverts that drained the river at its mouth with the ocean with a bridge that will span the estuary. These culverts may have posed as a fish passage problem during low and extremely high flows and have altered the natural tidal exchange.

Viewed as increasing flood and fire risk, degrading crop and rangelands, consuming large quantities of water, and displacement of native species and habitat, invasive plants have been targeted as a priority for removal and management in the watershed, particularly in the Coastal Subbasin. While improving overall canopy cover, the removal of exotics and revegetation with native stock will also improve flows and help fish to navigate through the mainstem more easily. The Mission Resource Conservation District (Mission RCD) in conjunction with the Weed Management Area, has treated approximately 292 acres of 507 acres of *Arundo* had been in the watershed, mainly in the Coastal Subbasin along the mainstem and some tributaries. Another 100 acres is slated for treatment during the 2007/2008 season, mostly along lower Keys Creek (http://smslrwma.org/). These treatment efforts will be an on-going project in the subbasin.

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/). Other projects that have occurred or are currently underway that have improved stream habitat conditions or contributed to the monitoring of the stream habitat conditions include the following:

- Land acquisition for the SLR River Park and resource conservation;
- Corps and Mission RCD's *Arundo* and Salt Cedar removal projects along the SLR. Mission RCD projects replanted areas with native plant species;
- Water quality monitoring performed by the City of Oceanside and associated contractors (2001 to present). This monitoring includes the analysis of chemistry, bacteria, and toxicity data collected during storm water events and dry weather data from the dry weather monitoring program;
- Stream bioassessment performed by consultants for the City of Oceanside;
- Spring 2008 to December 2009 water temperature monitoring by the Department of Fish and Game in conjunction with Trout Unlimited;
- Spring 2008 to December 2009 water chemistry analysis and bioassessment by Trout Unlimited in conjunction with the San Diego Coastkeeper;
- Water quality control via animal waste improvement projects;
- Mission RCD working with area farmers on Best Management Practices for pesticide and erosion control

and prevention;

- Collectively, the San Luis Rey Watershed Copermittees, such as the City of Oceanside, hosted and participated in numerous cleanup and outreach events, including creek and coastal cleanups and regional event presentations at which watershed concepts were emphasized;
- The San Luis Rey Watershed Copermittees delivered formal presentations to approximately 1,035 students throughout the watershed. Common learning tools used in these presentations include the Enviroscape watershed model, outdoor field trips puzzles, water quality posters, videos, and PowerPoint presentations (PBSJ 2003).

Refugia Areas

CDFG/PSMFC biologists identified and characterized refugia habitat in the Coastal Subbasin by using professional judgment and criteria developed for 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 team also used results from information processed by the EMDS at the stream reach scale (Table 10).

The most complete data available in the Coastal Subbasin was the mainstem surveyed by CDFG. However, the mainstem was still lacking data for some factors considered. Salmonid habitat conditions in the Coastal Subbasin on surveyed streams are generally rated as low potential refugia (Table 14). Portions of the mainstem provide potential rearing habitat for juvenile trout. With habitat improvement projects the SLR River estuary could potentially provide critical rearing habitat as well. In the absence of performing full habitat inventories in Coastal Subbasin tributaries, sections of a few tributary streams (Table 14) containing flowing water were surveyed on foot in order to make general observations of the habitat conditions. Based on these limited surveys, Ostrich Creek, Gopher Canyon, and Live Oak Creek most likely provide low quality refugia. Pilgrim Creek, located near the western end of the subbasin was not surveyed; therefore it is difficult to speculate the type and quality of habitat present in this creek. There is a barrier approximately 1 mile upstream its confluence with the SLR River and flows appear to be diverted for irrigation. The following refugia area rating table (Table 14) summarizes subbasin salmonid refugia conditions.

Table 14. Tributary salmonid refugia ratings in the Coastal 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			
Pilgrim Creek					x		x Needs survey
Gopher Canyon				x			x
Ostrich Creek				x			x
Live Oak Creek				x			x

Key Subbasin Issues

- The Coastal Subbasin is not hydrologically connected to flows in the Middle and Upper subbasins, which adversely impacts water quality and quantity, complex instream habitat, native flora and fauna, recruitment of new streambed substrates and providing beach sand replacement along the coast;
- Invasive plant species, *Arundo and Tamarisk,* have altered the riparian landscape and degraded instream habitat conditions of the SLR River;
- The natural function of the SLR River estuary, which once sprawled more than 2,200 acres, has been altered considerably by the marina, urban development, and on-going flood protection activities within the estuary and floodplain area. Presently, the estuary has been downsized to an approximately 164 acre

floodplain with degraded habitat conditions;

- Urban and agricultural runoff poses a problem to aquatic ecosystems in the mainstem SLR River;
- Partial fish passage barriers exist throughout the SLR River within the subbasin;
- Sediment level in streams is high and creates a multitude of problems for fish habitat;
- The river's streambed is most likely still negatively impacted by previous upstream gravel mining practices.

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:

- Southern California Coast Steelhead (DPS) are federally listed as endangered;
- The Coastal Subbasin once supported steelhead runs, but they have been nearly extirpated from the SLR River. Steelhead most likely used the subbasin, particularly the estuary/lagoon as important rearing habitat during juvenile outmigration;
- Very few steelhead have been observed in the subbasin since the late 1940s;
- Contributing to the lack of observations have been the absence of general and focused surveys for these fish. Aside from a few seining efforts performed in the estuary in 2000 and 2003, no focused or general surveys have occurred in the mainstem for steelhead since the 1940s;
- One adult steelhead was observed during CDFG 2007 habitat surveys in Oceanside, approximately seven miles upstream its mouth with the ocean. A second adult was reported but not confirmed by CDFG personnel;
- There is also a lack of historical information on steelhead using any of the tributaries in the Coastal Subbasin. A literature review provided no records of steelhead sightings in any of these tributaries; however, general or focused surveys have not been performed on any of these tributaries;
- Unarmored threespine stickleback and tidewater goby are federally listed species that once inhabited the SLR River in the Coastal Subbasin but may have been extirpated.

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

Findings and Conclusions:

<u>Flow and Water Quality:</u>

- The Coastal Subbasin is not hydrologically connected to flows in the Middle and Upper subbasins as practically all river flows are diverted to the Escondido Canal. Stream flows are also seriously impacted by numerous extraction pumps and other anthropogenic uses located throughout the subbasin;
- Low summer flows may be stressful to salmonids, and dry or intermittent reaches on the SLR River seasonally prevent connection to the estuary;
- Water quality is being impacted by agricultural and urban runoff that have direct access to streams;
- The SLR River urban sites had an Index of Biotic Ratings of Very Poor during both surveys. The in-stream physical habitat of these sites was qualified as marginal, which could have limited macroinvertebrate colonization.

<u>Erosion/Sediment:</u>

- Excessive sediment in stream channels has resulted in an overall loss of spawning, rearing and feeding habitat for salmonids. The majority of the SLR River channel is composed of Quaternary Alluvium consisting of sand and silt. High sediment levels are confirmed by embeddedness measurements in surveyed reaches;
- Livestock have unrestricted access to some tributaries, resulting in stream bank erosion;
- Soils (and bedrock) in streams of the Coastal Subbasin are prone to erosion, and slides and streambank failures have been observed to contribute fines to the streams.

Riparian Condition/Water Temperature:

- Canopy density measurements on the SLR obtained suitable values on three of the four reaches. The lower reach, where canopy target values were not met are partially related to the naturally, broad river channel. Riparian trees are present, but are not tall enough to sufficiently cover the entire river;
- Invasive plant species such as *Arundo donax* and *Tamarisk sp*. are widespread and have displaced large amount of native riparian vegetation;
- The Corps Operation and Maintenance Plan in the lower seven miles of the river channel has removed and will continue to remove large amounts of vegetation over the next couple of years. This will adversely affect the canopy cover in this area;
- Water temperature data collected by CDFG during summer habitat inventories indicate acceptable levels, with some streams nearing stressful conditions. However, these data are limited, and therefore inconclusive.

Instream Habitat:

- Based on observations and data recorded during instream habitat inventories, high quality salmonid habitat is lacking in all surveyed reaches of the SLR River within the Coastal Subbasin. Conditions present at the time of the survey indicated a low number of pools as well as a poor percentage of pool habitat by surveyed stream length. Furthermore, the majority of the pools present were shallow and pool shelter cover is generally lacking;
- Stream bioassessments performed in the lower mainstem SLR River had Index of Biotic Integrity Ratings of Very Poor during 2005 and 2006 surveys (Weston Solutions 2007);
- The SLR estuary's health assessed during the 2003-2005 period was rated as poor to fair based on analysis of Benthic Response Index (BRI) and Relative Benthic Index (RBI) scores;
- Tributaries appear to offer very limited additional spawning and rearing habitat due to low flows and unsuitable instream conditions.

Gravel/Substrate:

- Suitable salmonid spawning areas were limited in surveyed reaches of the SLR River. Overall numbers of potential spawning gravels were low and embeddedness measurements did not meet target values, confirming that sediment levels in the subbasin are high;
- The unsuitable embeddedness ratings are the result of the following factors: the natural channel morphology of the alluvial streambed, past (mining) and present human-related activities and the lack of hydrologic connectivity from the middle and upper watershed.

Refugia Areas:

- Salmonid habitat conditions on the mainstem are generally rated as low quality refugia;
- A few tributaries that were surveyed, but not inventoried, such as Gopher Canyon, Ostrich Creek, and Live Oak Creek, also appeared to provide low quality refugia;
- The once expansive SLR River estuary/lagoon could have once provided excellent habitat for rearing juvenile steelhead before their entrance into the ocean. In its current state, the estuary provides low

potential refugia as rearing habitat for juvenile fish is limited.

Barriers:

- Several partial fish passage barriers exist in the SLR River, such as the rip-rap below the Douglas Avenue and College Avenue bridges, road crossing at RM 11 and a metal sheet spanning the river at RM 17.5 that would seasonally obstruct the upstream movement of adult steelhead and hinder juvenile emigration to the estuary and thus the ocean;
- Pilgrim Creek contains possible fish passage barriers in its lower reaches.

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

Findings and Conclusions:

- The dominant material in the Coastal Subbasin is median sand, which is highly transportable during floods;
- Severely erodible soils comprise 95% of the watershed, including the Coastal Subbasin; slides from the stream banks and roads have been observed to contribute fines to the stream;
- 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 Coastal Subbasin is in a potentially seismically active area. 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;
- Seismic events off the coast may produce Tsunamis capable of redepositing sediments, filling channels, and initiating even more landsliding;
- Uplift has increased the erosion potential of the area;
- Wildfires that occurred within the watershed during the fall of 2007 most likely resulted in an increase in sediment input into the SLR River.

How has land use affected these natural processes?

Findings and Conclusions:

- The channelization of the lower river for flood protection purposes has altered the natural hydrologic processes of the river and has caused uniformity throughout much of the river's channel;
- Agricultural and urban runoff have affected the water quality of many of the subbasin's streams;
- Disturbance of the basin's already unstable soils by land use activities has altered runoff rates;
- Riparian vegetation has been cleared through agricultural activities and is currently being removed for flood control and maintenance projects in the lower river;
- Large areas of native vegetation along the mainstem and in tributaries have been displaced by non-native plants. These non-natives have altered the channel morphology of the river;
- Invasive plants occupy habitat that normally has little vegetation, for example, the SLR River's sandy channel bed in the Coastal Subbasin;
- The SLR River estuary's natural function has been greatly altered due to the development that has occurred in what was once an expansive network of wetlands, marsh, and stream channels but is now a marina. In addition to steelhead, other fish species are dependent on an estuarine environment for completion of their life histories.

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

Findings and Conclusions:

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

- Low summer flows and areas in the SLR River that go completely dry during the late spring to early fall months;
- Poor water quality;
- Fish passage barriers;
- Spread of exotic flora such as *Arundo* and *Tamarisk*;
- High levels of fine sediments in streams;
- Loss of habitat area and complexity;
- A shortage of areas with suitable spawning gravel in tributaries;
- Lack of suitable habitat in the estuary;
- Potentially high summer water temperatures;
- Competition with warm water game fish, bullfrogs, and crayfish.

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

Habitat improvement activity recommendations are limited to the SLR River since it was the only stream extensively surveyed during the assessment. Other streams, Pilgrim Creek, Live Oak Creek, and Ostrich Creek in the subbasin, may have the potential to support steelhead/trout, but further studies are needed in order to make suitable habitat improvement recommendations for those individual watersheds.

Barriers to Fish Passage

Stream	Recommended Actions XXX: Highest Priority		
SLR River:	Continue efforts to identify and alleviate fish passage impediments at culverts or other public or private road crossings.	Improve fish passage by modifying concrete rip-rap areas below bridges at Douglas Avenue and College Avenue.	Improve fish passage by removing structures on private lands that are currently partial barriers.
	XXX	XXX	XX

Flow and Water Quality

Streams	Recommended Actions XXX: Highest Priority			
SLR River:	Insure that water diversions used for domestic or irrigation purposes bypass sufficient flows to maintain all needs of fishery resources.	Provide seasonally appropriate, pulse flow releases in the upper watershed during adequate water years.	Plant willows, cottonwoods, or alder trees to help reduce water temperature in areas with insufficient shade.	Remove and prevent excessive agricultural or urban runoff contributions to aquatic ecosystems.
	XXX	XXX*	X	XX

*See Basin Profile for limitations concerning this recommendation.

Erosion and Sediment Reduction

Streams	Recommended Actions XXX: Highest Priority			
SLR River:	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.	Build livestock exclusionary fencing along creeks and create offsite watering areas.	Install instream structures that enhance natural sorting of spawning gravels.
	XX	X	X	X

Riparian and Instream Habitat

Streams	Recommended Actions XXX: Highest Priority		
SLR River:	Increase depth, area or shelter complexity in pools, by adding boulders. To increase the number of pools install pool forming structures.	Identify and prioritize locations within the estuary where vegetation can be returned to salt tolerant species, thus improving the habitat recovery of the estuary for all marine dependent species that may use the estuary.	Continue to remove *Arundo* and *Tamarisk* plant species in conjunction with upstream eradication efforts. Where appropriate restore these areas with native vegetation such as willow, cottonwood and sycamore to increase streamside shade canopy and allow for woody recruitment.
	X	XX	XXX

Education, Research, and Monitoring

Streams	Recommended Actions XXX: Highest Priority		
SLR River:	Continue, expand, or develop education programs concerning water conservation, water quality, and importance of watershed/riverine ecosystems.	With the removal of the Pacific Street bridge in the estuary, water quality and estuary conditions will require monitoring. Salinities should be collected in the estuary and upstream to determine the extent of brackish conditions. Biological surveys should be performed in the estuary for at least a three year period.	Water quality monitoring should continue on a yearly basis to characterize conditions in the SLR River and its tributaries. Water temperature monitoring should be conducted for a couple of years to assess SLR River temperatures throughout the subbasin.
	XX	XX	XXX

Subbasin Conclusions

There have been more biological and habitat surveys conducted on the SLR River in the Coastal Subbasin than in any of the other subbasins. These studies describe deterioration in steelhead habitat due to an assortment of historical and current anthropogenic activities in the subbasin and throughout the basin. Lack of hydrologic connectivity with the middle and upper watershed, channelization of the river, riparian vegetation removal, invasion of exotic plant species, significant alteration of the estuary, upstream sand and gravel mining, agricultural practices, and urban development have all played a role in changing the natural function of the river, water quality and quantity and thus instream habitat for fish. The infusion of Colorado River water into the basin (beginning in the late 1940s but increasing throughout 1960s) for irrigational and household uses has decreased the water quality of the river, particularly in the Coastal Subbasin. This imported water source contains high levels of TDS and chloride.

The geology of the area also contributes to fluctuating riverine conditions. Soils in this subbasin and upstream are susceptible to erosion and enter the streams through the many road related and stream bank slides. High amounts of sediment are present in the river and its tributaries. Potential steelhead spawning areas have become heavily silted and are therefore unproductive in much of the subbasin. While not conclusive, measured water temperatures in the river neared stressful conditions when compared to suitable steelhead habitat criteria. Additionally, there are several partial, fish passage barriers in the river that fragment steelhead habitat and would hinder/prevent the movement of steelhead trout throughout the subbasin. These barriers are as follows: road crossings containing culverts not designed for fish passage, concrete and boulder rip-rap under bridges that prevent low flow fish passage, an upright metal sheet that spans the river effectively creating a low flow barrier, and dry reaches that would limit the upstream and downstream movement of steelhead/trout.

The lack of historical information regarding previous habitat conditions and presence of steelhead within the Coastal Subbasin makes it difficult for one to speculate on historical use of the subbasin for spawning and rearing habitat. Considering the river is located in what was once a large floodplain, it seems likely that steelhead used this portion of the river as a migration corridor to more suitable spawning areas upstream of the Coastal Subbasin; however, with cooler coastal temperatures, adequate stream flows, and diverse, abundant riparian, steelhead may have utilized this section of the SLR River and almost certainly the estuary as important rearing habitat (Boughton 2006). Having perennial river flows prior to the completion of the Escondido Canal diversion and the Henshaw Dam, the SLR River instream habitat conditions would have been significantly different than their current state. In addition to being more conducive to upstream adult migration and

downstream smolt migration to the ocean, the river would have contained more complex habitat.

Estuary conditions were far more suitable for steelhead prior to human's intervention, as the estuary once encompassed over 2,200 acres and included intermittent connectivity with the Santa Margarita River lagoon to the north (MBC Applied Environmental Sciences 2003). This expansive area would have provided excellent rearing habitat for juvenile steelhead before entering the ocean. Previous studies (Smith 1994, Bond 2006, and Hayes et al. 2008) have shown that estuaries in many systems have provided important growth opportunities for out-migrating smolts and brackish areas for fish to adjust to salt water (Healey 1982); these important growth opportunities would improve the chance for smolt survival in the ocean. The removal of the Pacific Street crossing could restore more normal conditions in the lagoon and increase the potential for recovery or recolinization of a variety of species of fish, amphibians, and reptiles. An ongoing hydrologic/ biological study should be implemented to study the ongoing effects of the bridge replacement on sediment transport, water quality, lagoon habitat, and estuarine-dependent fish species.

It is unknown whether steelhead used any of the tributaries within the subbasin. While several large tributaries exist, such as Pilgrim Creek, Ostrich Creek, and Live Oak Creek, there is a lack of recorded or anecdotal information regarding the presence of steelhead in these streams. Whether any of these streams historically retained perennial flows to provide rearing habitat is also unknown.

The current stream habitat condition ratings for steelhead in the Coastal Subbasin were split depending on the category: low suitability for embeddedness and pool depth and moderate to high suitability for pool shelter and canopy density. The U.S. Army Corps of Engineers (Corps) Operation and Maintenance Plan along the lower seven miles of the river in Oceanside will most likely impact canopy density, pool shelter, and pool depth as riparian trees and *Arundo* near the river are scheduled to be removed. While the removal of *Arundo* will help improve habitat conditions for numerous flora and fauna species, near-stream native tree removal will most likely have an adverse effect on instream steelhead habitat. Furthermore, the numerous land and resource use projects currently in the planning stages, such as the Gregory Canyon Landfill, Rosemary's Mountain Quarry, large housing developments at the Interstate 15/Highway 76 interchange, City of Oceanside water wells near the SLR River, etc., will most likely have a significant effect on the riparian, instream habitat, and water quality and quantity of the lower SLR River.

While this area remains a potentially important migration corridor for adult fish, as evident by the adult steelhead observed in the spring of 2007 at RM 7, near College Ave, it could also serve as an important migration/rearing area for juvenile trout on their out migration to the ocean, especially during normal to high flow water years conducive to the movement of steelhead. In addition to the challenges of having on-going water quality issues, little to no surface flows in the lower to mid SLR River, reducing the presence of invasive, non-native flora and fauna, there is the need to maintain hydrologic connectivity of the Northern Subbasin streams with the estuary. Implementing seasonally appropriate, pulse release flows during adequate water years, would greatly facilitate the migration of adult fish and out migration of juvenile fish. These increased flows could also help to restore complex instream habitat conditions. Pulse release flows, in conjunction with fish passage improvements, ongoing exotic plant removal, restoring estuary habitat and other habitat restoration projects are needed to further enhance the overall conditions for steelhead in the subbasin.