9. Interior Coast Range Biogeographic Population Group

"Assessment at the group level indicates a priority for securing inland populations in southern Coast Ranges and Transverse Ranges, and a need to maintain not just the fluvial-anadromous life-history form, but also lagoon-anadromous and freshwater-resident forms in each population."

NOAA Fisheries Technical Recovery Team
Viability Criteria for South-Central and Southern California, 2007

9.1 LOCATION AND PHYSICAL CHARACTERISTICS

The Interior Coast Range BPG region is the largest of the four BPGs in the SCCCS Recovery Planning Area and includes the east-facing (interior) slopes of the Central Coast Ranges (Santa Lucia Mountains and Santa Cruz Mountains) and the west-facing slopes of the Inner Coast Range (Diablo, Gabilan, Caliente, and Temblor ranges) (Figure 9-1). This region extends 180 miles across the entire length (north-to-south) of the SCCCS Recovery Planning Area and includes portions of Santa Clara, San Benito, Monterey, and San Luis Obispo Counties. This BPG consists of two major watersheds, the Pajaro River and Salinas River, which flow into the Pacific Ocean at Monterey Bay. The Pajaro River watershed includes the Salsipuedes, Corralitos, Casserly, San Benito River, Uvas, Pacheco and Llagas sub-watersheds. The Salinas River watershed is the largest coastal watershed contained entirely within California, covering over 2.8 million acres (4,426 square miles) and contains two major sub-basins: the Lower Salinas sub-basin, which includes the Gabilan Creek and Arroyo Seco watersheds, and the Upper Salinas sub-basin, which includes the San Antonio River, Nacimiento River, and Estrella River watersheds (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b).

Pajaro River

Tectonic activity associated with the northwest-trending San Andreas Fault has created a parallel series of northwest-southeast trending basins and ranges in this part of California. The mainstem of the Salinas River runs through the center of most of this BPG and two major

tributaries, the San Antonio and Nacimiento Rivers are unusual in that they flow southward for most of their length before their confluence with the Salinas River, which flows northwest (see Figure 9-1).

Salinas River

San Antonio River

Average annual precipitation in this region is relatively low and shows high spatial variability. In general, the higher elevations get more moisture, but because of the "rain shadow" effect created by the coastal slope of the Central Coast Range, the eastern half of the Interior Coast Range BPG receives significantly less precipitation than the western half. The higher elevations of the western portion of Pajaro River watershed extend into the redwood coniferous forests of the Santa Cruz Mountains and receive significantly more rainfall than do other portions of the Interior Coast Range BPG. As noted in Chapter 2, the San Benito River flows on the east side of the Gabilan Range, and is considerably drier, with sparse shading, and limited potential to provide over-summering habitat for rearing juvenile steelhead; similar conditions exist in the Estrella River, tributary to the upper Salinas River which joins the Salinas from the east.

Nacimiento River

Although the highly dissected topography contributes to a very large total stream length in this region (7,773 miles), the majority of drainages naturally exhibit seasonal surface flow or have extensive intermittent reaches because of the highly variable patterns of precipitation (influenced by an orographic effect as winter storms pass over the coastal ranges) and the complex geology (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b, Alt and Hyndman 2003, McCulloch 1990, Norris and Web 1990, Page 1981, Muir 1972).

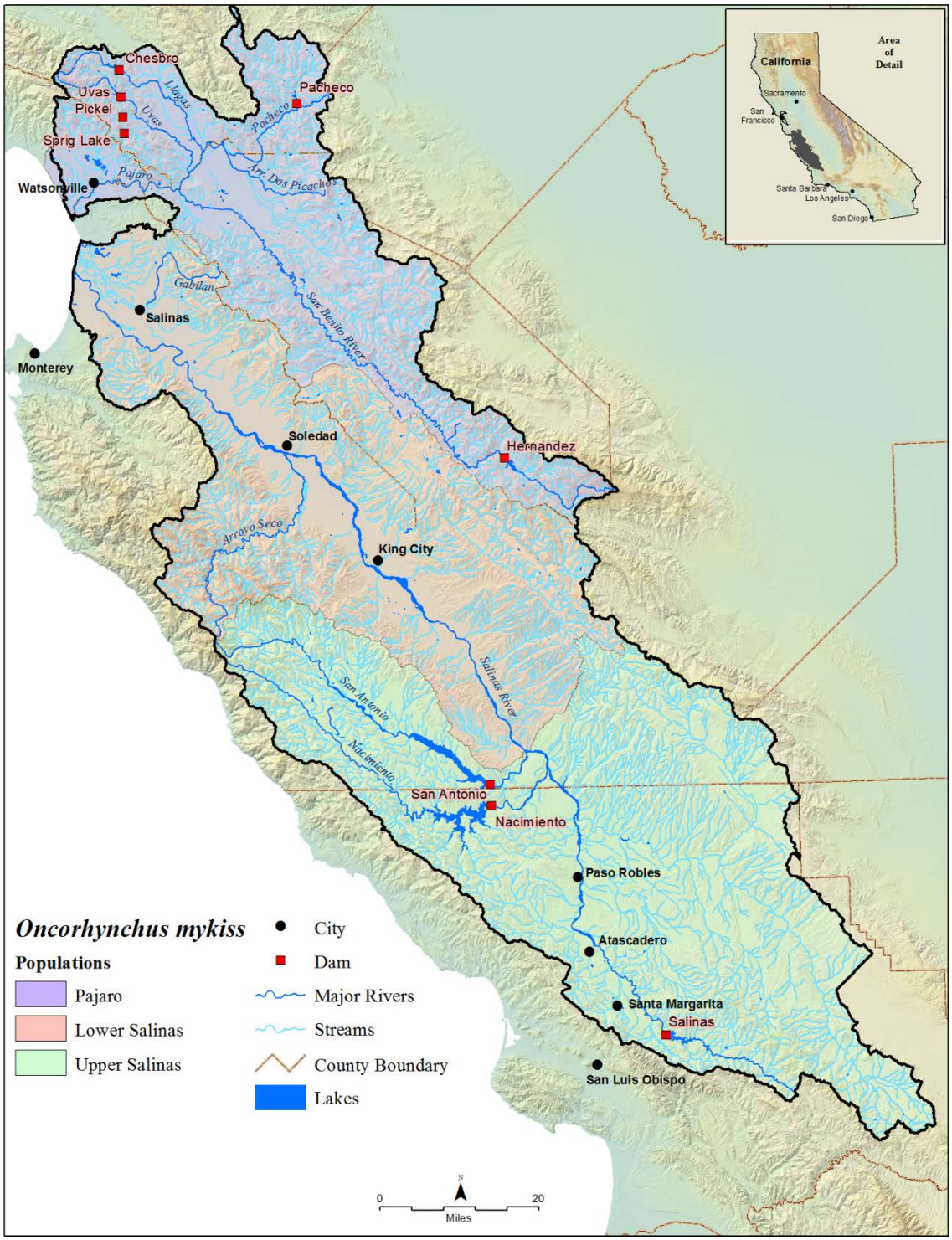

Figure 9-1. The Interior Coast Range BGP. Seven populations/watersheds were analyzed in this region: two in the Pajaro River watershed (mainstem Pajaro River and Uvas Creek); three in the Lower Salinas River watershed(mainstem Salinas, Gabilan Creek, Arroyo Seco), and two in the Upper Salinas River watershed (San Antonio River and Nacimiento River, including the Salinas mainstem).

9.2 LAND USE

Table 9-1 summarizes land use and population density in the Interior Coast Range BPG. Although human population density is relatively low for the region as a whole (averaging about 100 persons/square mile), population centers such as Atascadero, Paso Robles, and Salinas are growing rapidly and are surrounded by large tracts of semi-developed rural land. Most of the land in the Pajaro River watershed, along the mainstem of the Salinas River (*i.e.,* the Salinas Valley), and throughout the eastern half of the BPG region, is privately owned. However, non-governmental organizations such as The Nature Conservancy, the Land Trust of Santa Cruz County, the Big Sur Land Trust, and the Peninsula Open Space Trust have acquired significant lands within these watersheds. Public ownership of land is concentrated in the Los Padres National Forest and military bases, such as Fort Hunter-Liggett and Camp Roberts, located in the western portions of this BPG. Additionally, several rivers have been evaluated for consideration as federally-designated Wild and Scenic Rivers, including Arroyo Seco and Tassajara Creek (tributaries to the Salinas River within the Los Padres National Forest).

Arroyo Seco –Salinas River Tributary

Agriculture (row crop, orchard cultivation, livestock ranching, and increasingly vineyards) within the Salinas River watershed are important land uses that directly or indirectly affect watershed processes throughout this BPG. A major consequence of agricultural activity in this region is reservoir development (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b; see also, Central Coast Salmon Enhancement 2008, Grossinger *et al.* 2008, U.S. Army 2007, Harris *et al.* 2006, Upper Salinas-Las Tablas Resource Conservation District 2004, Newman et al. 2003, Watson *et al*. 2000, California *Regional* Water Quality Control Board 1999, Stephenson and Calcarone 1999, California Department of Water Resources 1978). See Figure 9-2 for the pattern of federal and non-federal land ownership within the Pajaro River watershed; and Figure 9-3 for the pattern of federal and non-federal landownership within the Salinas River watershed.

Confluence of Arroyo Seco and Salinas River – Agricultural Development

There are at least 37 dams in this region that are large enough to be regulated by the California Department of Water Resources and/or Department of Defense (Figure 9-1 shows nine of the most significant dams, (though Sprig and Pickel Dams no longer

impound water or block fish passage). These dams are owned and operated by, state, public utility, local government, or private interests for irrigation, flood control and stormwater management, recreation, municipal water supply, hydroelectric power generation, fire protection, farm ponds, or a combination of these purposes (California Department of Fish and Wildlife 2012a, 2012b, California Department of Water Resources 1988).

San Antonio Dam

The largest reservoirs in this region, San Antonio Lake (on the San Antonio River), Lake Nacimiento (on the Nacimiento River), and Santa Margarita Lake (on the Upper Salinas River mainstem), receive extensive recreational use. The larger dams such as Uvas (Pajaro River watershed), San Antonio, Nacimiento, and Salinas (Salinas River watershed) do not provide upstream fish passage, though may inadvertently allow downstream fish migration from areas above the reservoirs (which act as a refugia for non-native warm water species). Additionally, there is a large seasonal dam and diversion structure on the lower Salinas River which is designed to impound and distribute spring, summer, and early fall releases from the upstream reservoirs to provide surface water deliveries for nearby agriculture; these surface water diversions are intended to offset groundwater pumping and therefore reduce saltwater intrusion into the coastal groundwater basin. The operation of this facility is governed by a Biological Opinion issued by the NMFS which describes the standards, criteria, and timing for that are necessary for the completion of the steelhead's life-cycle within the Salinas watershed (National Marine Fisheries Service 2007c). Several of the smaller dams such as Sprig and Pickel have been modified to allow fish passage: in the case of Sprig Dam, it is no longer in operation and has been permanently drained, with an open portal at its base; Pickel Dam has an open port at its base as well as a fish ladder.

Salinas River - Rock Quarry Operation

Instream gravel mining operations are also significant land uses in both the Pajaro and Salinas River watershed (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b, Bodensteiner *et al.* 2003; see also Monterey County Water Resources Agency 2010a, 2010b, 2011a, and 2011b).

Table 9-1. Physical and Land Use Characteristics of Watersheds in the Interior Coast Range BPG. Sub-watersheds are in parentheses).

PHYSICAL CHARACTERISTICS					LAND USE				
WATERSHEDS (north to south)	**Area** (acres)[1]	**Area** (sq. Miles)[1]	**Stream Length**[2] (miles)	**Ave. Ann. Rainfall**[3] (inches)	**Total Human Population**[4]	**Public Ownership***	**Urban Area**[5]	**Agriculture/ Barren**[5]	**Open Space**[5]
Pajaro River	838,776	1,311	1,843	16.9	235,807	7%	4%	14%	83%
Lower Salinas Basin	1,255,902	1,962	2,598	16.5	286,853	14%	3%	19%	78%
(Gabilan Creek)	(99,929)	(156)	(247)	(18.9)	(154,907)	(0%)	---	---	---
(Arroyo Seco)	(196,430)	(307)	(477)	(18.5)	(920)	(58%)	---	---	---
Upper Salinas Basin	1,576,869	2,464	3,332	16.4	95,399	24%	1%	4%	94%
(San Antonio River and Nacimiento River combined)	(456,758)	(714)	(1,030)	(17.4)	(4,598)	(55%)	---	---	---
TOTAL or AVERAGE	**3,671,547****	**5,737****	**7,773****	**17.4**	**778,484****	**15%****	**3%**	**12%**	**85%**

[1] From: CDFFP CalWater 2.2 Watershed delineation, 1999 (www.ca.nrcs.usda.gov/features/calwater/)
[2] From: CDFG 1:1,000,000 Routed stream network, 2003 (www.calfish.org/)
[3] From: USGS Hydrologic landscape regions of the U.S., 2003 (1 km grid cells)
[4] From: CDFFP Census 2010 block data (migrated), Cal Fire FRAP (http://frap.cdf.ca.gov/data/frapgisdata/select.asp)
[5] From: CDFFP Multi-source land cover data (v02_2), 2002 (100 m grid cells) (http://frap.cdf.ca.gov/data/frapgisdata/select.asp)
** Includes National Forest Lands and Military Reservations; does not include State or County Parks (from: http://old.casil.ucdavis.edu/casil/gis.ca.gov/teale/govtowna/)*
*** Total or average for Pajaro River watershed (including Uvas Creek sub-watershed), Lower Salinas Basin (including Gabilan Creek and Arroyo Seco sub-watersheds), and Upper Salinas Basin (including San Antonio River and Nacimiento River sub-watersheds)*

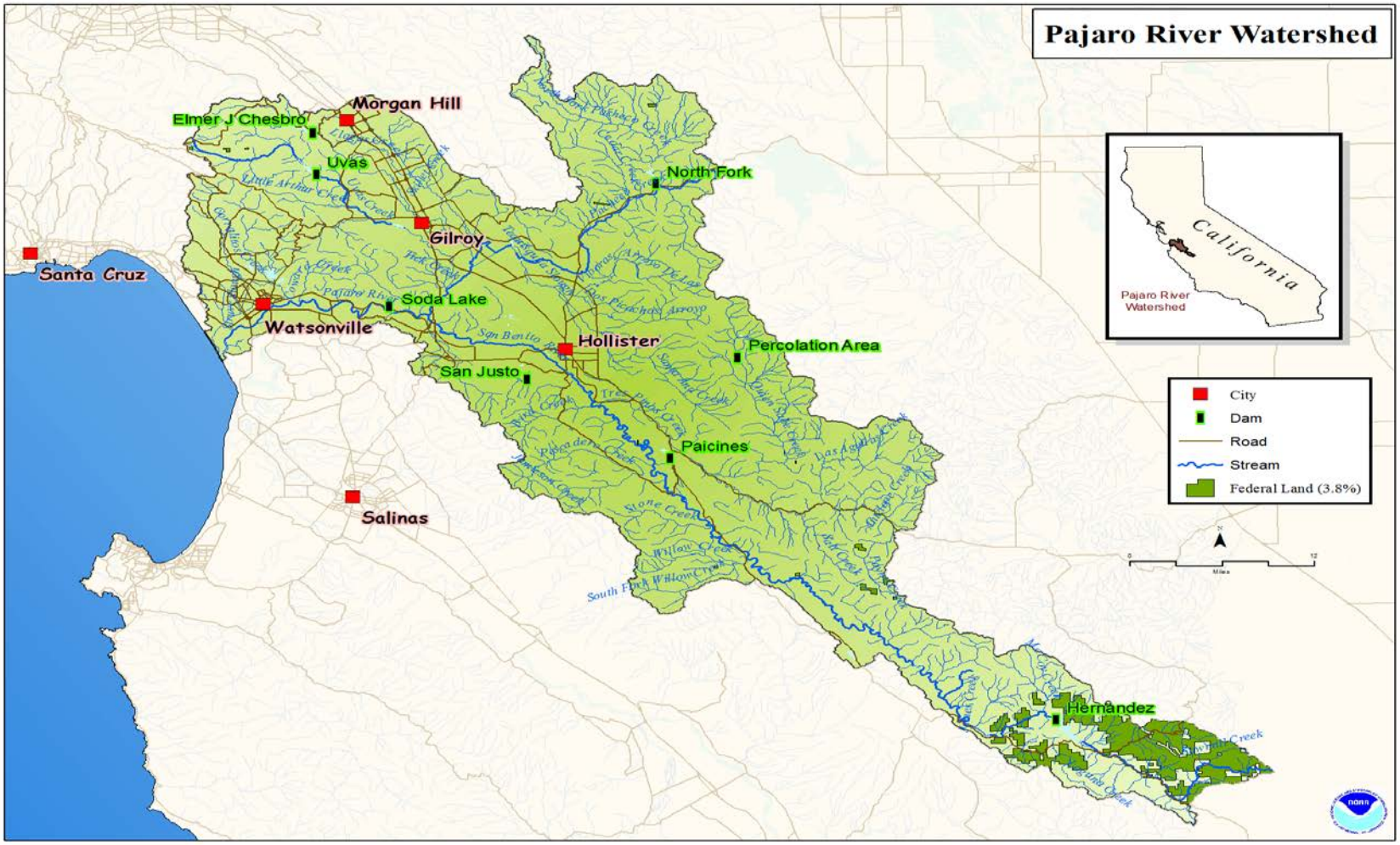

Figure 9-2. Federal and Non-Federal Land Ownership within the Pajaro River Watershed.

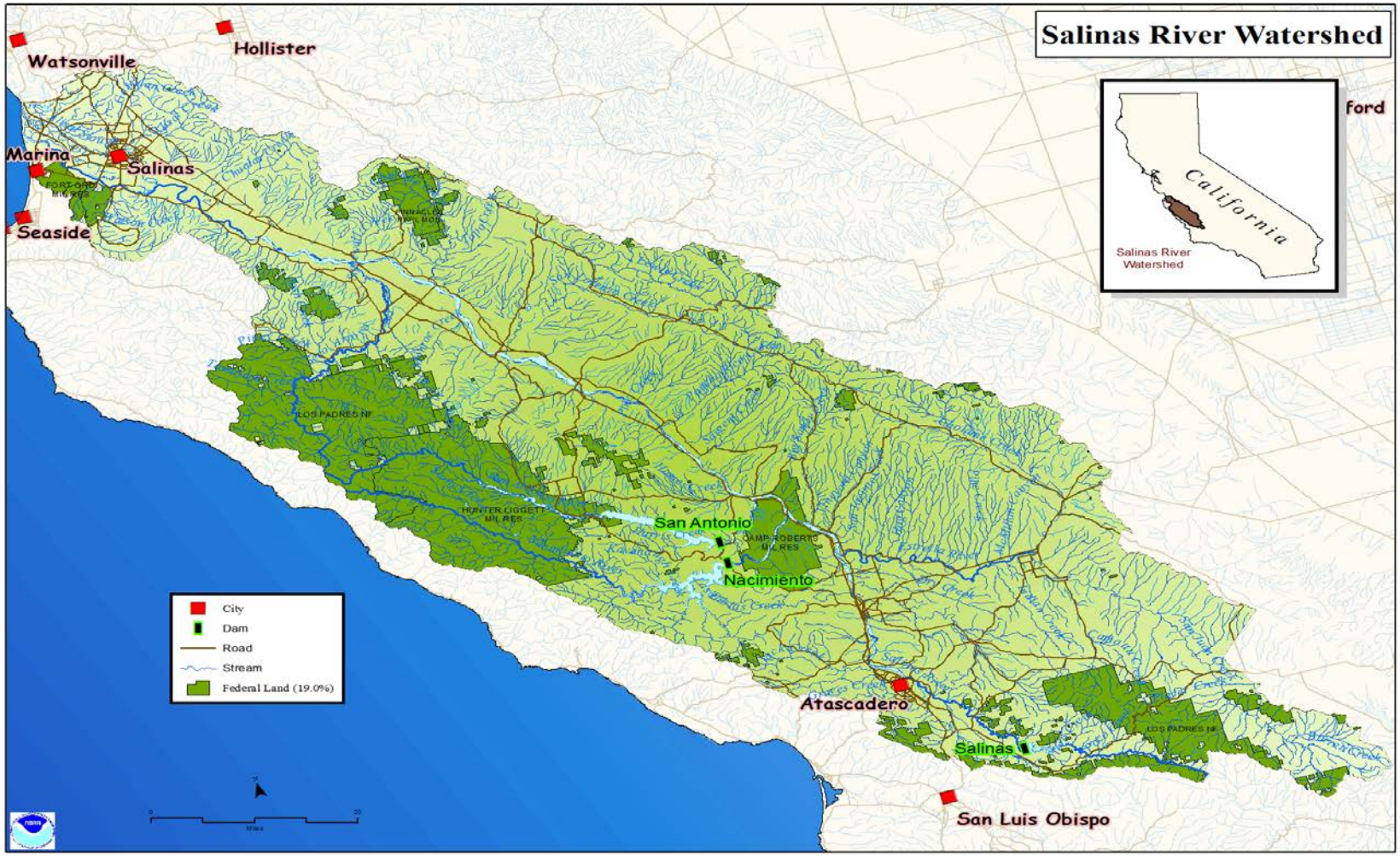

Figure 9-3. Federal and Non-Federal Land Ownership within the Salinas River Watershed.

9.3 Current Watershed Conditions

Watershed conditions were assessed for the mainstems of the two major rivers and for five sub-watersheds in the Interior Coast Range BPG chosen from those identified by the TRT, with the focus on conditions most directly relevant to steelhead. The mainstem and major tributaries of most of the drainages in this BPG currently provides fair to poor habitat conditions for anadromous *O. mykiss*. Habitat conditions were rated as "Fair" in the Uvas Creek, Arroyo Seco, and Nacimiento River watersheds, and "Poor" in the Pajaro River, Salinas River, and San Antonio River watersheds (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b; see also, Smith 2013, 2007a, 2007b, 1998, 1992, Casagrande 2012, 2011, 2010a, 2010b, 2010c, 2003, 2001, Central Coast Salmon Enhancement 2008, Santa Clara Valley Water District 2007, 2006, Unites States Army 2007, Harris *et al*. 2006, Casagrande and Watson 2006, San Benito County Water District 2006, **C**asagrande and Hager 2003, Upper Salinas-Las Tablas Resource Conservation District 2004, Hagar Environmental Science 2001, Hager 2001, Londquist 2001, Stephenson and Calcarone 1999, Harvey & Stanley Associates 1983). Habitat quality in Uvas Creek generally improves downstream, with lower turbidity, improved substrate quality, and invertebrate production associated with winter flows contributed by downstream unregulated tributaries and the distance from Uvas Dam (Casagrande 2010a). However, the Gabilan Creek watershed is adversely impacted with fine sediment and water diversions, and upstream passage is heavily restricted by downstream fish passage barriers (Casagrande 2010b).

Pajaro River Valley- Agricultural Development

Each of the watersheds included in this BPG are subject to one or more instream, riparian, or upland land use conditions that pose significant threats to steelhead. In general, habitat quality declines in a downstream direction through each of these watersheds. The upper watersheds tend to be in relatively good condition, and the mainstems tend to be in fair to very poor condition.

Uvas Creek – Pajaro River Tributary

A major concern in this BPG is that the mainstems of the two primary drainages, the Pajaro and Salinas rivers, are severely impaired by intensive anthropogenic activities related to agriculture, and residential development and associated water development and management (see discussion below). Additionally, historic logging in the upper watershed of the Pajaro

River has created on-going legacy effects as a result of the removal of old growth forests, and associated roads. This threat is being addressed through a variety of programs sponsored by the County of Santa Cruz, including the Integrated Watershed Restoration Program for Santa Cruz County. The County also has a Large Woody Material Program, though this does not specifically address legacy effects.

The mainstems of these rivers are critically important because provide the conduits that connect the ocean, estuary, and upper watershed habitats needed by anadromous *O. mykiss* to complete their life cycle.

Salinas River Valley – Residential Development

Major tributary watersheds, such as Arroyo Seco provide excellent spawning and rearing habitat for steelhead, though sections have ephemeral flows, particularly in the lower reaches affected by irrigation for agricultural development. Additionally, portions of the upper reaches of the San Antonio and Nacimiento rivers, provide generally seasonal habitat for salmonids, but receive low ratings because they are highly constrained by passage barriers along their lower reaches including dams and/or seasonally dry reaches (*e.g.*, in the mainstem of the Salinas River). Dams and dam operations, particularly in the upper tributaries to the Pajaro and Salinas River systems have had a number of significant adverse effects on hydrologic processes which are essential to creating and maintaining suitable steelhead habitats. These facilities have altered the timing, duration and magnitude of flows which are not only essential to provide migration opportunities for both adult and juvenile steelhead between the ocean and upstream spawning and rearing habitats, but also in providing appropriate sized sediment necessary for spawning and maintaining ecologically functioning riparian habitats. As noted above, reservoirs associated with these dams also act as refugia for non-native warm water species. (see discussion on the importance of restoring flow regimes in section 7-5 above).

Agricultural activities (including agricultural effluents) have also significantly impacted steelhead habitats through encroachment into the riparian corridor which has reduced channel complexity, reduced groundwater level through extensive water extraction for irrigation (*e.g.*, in the lower Pajaro and Salinas Rivers), and degraded water quality through the elevation of fine sediments and the application of agricultural pesticides and fertilizers. Instream gravel mining operations in both the Pajaro and Salinas River watersheds have also contributed to degraded habitat conditions, particularly mainstem habitats. Gravel mining can increase turbidity, reduces habitat complexity, and impedes sediment transport (Cluer 2004).

Pajaro River Estuary

Estuarine habitat loss (including both areal extent and habitat functions) is also a significant threat source to anadromous *O. mykiss* populations in the Interior Coast Range BPG.

Despite the large geographic size of this BPG region, its major watersheds share a single estuarine complex that has been substantially altered and reduced by a variety of agricultural and urban developments. Today, the mouths of the Pajaro River and the Salinas River at the Pacific Ocean are separated from each other by less than 10 miles. Historically, the lower reaches of these drainages meandered across a broad coastal plain to create a single estuarine complex that extended from Watsonville in the north to Marina in the south. Less than 50% of the Pajaro River estuary remains extant and the Salinas River estuary has been reduced in size by over 90%. Both the Salinas and Pajaro River Estuaries presently provide potential rearing habitat for juvenile steelhead in the wind-mixed western portion of the Salinas River Estuary, and normally tidally influenced downstream portion of the Pajaro River Estuary (Smith 2013, 2007a, 1992). Estuaries can provide favorable rearing habitats for juvenile *O. mykiss*, and have been shown in some cases to provide a disproportionate number of the returning anadromous adult *O. mykiss* in some systems (Hayes *et al*. 2012, 2011, 2008, Bond 2006). However, rearing young-of the-year or other smaller juveniles do not have ready access to these estuaries because of the great distances between the estuaries and the upstream spawning areas (40+ miles in the Arroyo Seco on the Salinas River) and the low or interrupted flows in the lower main stems of the Salinas and Pajaro Rivers. Nevertheless, severe estuarine losses and decline of estuarine functions can affect anadromous *O. mykiss* populations in widely separated tributaries of the Salinas River, such as Arroyo Seco and the San Antonio and Nacimiento Rivers. Research on these estuaries, in particular steelhead use of the estuary for rearing, would increase the understanding of the role of estuaries in the life history of these populations, and facilitate the management of the estuaries (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b, Hagar 2005a, 2005b, Casagrande 2003, Gilchrist 1997).

Salinas River Estuary – Old Salinas River Channel

Fire frequency in the Interior Coast Range BPG is relatively low compared to other BPGs (*e.g.*, the Big Sur Coast BPG to the south). Wildland fires are not currently a significant threat source for anadromous *O. mykiss* in the Pajaro River, Gabilan Creek, and lower Salinas River watersheds. However, the Summit Fire in 2008 within the Pajaro watershed burned a significant portion of the Corralitos, Browns Valley, and upper Uvas Creek sub-watersheds within the Pajaro River system. Additionally, wildfires pose a threat in the Arroyo Seco and upper Salinas River drainages, where 15 percent and 27 percent of the watershed has burned within the past 25 years, respectively. Increased road density allows greater access to many parts of these watersheds, and increased population density in fire-prone areas has increased fire frequency. Increased fire frequency can increase slope erosion and sediment deposition into streams, resulting in changes to substrate composition and embeddedness, water quality (*e.g.*, turbidity), and water temperature increases through loss of riparian habitat (Varkaik *et al.* 2013, Keeley *et al.* 2012).

Despite widespread and varied habitat degradation to the coastal and middle mainstems of all these watersheds, native non-anadromous *O. mykiss* populations still inhabit the relatively high-quality habitats that persist upstream of the dams in this region, and low numbers of anadromous *O. mykiss* attempt to enter and spawn in each of the watersheds of the Interior Coast Range BPG when flow conditions are suitable.

9.4 THREATS AND THREAT SOURCES

Habitat impairments (sources of threats) identified in the CAP Workbooks for the Interior Coast Range BPG, ranged from seven sources in the Nacimiento River and San Antonio River watersheds to 16 in the Salinas River mainstem; additional information developed since the preparation of the CAP Workbooks has also been incorporated into the threat assessment. The level of threat is generally very high in all watersheds in this BPG, including major tributaries such as Uvas and Gabilan Creeks and along the mainstem Pajaro and Salinas Rivers (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b; see also, Smith 2013, 2007a, 2007b, 2007c, 1982, Casagrande 2013, 2011, 2003, 2001, California Department of Fish and Wildlife 2012a, 2012b, Central Coast Salmon Enhancement 2008, Casagrande and Watson 2006, San Benito County Water District 2006, Santa Clara Valley Water District 2006, Hagar Environmental Science 2005a, 2005b, 2001, Monterey County Water Resources Agency 2005, Upper Salinas-Las Tables Resource Conservation District 2004, Casagrande *et al*. 2003, Hager 2001, Londquist 2001, Watson *et al.* 2000, Stephenson and Calcarone 1999, Sundermeyer 1999, Harvey & Stanley 1983; see also, Cuthbert *et al.* 2011b, 2011a, and 2010).

Ten anthropogenic activities ranked as the top five sources of stress to anadromous *O. mykiss* viability in this BPG (Table 9-2). These sources are not mutually exclusive and can be grouped into the following four general threat categories: 1) barriers to upstream and downstream migration (roads, dams, groundwater extraction, sand and gravel mining); 2) agricultural conversion of floodplain habitats; 3) recreational facilities and activities, and 4) water management activities, including dam operations, diversions, and groundwater extractions (Hunt & Associates 2008a, Kier Associates and National Marine Fisheries Service 2008a, 2008b).

As noted above, historic logging in the upper watershed of the Pajaro River has created on-going legacy effects as a result of the removal of old growth forests, and associated roads. Other watershed developments, including agricultural developments have increased erosion and sedimentation, particularly in the lower mainstem of the Pajaro River and Salinas Rivers, and within some tributaries, has contributed to habitat degradation, particularly of spawning and rearing habitats (see for example, Monterey County Agricultural Commissioner's Office 2011, Monterey Bay National Marine Sanctuary Advisory Council 2008, 2003).

Exotic fish species, including, but not limited to, striped bass (*Marone saxatilis*), has the potential to prey upon and compete with *O. mykiss* and require further monitoring and evaluation of their impacts on steelhead and steelhead habitat (Casagrande 2011). The spread of other exotic and invasive species, including plant species, also continues to increase with the increasing human population and related changes in land uses within the Interior Coast Range BPG; for example, Giant Reed (*Arundo donax*) in *watersheds such as Salinas River has become* more extensive and potentially invasive in other watersheds within the Interior Coast BPG. The early detection, rapid response to, and preferably prevention of, these introductions is an important component in any comprehensive steelhead recovery effort within the Interior Coast Range BPG.

The periodic artificial breaching of the sandbars at the mouths of the Pajaro and Salinas Rivers is also a potential threat to rearing juvenile steelhead in these estuaries, and must be managed in conjunction with upstream flow to ensure the rearing functions of these estuaries is maintained, and the migration of both adult and juvenile steelhead is not adversely affected (National Marine Fisheries Service 2009b; see also Seghesio 2011, Behrens 2008, Gladstone *et al.* 2006, Stretch and Parkinson 2006, Martin 1995, Kjerfve 1994, Thorpe 1994, Smith 1990).

See Figure 9-5 for an overview of the dams and other fish passage impediments within the SCCCS DPS, but note that not all of the dams currently impede fish migration, either because they are seasonally operated to allow fish passage (*e.g.,* Sprig Lake and Pickel Dam within the Pajaro River watershed), or have fish passage facilities. Also, the status of fish passage impediments is in constant flux, with old impediments being removed or modified, while new impediments may be installed, or discovered through updated inventories; a current list of priority fish passage impediments can be found on the California Department of Fish and Game Website:
http://www.cafishpassageforum.org/

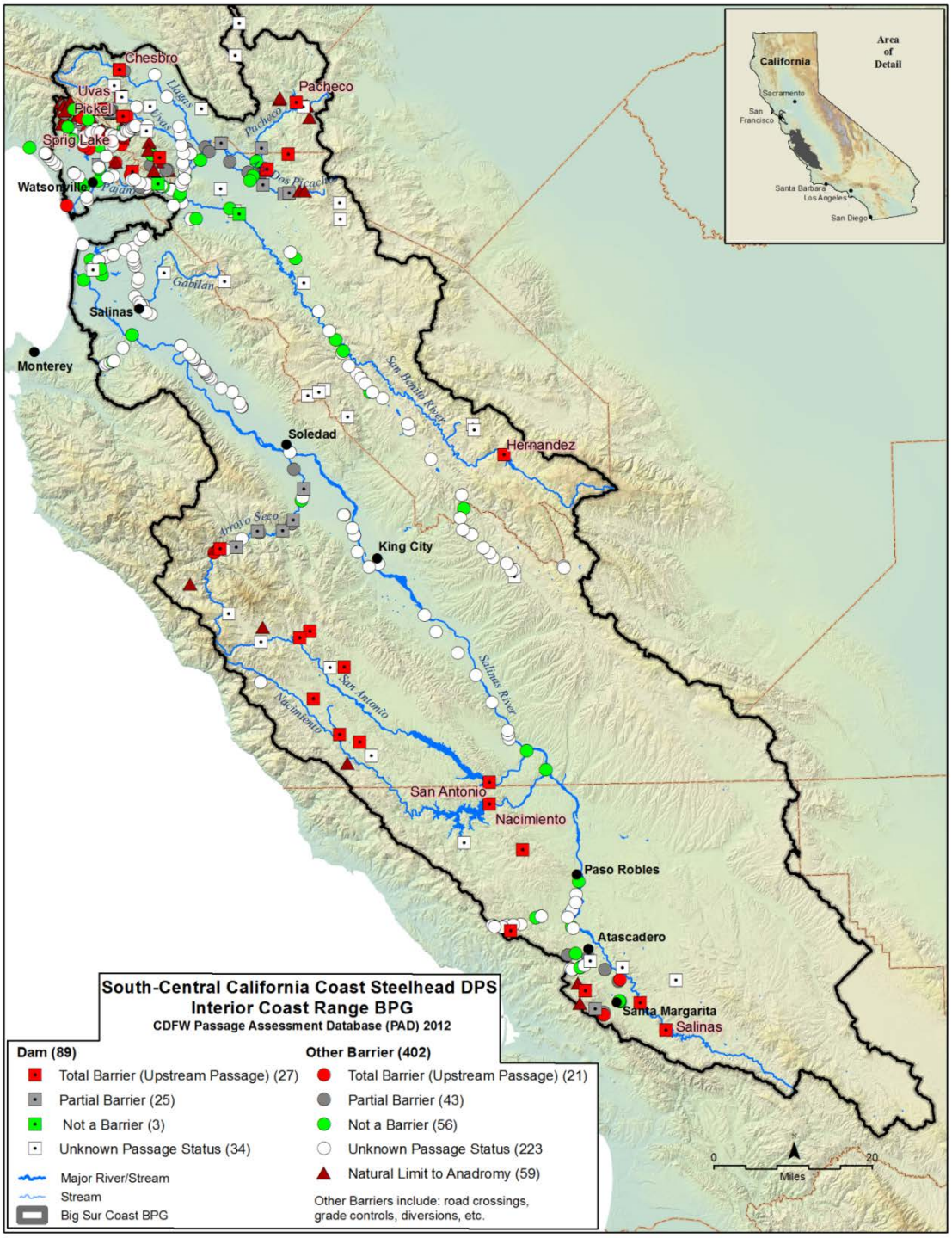

Figure 9-4. Major Fish Passage Impediments, Interior Coast Range BPG. Note: the status of fish passage impediments is in flux, with existing ones being removed or modified, while new ones may be installed, or discovered through updated inventories; a current list of priority fish passage impediments can be found on the California Department of Fish and Wildlife website: http://www.cafishpassageforum.org/

Table 9-2. Threat source rankings in each component watershed in the Interior Coast Range BPG (see CAP Workbooks for details).

Interior Coast Range BPG Component Watersheds (north to south)							
THREAT* SOURCES	Uvas Creek	Pajaro River Mainstem	Salinas River Mainstem	Gabilan Creek	Arroyo Seco	San Antonio River	Nacimiento River
Dams and Surface Water Diversions							
Groundwater Extraction							
Agricultural Development							
Recreational Facilities							
Levees and Channelization							
Non-Native Species							
Urban Development							
Flood Control Maintenance							
Agricultural Effluents							
Roads							
Culverts and Road Crossings (Passage Barriers)							

Key: Threat cell colors represent threat rating from CAP Workbook: Red = Very High threat; Yellow = High threat; Light green = Medium threat; Dark green = Low threat

**Wildfires were not identified during the CAP Workbook analyses as one of the top five threats in these watersheds, but wildfires within the headwaters of Gabilan Creek (Fremont Peak) in the northern Gabilan Range, as well as wildfires in the tributaries of the Salinas River could be a significant threat to these populations.*

9.5 SUMMARY

Dams and water diversions (including groundwater extractions) on the major rivers of the Interior Coast Range BPG (Salinas and Pajaro Rivers) have had the most severe adverse impacts on steelhead populations, reducing and degrading mainstem habitats (including spawning and rearing habitats), cutting off access to upstream spawning and rearing habitats, and altering the magnitude, duration, and timing of flows necessary for immigration of adults and emigration of juveniles throughout the watersheds. Additionally, land-use practices in the Pajaro and Salinas Valleys, particularly conversion of the riparian corridor to agricultural and other land uses, and associated flood control practices including channelization and periodic clearance of the channel of native vegetation and other natural stream features have significantly impacted these important steelhead-bearing watersheds. Numerous small fish passage barriers have also cumulatively impacted the Pajaro River system by preventing or impeding the natural rates of migration of fish (both adults and juvenile) between the ocean and estuary and upstream spawning and rearing habitats. Table 9-3 summarizes the critical recovery actions needed within the Core 1 populations of this BPG. Recovery Action Tables 9-4 through 9-6 provide additional specific recovery actions for the Interior Coast Range Population Group, and prioritizes those actions within each watershed.

Restoring conditions for steelhead passage, spawning, and/or rearing in these watersheds will require multiple, long-term measures related to water management and barrier removal or modification to allow effective fish passage. Promoting rain water harvesting and off-channel storage of winter "surplus" flows and other innovative water use practices in tributary streams (*e.g.*, Uvas, Little Arthur, Bodfish, and Gabilan Creeks) may be effective alternative water management practices to address the impacts of existing water extractions in smaller watersheds. Impediments to fish passage stemming from the construction and operation of dams and groundwater extractions (*e.g.*, the mainstems and tributaries of the Pajaro and Salinas Rivers), modification of channel morphology and adjacent riparian habitats for flood control, and other instream activities such as sand and gravel mining need to be further evaluated for this BPG. Additionally, the loss of estuarine functions caused by reduced freshwater inflow, filling, and pollution from point and non-point agricultural and other anthropogenic waste discharges need to be addressed further in the Salinas and Pajaro River Estuaries.

Uvas Creek (Pajaro River) Fish Rescue Volunteer - 2012

The threats sources discussed in this section should be the focus of a variety of recovery actions to address specific threats to the viability of anadromous *O. mykiss* populations. Spatial and temporal data acquired on specific indicators associated with threat sources or stresses, such as water temperature, pH, nutrients, *etc*., are generally inadequate to be the target of specific recovery actions. This type of data acquisition should be the subject of site-specific investigation in order to refine the recovery actions or to target additional recovery actions as part of any recovery strategy for the Interior Coast Range BPG.

Management of the steelhead populations of the Interior Coast Range BPG will also require additional investigations of the population structure of the BPG; these studies should

include, but not be limited to, the role of the various individual watersheds and sub-watersheds, in the maintenance of the BPG as a whole; how these individual populations contribute to the diversity of the BPG; the role of the non-anadromous fraction of the *O. mykiss* populations in the maintenance of the steelhead populations, and the role and use of the estuaries by steelhead, particularly rearing juveniles.

Table 9-3 below highlights critical Recovery Actions recovery actions for the Carmel River Basin BPG. The following Tables 9-4 through 9-6 identify a full suite of recovery actions necessary to recover these populations and describe and prioritize recovery actions for each sub-watershed in the Interior Coast Range BPG. These tables also provide provisional cost estimates for implementing such actions in five year increments, and where applicable, extended out to 100 years, though many of the recovery actions can and should be achieved within a shorter period (Hunt & Associates 2008a 2008b, Kier Associates and National Marine Fisheries Service 2008a, 2008b).

Table 9-3. Critical recovery actions for Core 1 populations within the Interior Coast Range BPG.

POPULATION	CRITICAL RECOVERY ACTIONS
Pajaro River	Develop and implement operating criteria to ensure the pattern and magnitude of groundwater extractions and water releases from Uvas Dam and Pacheco Dam to provide the essential habitat functions to support the life history and habitat requirements of adult and juvenile steelhead. Physically modify passage impediments (*e.g.*, Uvas Dam) to allow steelhead natural rates of migration to upstream spawning and rearing habitats and passage of smolts and kelts downstream to the estuary and ocean, and restoration of spawning gravel recruitment to the lower mainstem (*e.g.,* Uvas Creek). Manage instream mining to minimize impacts to migration, spawning, and rearing habitat, and protect spawning and rearing habitat in major tributaries, including Uvas, Corralitos, Llagas, and Pacheco Creeks, and the San Benito River. Identify, protect, and where necessary, restore estuarine rearing habitats, including management of artificial breaching of the sandbar at the river's mouth.
Salinas River	Develop and implement operating criteria to ensure the pattern and magnitude of groundwater extractions and water releases from Salinas Dam to provide the essential habitat functions to support the life history and habitat requirements of adult and juvenile steelhead. Physically modify all fish passage impediments, including the Salinas Dam, to allow steelhead natural rates of migration to upstream spawning and rearing habitats, and passage of smolts and kelts downstream to the estuary and ocean. Manage instream mining to minimize impacts to migration, spawning, and rearing habitat, and protect spawning and rearing habitat in major tributaries, including the Arroyo Seco. Identify, protect, and where necessary, restore estuarine rearing habitats, including management of artificial breaching of the sandbar at the river's mouth.
Arroyo Seco River	Develop and Implement operating criteria to ensure the pattern and magnitude of groundwater extractions from the Arroyo Seco and lower Salinas River provide the essential habitat functions to support the life history and habitat requirements of adult and juvenile steelhead. Physically modify fish passage impediments, including concrete road crossing and diversion structure to allow steelhead natural rates of migration to upstream spawning and rearing habitats, and passage of smolts and kelts downstream to the estuary and ocean.
San Antonio River	Develop and implement operating criteria to ensure the pattern and magnitude of groundwater extractions and water releases, including bypass flows around diversions and dams (*e.g.,* San Antonio Dam), to provide the essential habitat functions to support the life history and habitat requirements of adult and juvenile steelhead. Physically modify San Antonio Dam to allow steelhead natural rates of migration to upstream spawning and rearing habitats, and passage of smolts and kelts downstream to the estuary and ocean
Nacimiento River	Develop and implement operating criteria to ensure the pattern and magnitude of water extractions and water releases, including bypass flows around diversions and dams (*e.g.,* Nacimiento Dam) to provide the essential habitat functions to support the life history and habitat requirements of adult and juvenile steelhead. Physically modify Nacimiento Dam to allow steelhead natural rates of migration to upstream spawning and rearing habitats, and passage of smolts and kelts downstream to the estuary and ocean.