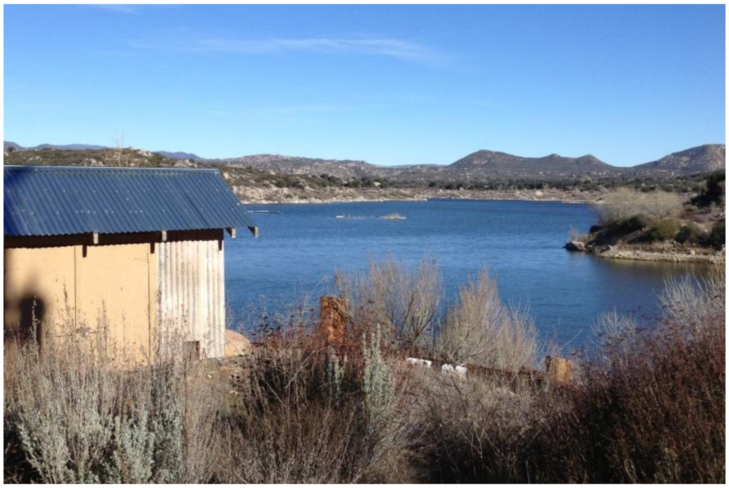
5 Watershed Characterizations

The San Diego IRWM Region addressed in this IRWM Plan is comprised of eleven hydrologic units (HUS) or watersheds that are defined by the San Diego Regional Water Quality Control Board (Regional Board) and are tributary to coastal waters. Seven of the watersheds comprise major regional water courses and four of the watersheds are comprised of multiple small sub-watersheds, each draining to coastal waters or coastal wetlands. In this Plan, the eleven HUs are referred to as watersheds.

This chapter was developed in conjunction with watershed-based stakeholders throughout the Region. As discussed in *Chapter 6, Governance and Stakeholder Involvement,* four watershed workshops were held in September 2012 throughout the Region to solicit input and information from watershed-based stakeholders. Due to the variation in stakeholders, available data, and other factors between each of the Region's watersheds, the information in the following sections may vary in terms of detail and content.

El Capitan Reservoir with snow-capped Cuyamaca Mountain in background.

Photo credit: Rob Hutsel, San Diego River Park Foundation



Morena Reservoir, looking east.

Photo credit: Jeff Pasek, City of San Diego

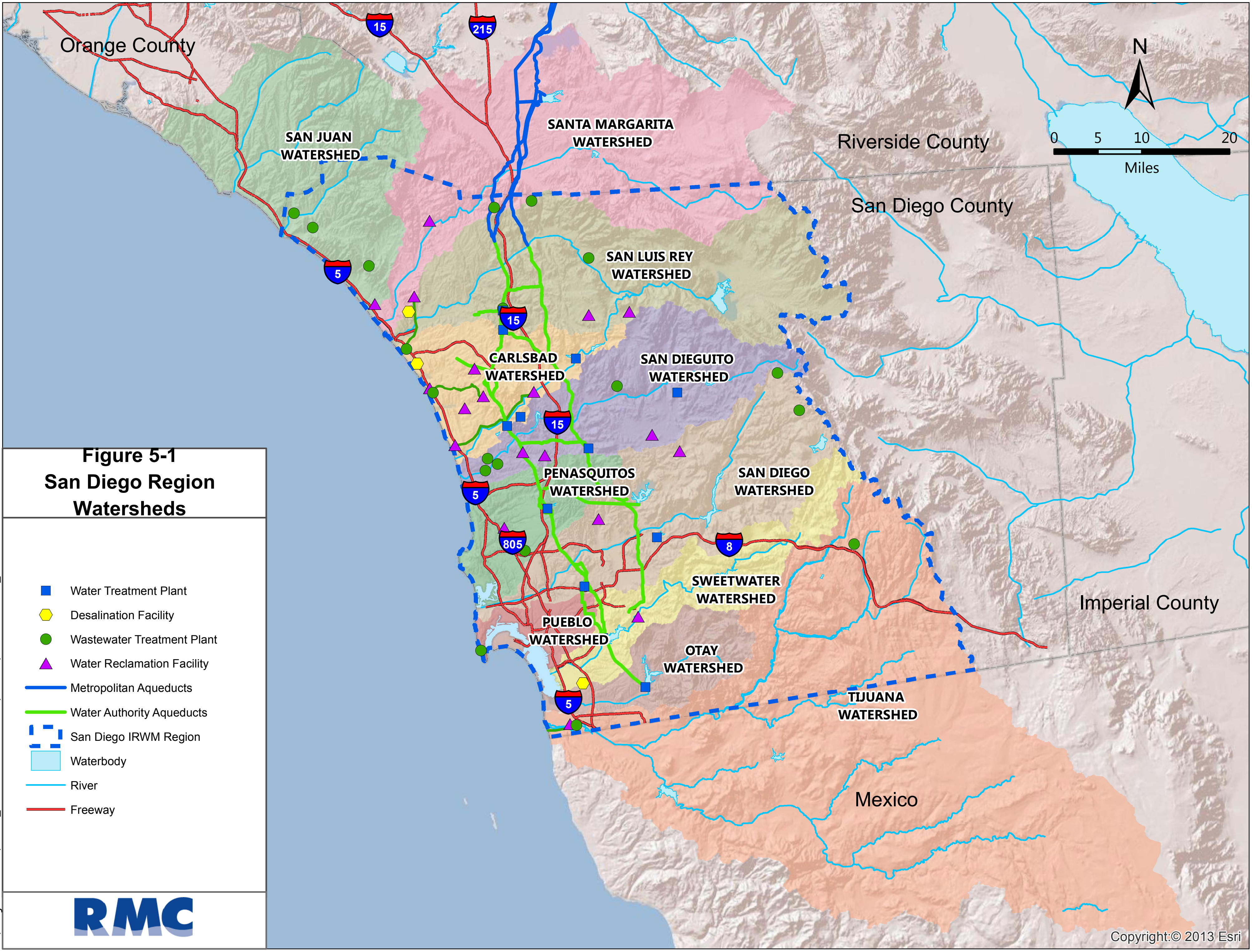


Figure 5-1 San Diego Region Watersheds

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5.1 San Juan Watershed

The San Juan Watershed (San Juan Hydrologic Unit or San Juan HU (901)) is comprised of five hydrologic areas, and lies within all three of the IRWM Regions in the San Diego IRWM Funding Area designated by DWR (refer to Section 3.14 in *Chapter 3, Region Description* for more information on neighboring IRWM Regions). Two of the watershed's five hydrologic areas are within San Diego County:

- San Mateo Hydrologic Area (HA) (the drainage area of San Mateo Creek)
- San Onofre HA (which includes drainage areas of San Onofre Creek, Las Pulgas Creek, and Stuart Mesa)

Approximately 30% of the San Juan Watershed is located within San Diego County, covering approximately 150 square miles and lying within the jurisdiction of the Camp Pendleton, a United States Marine Corps (USMC) Base. Figure 5-2 presents a map showing boundaries of the watershed and its principal features.

Camp Pendleton lands are largely open space and support nearly intact habitats. Water supply within the Camp Pendleton portion of the San Juan Watershed is from local groundwater and imported water.

A portion of the San Mateo HA lies within Riverside County, and while this hydrologic area is included in the Upper Santa Margarita Watershed IRWM Region, it does not have developed water infrastructure or identified water management needs (RCWD, 2009).

The majority of the remaining three hydrologic areas are located within the South Orange County IRWM Region. The South Orange County IRWM Region defines the San Juan Watershed on a finer scale than hydrologic areas in their 2013 IRWM Plan, describing seven sub-watersheds of the larger San Juan Watershed that are located within the South Orange County IRWM Region (County of Orange, 2013).

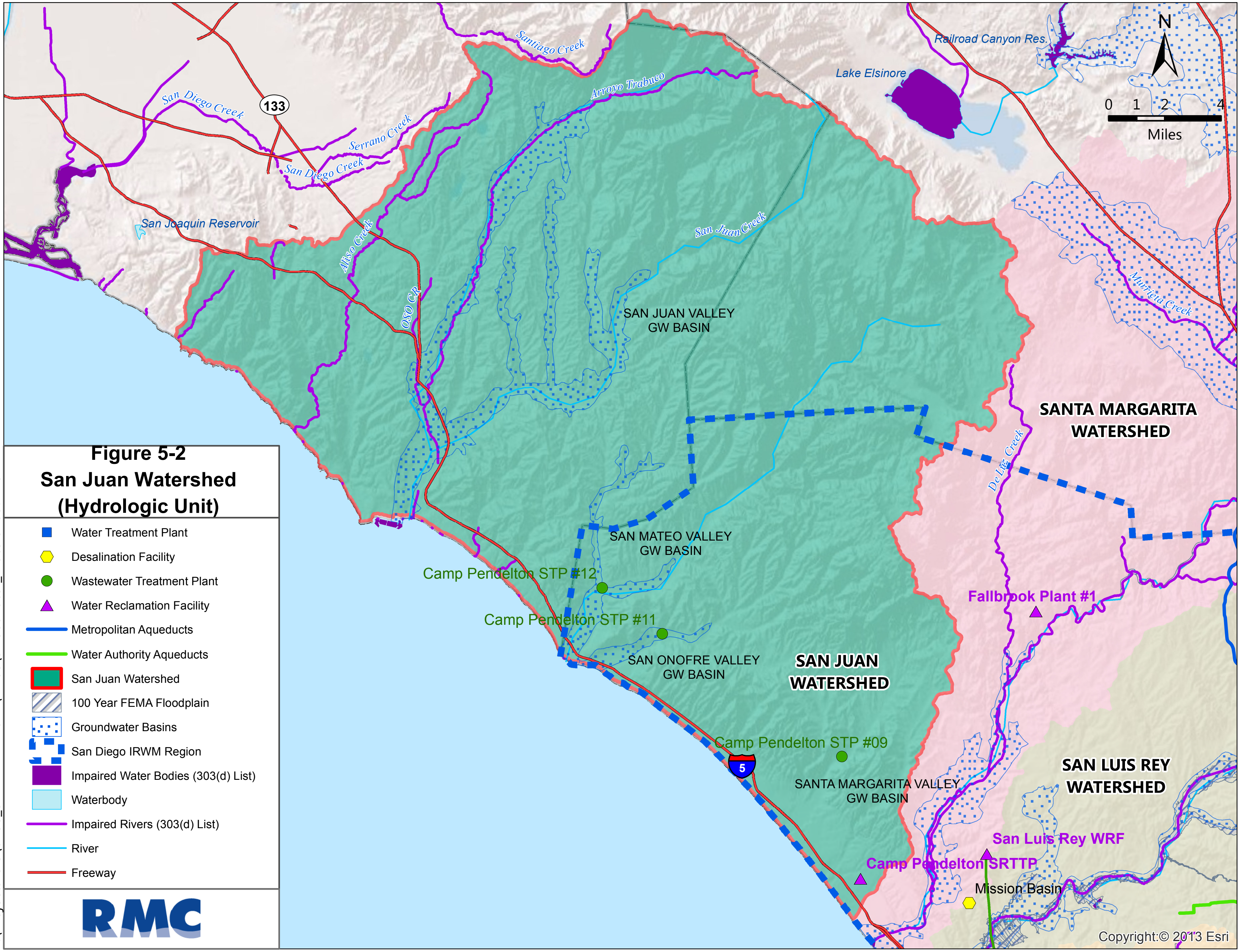

Figure 5-2
San Juan Watershed
(Hydrologic Unit)

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San Juan Watershed

Hydrology

The San Juan Watershed has major creek systems within the San Mateo and San Onofre HAs, all of which drain west into the Pacific Ocean. The creeks within the San Juan Watershed are generally intermittent, and may run dry from July through November (PCW, No Date [N.D.]). In the watershed as a whole, the two major drainages are associated with the San Juan Creek (located in the South Orange County IRWM Region) and the San Mateo Creek (within both the San Diego IRWM Region and the South Orange County IRWM Region).

The San Mateo HA drains San Mateo Creek, which is the second largest creek in the San Juan Watershed and is located in all three IRWM Regions in the San Diego Funding Area. The San Onofre HA includes drainage areas of San Onofre Creek, Las Flores Creek, and Aliso Canyon basin (PCW, N.D.).

Water Systems

Water systems within the San Diego IRWM Region's portion of the San Juan Watershed lie largely within the jurisdiction of the USMC, which is responsible for providing water and wastewater services within Camp Pendleton. Camp Pendleton receives imported water supplies from the San Diego County Water Authority, although these supplies are generally limited to approximately 850 acre-feet per year (SDCWA, 2011). Water supply for Camp Pendleton is primarily provided by surface water and local groundwater basins (USMC, 2011). Much of the water in the South Orange County portion of the watershed is imported, though some areas rely heavily on groundwater as well (County of Orange, 2013).

Groundwater basins within the San Juan Watershed include the San Juan Valley (9-01), San Mateo Valley (9-02) and the San Onofre Valley (9-03) basins. According to Bulletin 118, the San Mateo Valley basin has recharge areas along San Mateo Creek, and the San Onofre Valley basin has recharge derived from percolation of runoff from rainfall and from treated wastewater effluent (DWR, 2003 and DWR (a), 2004). While treated wastewater recharges groundwater, recharge occurs downgradient from drinking water supply wells in the San Mateo and San Onofre basins; treated wastewater does not contribute to the drinking water supply.

Camp Pendleton extracts groundwater for use within each basin in San Diego County, as well as for transfer between the San Mateo and San Onofre Basins (USMC, 2011). The San Juan groundwater basin is a high priority basin for a Salt and Nutrient Management Plan (SNMP), but lies within the South Orange County IRWM Region, and is not discussed further in this Plan. Both the San Mateo and San Onofre groundwater basins are considered medium priority (Tier B) for SNMPs.

Water supply and wastewater agencies within the portion of the San Juan Watershed that lies within the Region include USMC Camp Pendleton and Fallbrook Public Utilities District.

Internal Boundaries and Land Uses

The San Juan Watershed spans Riverside, Orange, and San Diego Counties. Within San Diego County, the San Juan Watershed is primarily within the jurisdiction of the Federal Government, and specifically within the jurisdiction of the USMC Base Camp Pendleton. The San Juan Watershed also includes jurisdictional boundaries for the County of San Diego, and the Fallbrook Public Utility District (PUD). Furthermore, the USMC Base Camp Pendleton and the Fallbrook Public Utilities District are member agencies of the San Diego County Water Authority, so portions of the San Juan Watershed lie within the Water Authority's service area. Nearby jurisdictions include the cities of Oceanside and San Clemente to the south and north, respectively, and the community of Fallbrook to the east. Within the South Orange County IRWM Region, the coastal portions of the watershed are highly developed, and include ten incorporated cities (County of Orange, 2013).

The land uses within the San Onofre and San Mateo HAs include open space, military base operations, agriculture, and very limited residential areas. In addition, there is a state beach and campground along the Interstate 5 corridor near the northern boundary of Camp Pendleton, and a golf course near the southern boundary (PCW, N.D.). The San Onofre nuclear power plant is also located within the watershed, in proximity to Camp Pendleton. There are no tribal lands located within the portion of the San Juan Watershed that lies within the San Diego IRWM Region.

San Juan Watershed

Water Quality and Water Quality Impairments

There are no water bodies within the San Diego County portion of the San Juan Watershed on the 303(d) list of impaired water bodies. However, past water quality monitoring has indicated that surface waters in the San Juan Watershed are high in total dissolved solids (TDS) (SCCWRP, 2007). In addition, several elevated constituents have been reported in groundwater wells at Camp Pendleton, including nitrates, TDS, iron, and sodium, although there appear to be no long-term trends in the occurrence of these constituents (PCW, N.D.). The South Orange County portion of the watershed has multiple 303(d)-listed waterways including all or part of: Aliso Creek, Dana Point Harbor, San Juan Creek, Aliso Beach, Dana Point Hydrologic Subarea, Laguna Beach Hydrologic Subarea, lower San Juan hydrologic subarea, Poche Beach. San Clemente City Beach, San Capistrano Beach, South Capistrano County Beach, Arroyo Trabuco, English Canyon, Laguna Canyon Channel, Moro Canyon Creek, Oso Creek, Prima Deshecha Creek, and Segunda Deshecha Creek for selenium, toxicity, nutrients, pesticides, metals, total coliform, *Enterococcus*, or bacteria.

A Water Quality Improvement Plan will be developed for the entire San Juan Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

There are specific water quality objectives established in the Basin Plan for the San Mateo and San Onofre HAs. Water quality objectives are established separately for inland surface water bodies, groundwater. There are specific water quality objectives established for TDS, chlorides, sulfates, sodium, nitrates, nitrogen-phosphorus ratios, iron, manganese, methylene blue-activated substances (MBAS), boron, turbidity, color, and fluoride (SDRWQCB, 2010).

Stormwater and Flood Management

Stormwater and flood management within the San Juan Watershed portions of San Diego County fall under the jurisdiction of the County of San Diego and the USMC Base Camp Pendleton. Most of the San Diego County lands within the San Juan Watershed consist of undeveloped, park, and agricultural uses, so stormwater management by San Diego County is limited in the San Juan Watershed. However, Camp Pendleton stormwater management activities focus on water quality protection where parking lots and other developed areas feed surface waters (USMC, 2011). Flood control in the South Orange County IRWM Region portion of the watershed fall under the jurisdiction of the Orange County Flood Control District, which manages Orange County's Regional Backbone Flood Control Infrastructure to protect against the 100-year flood event (County of Orange, 2013).

Natural Resources

Only 7% of the watershed is developed, primarily in the northwestern portion of the San Juan watershed along the coast, with the remaining 93 percent undeveloped land in the southern and eastern portions of the watershed. Due to the largely undeveloped nature of the San Juan Watershed, it contains various wildlife, habitats, and special-status species. Within San Diego County, Camp Pendleton contains 21 recognized plant communities including coastal sage scrub, oak woodlands, chaparral, grasslands, coastal dunes, salt marshes, and riparian woodlands and also supports 16 threatened or endangered plant and animal species. In addition, the undeveloped low-lying creeks and streambeds found within Camp Pendleton function as wildlife corridors for various wildlife species to travel within the base, as well as travel to surrounding open space areas such as the Cleveland National Forest located in Riverside County (PCW, N.D.).

There are sixteen species of plants and animals listed under the federal Endangered Species Act (ESA) that reside within Camp Pendleton. Of particular interest from a water resource standpoint are: the Southern California steelhead, and the arroyo toad, both of which utilize stream corridors on Camp Pendleton; the tidewater goby, which resides in brackish water and coastal lagoon habitats on Base; and least Bell's vireo and southwestern willow flycatcher, two bird species that rely on riparian habitats on Base (USMC, 2011).

San Juan Watershed
Potential Climate Change Impacts Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the San Juan Watershed include but are not limited to: • Decrease in imported water supply • Decrease in groundwater supply • Decrease in surface water availability • Water quality concerns related to lower surface water flows • Sea level rise • Decrease in availability of necessary habitat • Exacerbation of wildfires Due to the relatively low level of imported water supply used within the San Diego IRWM Region portion of the San Juan Watershed, decreases in imported water supply are anticipated to be a potential although non-critical climate change impact. However, due to the use of groundwater and surface water within the San Juan Watershed, reductions of these resources could impact water users including the USMC Base Camp Pendleton and the Fallbrook PUD. Furthermore, due to the extensive amount of habitat and open space located within the San Juan Watershed, reduced water availability and potential water quality concerns could impact or decrease available habitat that is necessary for species survival. Due to the San Juan Watershed's location along the coast, sea level rise could potentially impact this watershed and its coastal ecosystems and habitats. Lastly, wildfires, which occurred within the San Juan Watershed as recently as 2007, could potentially occur more frequently due to climate change, which could substantially impact water quality and habitat within the watershed (RWMG, 2009).
Management Issues and Conflicts Management of the San Juan Watershed presents unique challenges due to its location within three different counties. Through the IRWM Program, the San Diego IRWM Region coordinates with Orange County and Riverside County (the Tri-County FACC) to discuss and address relevant issues within overlapping watersheds such as the San Juan Watershed. Furthermore, high military presence within the San Juan Watershed presents an additional jurisdictional layer (the Federal Government), which can impart management challenges and conflicts.

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5.2 Santa Margarita Watershed

The Santa Margarita Watershed (Santa Margarita Hydrologic Unit or Santa Margarita HU (902)) encompasses 750 square miles in northern San Diego and southwestern Riverside Counties. Twenty-seven percent (200 square miles) of the watershed is within San Diego County (and the region addressed in this 2013 IRWM Plan). Figure 5-3 presents a map showing primary features and boundaries of the Santa Margarita Watershed.

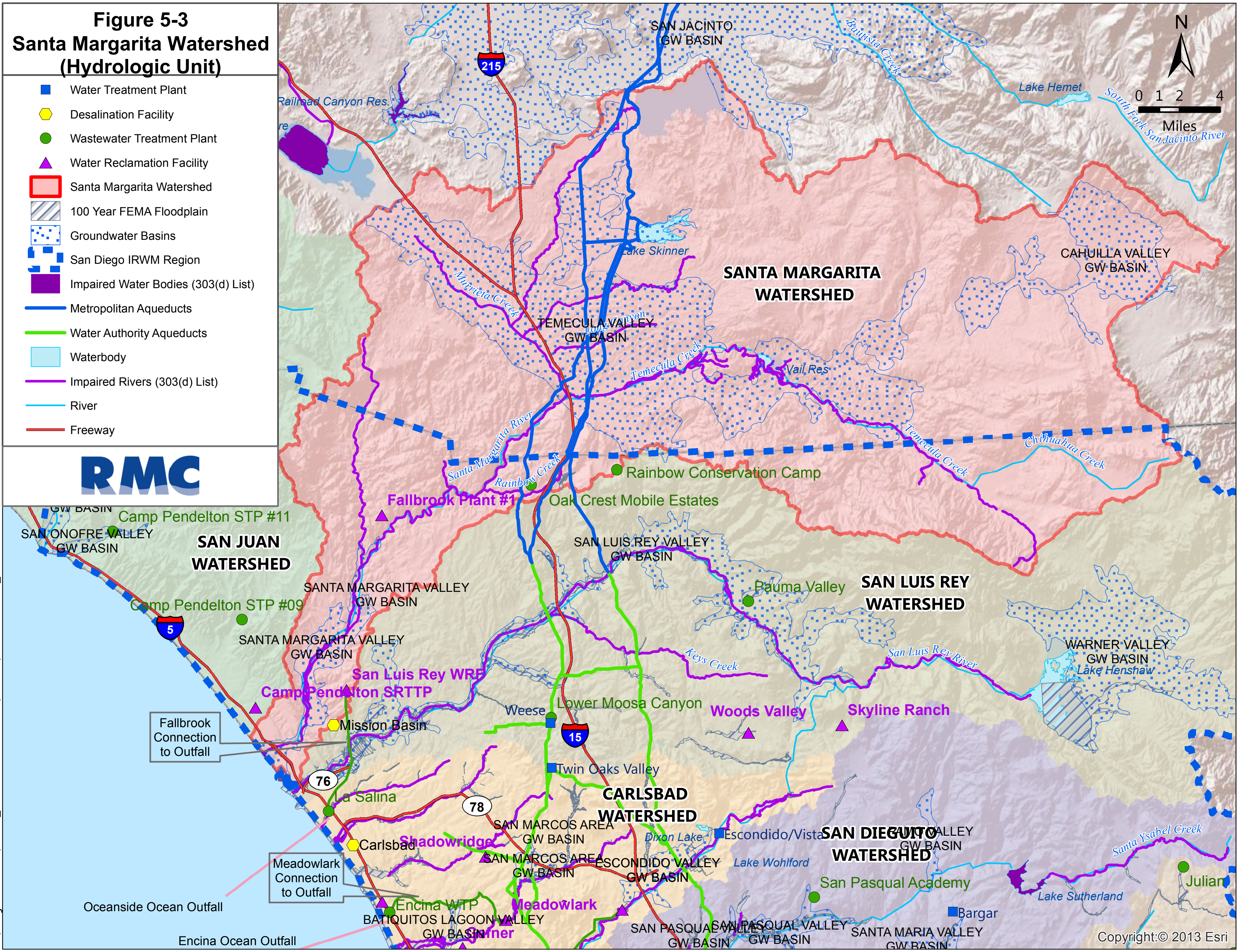
The Santa Margarita River is the primary watercourse in the watershed. The river is formed by the confluence of Temecula and Murrieta Creeks immediately upstream from the San Diego-Riverside County border. Rapidly urbanizing areas of Riverside County exist in the basin upstream of the confluence, while the lower portion of the watershed within San Diego County is largely undeveloped and includes portions of the USMC Base Camp Pendleton. The watershed features annual grasslands, coniferous forests, broad-leaved forests, desert transition, chaparral-covered hillsides, riparian woodlands, and coastal marshes. The San Diego Region portion is primarily chaparral, riparian woodlands, and coastal marshes. The Santa Margarita River discharges to an estuary in an undeveloped downstream portion of Camp Pendleton.

Groundwater basins within the lower portion of the Santa Margarita River Watershed represent an important local water supply source within the Region, and represent the primary source of supply to Camp Pendleton. Camp Pendleton is in the process of implementing a series of federally-funded master-planned water supply projects that include groundwater treatment for iron and manganese and a future-proposed groundwater demineralization facility.

The Santa Margarita Conjunctive Use Project – funding by Proposition 50 – provides for enhanced recharge and recovery from the groundwater basin to provide a water supply for both Camp Pendleton and Fallbrook as resolution of a long-standing water rights dispute with input from the United States Bureau of Reclamation.

Photo credit: Jack Bebe, Fallbrook Public Utilities District

Figure 5-3
Santa Margarita Watershed (Hydrologic Unit)



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Santa Margarita Watershed

Hydrology

The major surface water body within the Santa Margarita Watershed is the Santa Margarita River, which drains in a westerly direction from headwaters in Riverside County to the Santa Margarita Estuary and the Pacific Ocean. Major tributaries to the Santa Margarita River include Temecula Creek, Murrieta Creek, De Luz Creek, Sandia Creek, and Rainbow Creek (County of San Diego, 2008).

The Santa Margarita Watershed is comprised of nine hydrologic areas (HAs), five of which have portions within the San Diego IRWM Region. These hydrologic areas include Ysidora HA (902.1), De Luz HA (902.2), Pechanga HA (902.5), Aguanga HA (902.8), and Oakgrove HA (902.9). Four HAs lie entirely within the Upper Santa Margarita Watershed IRWM Region: Murrieta HA (902.3), Auld HA (902.4), Wilson HA (902.6), and Cave Rocks HA (902.7), De Luz, Pechanga, Aguanga, and Oakgrove HAs are in both the Upper Santa Margarita and San Diego IRWM Regions. Oceanside Harbor exists along the Pacific Ocean within the watershed but is not hydrologically connected to the watershed. The Santa Margarita River estuary (river mouth) fluctuates between being open to tidal flushing and closed due to lack of flow along the river.

According to the County of San Diego, the Santa Margarita River is the longest free-flowing, un-dammed river along the southern California coast. The Santa Margarita River is largely undeveloped and has not been channelized within the lower 27 miles (County of San Diego, 2008).

Water Systems

The westernmost segment of the Santa Margarita Watershed lies largely within the jurisdiction of the San Diego County Water Authority, which provides imported water supplies to three of its member agencies located in the watershed: USMC Base Camp Pendleton, Fallbrook PUD, and Rainbow Municipal Water District. In addition, localized groundwater pumping and surface water diversions from the Santa Margarita River provide water supplies to Camp Pendleton and the unincorporated community of De Luz (County of San Diego, 2005). Groundwater supplies are sourced from the Santa Margarita Valley Groundwater Basin (9-04) (DWR (b), 2004). According to Bulletin 118, natural recharge to the Santa Margarita Valley Groundwater Basin occurs primarily from percolation of the Santa Margarita River (DWR (b), 2004). As described in *Chapter 7, Regional Coordination* (see Section 7.5.3 Salt/Nutrient Management Plans in the Region), the Lower Santa Margarita River Basin is a high priority Salt and Nutrient Management Plan (SNMP) basin. RCWD and USMC Camp Pendleton are developing an SNMP for the greater basin, with Fallbrook Public Utility District providing support. The Temecula/Murrieta groundwater basins, located in the Upper Santa Margarita IRWM Region are also considered high priority (Tier A) basins for SNMPs, but lie outside the bounds of the San Diego IRWM Region. While the Temecula/Murrieta groundwater basins are not discussed in detail in this Plan due to their distance from the San Diego IRWM Region, those basins are high-priority basins and are being actively managed by local stakeholders for both water quantity and water quality purposes.

Water use varies between the upper portion of the Santa Margarita (located in Riverside County) and the lower portion of the Santa Margarita (located in the San Diego IRWM Region). Within the San Diego IRWM Region, surface water from the Santa Margarita River is diverted and used directly, and is also used to recharge local groundwater basins. Within Camp Pendleton, water from the Santa Margarita River is diverted to Lake O'Neill through a diversion weir, which also diverts surface water from the Santa Margarita River to recharge ponds that are used to recharge the Santa Margarita Valley Groundwater Basin (USMC, 2011). Fallbrook PUD, Camp Pendleton and the United States Bureau of Reclamation are moving forward on a conjunctive use project that would extract and treat additional groundwater from the basin.

Although surface water, groundwater, and imported water comprise all current water supplies within the Santa Margarita Watershed, it is possible that desalination and indirect potable reuse will provide future water supply sources within this watershed. The USMC and the Water Authority are currently working on feasibility studies for a potential seawater desalination plant on Camp Pendleton near the mouth of the Santa Margarita River. Desalination efforts are still in the planning stage within Camp Pendleton, but could potentially result in a 50 to 150 million gallons per-day (MGD) seawater desalination plant (SDCWA, 2011).

Water supply agencies within the portion of the Santa Margarita Watershed that lies in the Region include USMC Camp Pendleton, Fallbrook PUD, and Rainbow Municipal Water District. The aforementioned agencies also

Santa Margarita Watershed

function as wastewater agencies within the watershed. The Cahuilla, Pechanga, and Ramona tribal reservations are located within the Upper Santa Margarita Watershed IRWM Region, and a portion of the Pauma Reservation is located within the San Diego IRWM Region's portion of the Santa Margarita Watershed (RCWD, 2007). The Pechanga Reservation pumps groundwater from the Temecula and Pauma groundwater basins, and the Pauma Reservation uses groundwater wells on reservation lands.

Water rights have been a challenge for this watershed since the 1920s beginning with Rancho Santa Margarita suing Vail Ranch (both land grants) for water rights. The legal conflict over water rights was further complicated in 1930 when the state of California issued an appropriate permit to Fallbrook Irrigation District (later to become Fallbrook PUD). Groundwater use in the Temecula Valley Groundwater Basin (located in Riverside County) further complicated matters by reducing downstream flows necessary to recharge the groundwater basins on Camp Pendleton. Since 1975, a Court-appointed Watermaster has been tasked with administering and enforcing various legal provisions pertaining to water rights and water systems associated with underground and sub-surface waters within the Santa Margarita River Watershed that support the sub-surface flow of all creeks, rivers, and stream systems (USMC, 2011). In 1989, the Court appointed a Steering Committee to oversee actions of the Watermaster. The Steering Committee is comprised of representatives from the following entities: United States (USMC Base Camp Pendleton) Eastern Municipal Water District, Fallbrook PUD, Metropolitan Water District of Southern California, Pechanga Tribe, Western Municipal Water District, and Rancho California Water District (RCWD) (Santa Margarita Watermaster, 2011).

Internal Boundaries and Land Uses

Within San Diego County, land use authority for the lower Santa Margarita Watershed is split between the jurisdiction of San Diego County, covering the unincorporated communities of De Luz, Fallbrook, and Rainbow, and federal lands belonging to Marine Corp Base Camp Pendleton and Naval Weapons Station Fallbrook (County of San Diego, 2008). In addition, the lower Santa Margarita Watershed includes jurisdictional boundaries for the USMC Base Camp Pendleton, Fallbrook PUD, a small portion of the City of Oceanside, and Rainbow Municipal Water District, all of which are member agencies of the San Diego County Water Authority. In the upper Santa Margarita Watershed falling within the San Diego IRWM Region, portions of Pechanga HA, Oakgrove HA, and Aguanga HA include Cleveland National Forest lands, which fall under the jurisdiction of the U.S. Forest Service, portions of the Pauma Indian Reservation, Bureau of Land Management lands, and rural unincorporated areas of San Diego County (County of San Diego, 2005).

In the Upper Santa Margarita Watershed IRWM Region, internal boundaries include the cities of Murrieta and Temecula, Riverside County, Anza Borrego State Park, Bureau of Land Management and U.S. Forest Service lands, ecological reserves, and water and wastewater agencies.

Land uses within the San Diego County portion of the Santa Margarita Watershed include undeveloped, military uses, open space, spaced rural residential, and agriculture (County of San Diego, 2008). Of these, undeveloped and military uses dominate the watershed, comprising 39% and 30% of the watershed, respectively. There are tribal reservations associated with four tribes in the Santa Margarita Watershed. These lands are largely located within the Riverside County (upper) portion of the watershed, although a small portion of the Pauma Reservation is located within the lower Santa Margarita Watershed in San Diego County. Less than 1% of the lower Santa Margarita Watershed (within San Diego County) includes tribal lands.

Water Quality and Water Quality Impairments

Several water bodies within the Santa Margarita Watershed are listed on the 303(d) list of impaired water bodies. Due to management issues and rapid population growth expected in the Riverside County portion of the watershed, water quality issues may worsen in the future (County of San Diego 2008). In 2011, the following 303(d) listings were applied to water bodies within the San Diego County portion of the Santa Margarita Watershed (SDRWQCB, 2009):

- Oceanside Harbor for copper
- Santa Margarita Lagoon for eutrophication
- Lower Santa Margarita River for *Enterococcus*, fecal coliform, phosphorus, and total nitrogen

Santa Margarita Watershed

- Upper Santa Margarita River for phosphorus and toxicity
- De Luz Creek for iron, manganese, nitrogen, and sulfates
- Rainbow Creek for iron, nitrogen, phosphorus, sulfates, and TDS
- Sandia Creek for TDS, iron and sulfates

Within the Santa Margarita Watershed as a whole, Warm Springs Creek, Long Canyon Creek, Santa Gertrudis Creek, Redhawk Channel, Temecula Creek, and Murrieta Creek, are also listed as impaired for metals, nutrients, TDS, toxicity, E. coli, fecal coliform, or pesticides (SDRWQCB, 2009).

In 2005, a TMDL was adopted for total nitrogen and total phosphorus in Rainbow Creek. Water quality listings stated above pertaining to eutrophication, nitrogen, and phosphorus are likely due to nutrient applications from agriculture, nursery operations, municipal wastewater discharges, urban runoff, and septic systems (PCW, N.D.). In addition to nutrient-related concerns, other water quality concerns within the watershed include excessive sedimentation, groundwater degradation and contamination, habitat loss, channelization, flooding, and scour (erosion) (Project Clean Water, N.D.). There is concern that imported water upstream is contributing to increased levels of salts through the lower Santa Margarita Watershed (County of San Diego, 2005). Rancho California Water District is preparing a salt and nutrient management plan (see below), which may result in potential Basin Plan amendments and mitigation measures for the future control of salinity, which would benefit the Lower Santa Margarita Watershed.

In light of these water quality concerns in the watershed, efforts are underway to address the water quality needs of the watershed and the sources of pollution. For example, the Santa Margarita Watershed Nutrient Initiative is working with stakeholders to develop and use modeling and the nutrient numeric endpoint (NNE) methodology to assess and address water quality in the watershed. It is hoped that this effort will clarify appropriate water quality standards in the watershed, and through stakeholder outreach and involvement, engage communities in working towards protecting and improving water quality in the watershed. Furthermore, a Water Quality Improvement Plan will be developed for the entire Santa Margarita Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

USMC Base Camp Pendleton has specific water quality concerns pertaining to groundwater quality. Manganese levels within on-base groundwater wells have been detected at levels exceeding secondary drinking water standards; this water quality concern is likely due to natural features associated with the surrounding bedrock. In addition, the Naval Facilities Engineering Command is currently managing groundwater monitoring and remediation activities on Camp Pendleton to address volatile organic compounds in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (USMC, 2011).

Per the State's Recycled Water Policy, Camp Pendleton is developing and implementing strategies to reduce salts and nutrients in groundwater in the Lower Santa Margarita River. Additionally, RCWD is leading development of a salt and nutrient management plan for the Upper Santa Margarita River that overlies the Temecula Valley Groundwater Basin (within Riverside County and the Upper Santa Margarita River IRWM Region). More information on the SNMP is found in *Chapter 7, Regional Coordination*.

The Basin Plan establishes specific water quality objectives for all hydrologic areas included within the Santa Margarita Watershed (SDRWQCB, 1994). For the HAs included within San Diego County, there are specific water quality objectives established for TDS, chlorides, sulfates, sodium, nitrates, nitrogen-phosphorus ratios, iron, manganese, methylene blue-activated substances (MBAS), boron, turbidity, color, and fluoride.

Santa Margarita Watershed

Stormwater and Flood Management

Within the watershed, the acreage of land uses within mapped flood hazard zones total more than 500 acres, and includes the following: agriculture, 146 acres; commercial and services, 38 acres; industrial, 4 acres; open space and recreation, 273 acres; residential, 42 ; and transportation, communications, and utilities, 40 acres.

Stormwater and flood management within the San Diego County portions of the Santa Margarita Watershed fall under the jurisdiction of the County of San Diego and the USMC Camp Pendleton. In 2008, the County of San Diego updated the Santa Margarita Watershed Urban Runoff Management Plan (WURMP) to meet revised requirements of the 2007 San Diego Municipal Stormwater Permit (County of San Diego, 2008). The 2008 WURMP focuses on management activities that can be taken to reduce urban runoff draining into the Santa Margarita Watershed, and therefore focuses on addressing water quality concerns associated with urban runoff. Stormwater and floodwater management in the Riverside County portions of the Santa Margarita Watershed can impact those portions falling within the San Diego IRWM region. Specifically, channelization and other flood management efforts can lead to increased sedimentation and debris downstream following a storm event (County of San Diego, 2005). The Riverside County Flood Control and Water Conservation District is responsible for stormwater and flood management in the Upper Santa Margarita watershed.

The County of San Diego conducts additional flood management efforts within the Santa Margarita River to reduce and address flood flows associated with FEMA-designated flood areas. According to the County of San Diego, localized flooding within Sandia Creek, a tributary of the Santa Margarita River, impacts access to the communities of Fallbrook and De Luz (County of San Diego, 2007).

The USMC reports that flooding on the Santa Margarita River has damaged infrastructure on Camp Pendleton several times since 1943 (USMC, 2011). Specifically, floods in 1969, 1978, 1980, and 1993 damaged the diversion weir on the Santa Margarita River that diverts water to Lake O'Neill. Flood protection measures on USMC Base Camp Pendleton consist of an earthen levee constructed along the southern edge of the main-stem of the Santa Margarita River channel. Completed in 1999, the levee construction also included the replacement of the bridge over the Santa Margarita River on Basilone Road. The levee and bridge are designed to protect against the 100-year storm event. Camp Pendleton's flood protection program also includes detention basins distributed throughout cantonment areas for the purpose of flood control, as well as measures to safeguard potable water wells in the floodplain against flood damage (USMC, 2011).

Natural Resources

Due to relatively undeveloped nature of the Santa Margarita Watershed, this watershed contains an abundance of habitats and wildlife (County of San Diego, 2008). Habitats within the Santa Margarita River Watershed include chaparral, riparian woodlands, coastal marshes, oak woodlands and montane habitats (PCW, N.D.). These habitats also support the largest populations of seven federally or state-listed endangered species (County of San Diego, 2008). Tribal nations in the Region have indicated concern that jurisdictional habitat conservation efforts to address sensitive habitats and species may not consider current or future tribal developments, and tend to categorize tribal lands as open space.

According to the USMC, there are sixteen special-status species located on Camp Pendleton (USMC, 2011). Of these species, the southern population of steelhead trout and the arroyo toad use stream corridors on Camp Pendleton, the tidewater goby uses brackish water and coastal lagoon habitats associated with the Santa Margarita Estuary, and the least Bell's vireo and the southwestern willow flycatcher both rely on riparian habitats (USMC, 2011). The Santa Margarita River steelhead population is considered a Core 1 population, assigned highest priority in recovery actions (NMFS, 2012). Fish passage was previously thought to be impeded by the Lake O'Neill diversion weir, but confirmed sightings of the Southern California steelhead in 2009 above the Lake O'Neill diversion weir indicate that fish passage is possible. Several invasive species have been identified on Camp Pendleton, including the bullfrog (*Lithobates catesbeiana*), the salt cedar (*Tamarix spp.*), and the giant reed (*Arundo donax*) (USMC Camp Pendleton 2011). Additionally, the perennial pepperweed (*Lepidium latifolium*) has been identified as a threat to Santa Margarita River habitat, while crayfish has been identified as widespread in the watershed (County of San Diego, 2005).

Santa Margarita Watershed
In 2006, stakeholders from the Santa Margarita Watershed and the San Luis Rey Watershed signed a Memorandum of Understanding that established a Weed Management Area and defined actions necessary to prevent the introduction, establishment, and spread of invasive non-native plants within the Santa Margarita and San Luis Rey Watersheds (Mission Resource Conservation District et al, 2006).
Potential Climate Change Impacts Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the Santa Margarita Watershed include but are not limited to: • Decrease in imported water supply • Decrease in groundwater supply • Decrease in surface water availability • Water quality concerns related to lower surface water flows • Sea level rise • Saltwater intrusion • Decrease in availability of necessary habitat • Exacerbation of wildfires Due to the relatively low level of imported water supply used within the San Diego IRWM Region portion of the Santa Margarita Watershed, decreases in imported water supply are anticipated to be a potential although non-critical climate change impact. However, due to the use of groundwater and surface water within the Santa Margarita Watershed, reductions of these resources could impact water users including the USMC Base Camp Pendleton and Fallbrook PUD. Furthermore, due to the extensive amount of habitat and open space located within the Santa Margarita Watershed, reduced water availability and potential water quality concerns could impact or decrease available habitat that is necessary to support endangered species. Due to the Santa Margarita Watershed's location along the coast, sea level rise could potentially impact this watershed and its coastal ecosystems and habitats. Furthermore, several military support facilities and training areas are located within proximity to the coast, and could potentially be impacted by sea level rise. Lastly, major wildfires, which occurred within the Santa Margarita Watershed as recently as 2007, could potentially occur more frequently due to climate change, which could substantially impact water quality and habitat within the watershed (RWMG, 2009).
Management Issues and Conflicts Management of the Santa Margarita Watershed presents unique challenges due to cross-jurisdictional management issues, as well as ongoing water quality and water rights litigation within the watershed. In addition, rapid development within the upper watershed area (primarily within Riverside County) and corresponding urbanization and population growth present further challenges associated with increased impervious surfaces, exacerbated water quality issues, and loss of natural resources (County of San Diego, 2005). Through the IRWM Program and other efforts, local jurisdictions are working collaboratively to address issues within the watershed, and in particular have focused on water quality issues within the Santa Margarita River. In 2011, the San Diego IRWM Region and the Upper Santa Margarita IRWM Region were awarded grant money from DWR to implement a multi-jurisdictional project that will evaluate nutrient water quality objectives for the Santa Margarita River Estuary and the entire Santa Margarita River. In 1940, a Stipulated Judgment ("1940 Judgment") was issued directing the use and allocation of groundwater and surface water for the stipulating parties. Although considered an adjudicated basin, quantified water rights have not been assigned. In 1963, a Final Judgment and Decree was issued further defining the use of groundwater in the region, and in 1966, a Modified Final Judgment and Decree ("Fallbrook Case") was entered incorporating interlocutory judgments and the 1940 Stipulated Judgment. This document produced an Application to Appropriate Unappropriated Water to the Department of Water Resources (DWR) in the Temecula

Santa Margarita Watershed
Creek, but was not fully executed until 2009 when the State Water Resources Control Board (SWRCB). These judgments were followed by years of court cases and power struggles by multiple parties, including the Federal government (U.S. Marine Corps Camp Pendleton) over water use in the watershed basins, citing the judgments did not fully meet the needs of the parties for effective water management. Finally, after many years, a settlement agreement, "Cooperative Water Resource Management Agreement between Camp Pendleton and Rancho California Water District", was reached and executed in March 2002. This agreement does not supersede the previous judgments (1940 Judgment and Fallbrook Case), but suspends inconsistent terms of the 1940 Stipulated Judgment for so long as the Cooperative Water Resource Management Agreement remains in effect. The Watermaster prepares the "Santa Margarita Watershed Annual Watermaster Report", providing annual reporting of water conditions in the watershed, but does not manage the groundwater basin. The Court has retained jurisdiction over all surface flows of the Santa Margarita River Watershed and all underground waters determined by the Court to be subsurface flow of streams or creeks or which is determined by the Court to add to, support or contribute to the Santa Margarita River stream system. Local vagrant groundwaters that do not support the Santa Margarita River stream system are outside the Court jurisdiction.

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5.3 San Luis Rey Watershed

The San Luis Rey Watershed (San Luis Rey Hydrologic Unit or San Luis Rey HU (903)) is the largest watershed completely within the San Diego IRWM Region. Figure 5-4 presents a map showing the watershed boundaries and primary features.

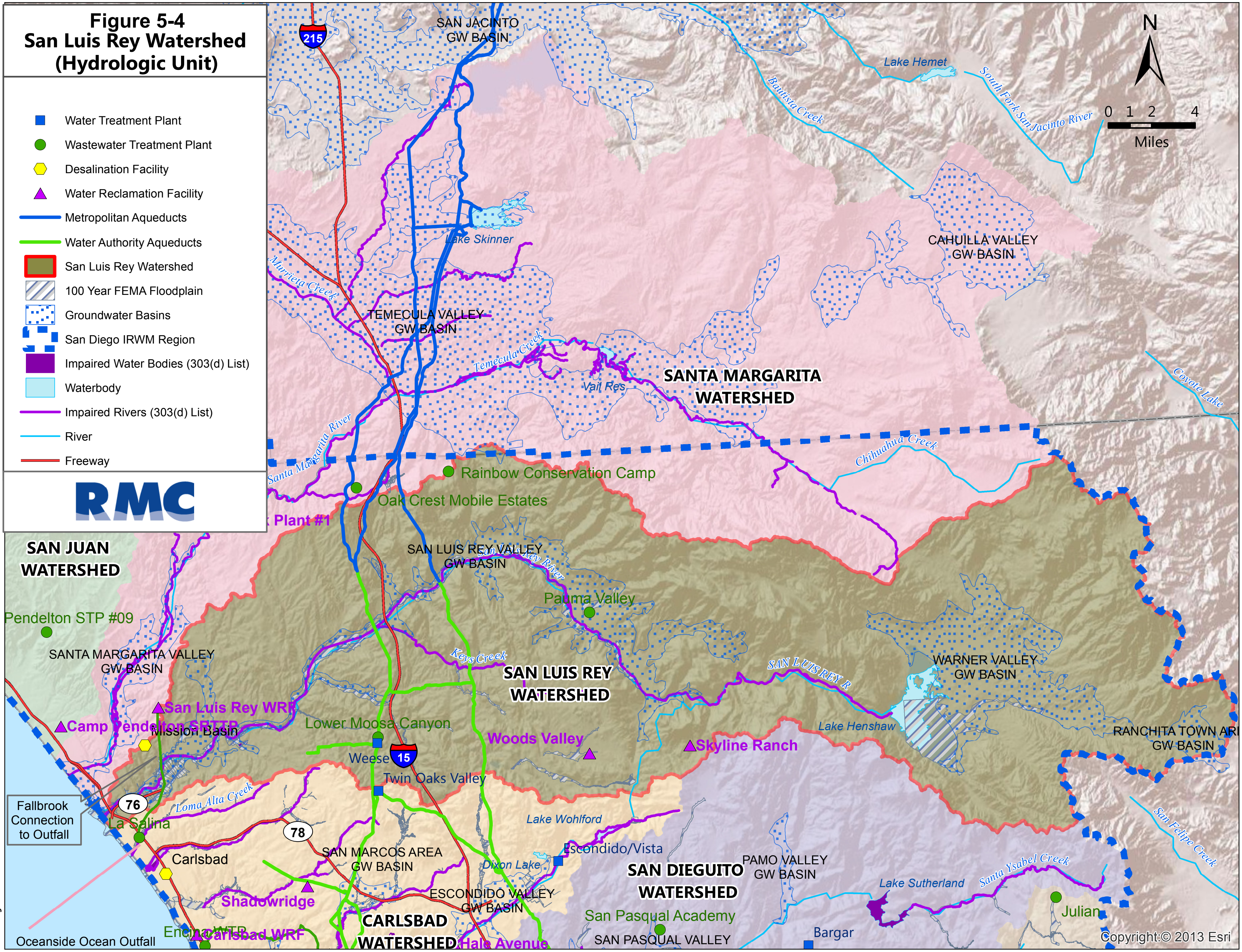
The San Luis Rey River is the primary watercourse within the watershed, and discharges to the Pacific Ocean north of the City of Oceanside. The watershed is bounded by the Monserate Mountains to the north, Cleveland National Forest and Camp Pendleton to the northwest, and the cities of Oceanside, Vista, San Marcos, and Escondido to the south. Lake Henshaw is the only major drinking water reservoir in the San Luis Rey Watershed.

Roughly one-fourth of the land area in the watershed is located west of Interstate 15, and this area has multiple uses including open space/ undeveloped, residential, commercial/industrial, and agricultural. East of Interstate 15, most of the land is either undeveloped or agricultural. Land use authorities include the County, the State, the Federal government, and several tribal nations.

Groundwater and surface waters in the upstream portion of the San Luis Rey Watershed are an important local supply source for the Vista Irrigation District, City of Escondido, Pala/Pauma communities, and local Indian Tribes. However, several large water agencies within the watershed (e.g. Valley Center Municipal Water District, Rainbow Municipal Water District, Fallbrook PUD) are virtually 100% reliant on the availability of imported water. The City of Oceanside, which is also a member agency of the San Diego County Water Authority and relies on imported water sources, is the only agency in the downstream portion of the watershed that develops any sort of local water supplies, through demineralization of brackish groundwater from the Mission Groundwater Basin.

The North San Diego County Regional Recycled Water Project – funded by Proposition 84-Round 1 – enables expansion of recycled water throughout the North County watersheds.

Photo credit: Kim Thorner, Olivenhain Municipal Water District



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San Luis Rey Watershed

Hydrology

The 562-square mile San Luis Rey Watershed is the largest watershed completely within the San Diego IRWM Region. The San Luis Rey Watershed is comprised of three hydrologic areas (HAs) including: Lower San Luis HA (903.1), Monserate HA (903.2), and Warner Valley HA (903.3).

The major surface water body within the San Luis Rey Watershed is the San Luis Rey River. The San Luis Rey River has headwaters in the Palomar Mountains and the Hot Springs Mountains, as well as several other mountain ranges along the eastern border of the San Diego IRWM Region. The San Luis Rey River flows in a westerly direction, draining into the Pacific Ocean near the City of Oceanside (Project Clean Water, N.D.).

There are four water supply reservoirs in the San Luis Rey Watershed, described in *Water Systems* below. The San Luis Rey River is hydrologically connected to Lake Henshaw, a manmade impoundment created by the Henshaw Dam (Vista Irrigation District, 2011). The Escondido Canal, located downstream of Lake Henshaw, conveys flows from Lake Henshaw to the City of Escondido via Lake Wohlford in the Carlsbad Watershed (City of Oceanside et al, 2008). West of the Escondido Canal, the San Luis Rey River is intermittent and perennial, as is common for many streams within Southern California (Oceanside et al, 2008).

Guajome Lake, a manmade lake located in Guajome Regional Park, is a small surface water body that is primarily used for recreational purposes (City of Oceanside, N.D.). Foss Lake, one of the only inland salt water wetlands in San Diego County, was previously expanded over 75 acres within the San Luis Rey Watershed (City of Oceanside et al., 2008).

Water Systems

Water systems within the San Luis Rey Watershed include those used to convey flows from the reservoirs and the San Luis Rey River. There are two water supply reservoirs in the San Luis Rey Watershed, including:

- Lake Henshaw, owned by Vista Irrigation District and stores surface water
- Turner Reservoir, owned by Valley Center Municipal Water District and stores surface water

Lake Henshaw, which is owned and operated by Vista Irrigation District, which has a cooperative agreement with the City of Escondido to provide flows to Lake Wohlford (located within the Carlsbad Watershed) through the Escondido Canal (City of Oceanside et al., 2008).

Water supply agencies within the San Luis Rey Watershed include the City of Oceanside, Vista Irrigation District, Valley Center Municipal Water District, Fallbrook PUD, Rainbow Municipal Water District, and Yuima Municipal Water District. In addition, a small portion of the USMC Base Camp Pendleton is located within the San Luis Rey Watershed; the USMC is responsible for providing water services within Camp Pendleton. All of the aforementioned water supply agencies are member agencies of the San Diego County Water Authority, and therefore receive imported water through the Water Authority's imported water aqueducts. In addition, three of the tribal nations located within the San Luis Rey Watershed have regulated Public Water Systems that supply water to their respective reservations. Those tribal nations include: Pala Band of Mission Indians, La Jolla Band of Luiseño Indians, and San Pasqual Band of Indians. The Rincon Band of Luiseño Indians purchases raw water from Escondido and the Vista Irrigation District, and the San Pasqual Band of Indians purchases treated water from Valley Center Municipal Water District.

Wastewater agencies within the San Luis Rey Watershed include the City of Oceanside, Fallbrook PUD, the Valley Center Community Services District, the City of Vista, the Rainbow Municipal Water District, and the Pauma Valley Community Services District. The Pala Band of Mission Indians operates a tertiary wastewater treatment plant that serves most of the buildings located on the Pala Reservation.

Groundwater basins underlying the San Luis Rey Watershed include the San Luis Rey Valley (9-7), Warner Valley (9-8), and Ranchita Town Area (9-25) basins defined according to DWR Bulletin 118. According to DWR, major recharge areas within the aforementioned groundwater basins include the San Luis Rey River and its tributaries and infiltration of runoff (DWR (c), 2004, DWR (d), 2004, and DWR (e), 2004). Vista Irrigation District operates groundwater wells in the Warner Valley basin, and groundwater from the basin is generally conveyed to Lake Henshaw, and then to the San Luis Rey River/Escondido Canal (Vista Irrigation District, 2011). The City of

San Luis Rey Watershed
Oceanside also operates groundwater wells to extract brackish groundwater from the Mission Basin, which is part of the San Luis Rey Valley basin (City of Oceanside, 2011). The Salt and Nutrient Management Planning guidance document developed by the Southern California Salinity Coalition and the San Diego County Water Authority further divides the San Luis Rey Valley groundwater basin into five subbasins: Oceanside/Mission, Bonsall, Pala, Pauma, and Moosa. The Pauma and Pala subbasins are a medium priority (Tier B) basin for SNMPs, while the Bonsall and Moosa subbasins are low priority (Tier D-2) for SNMPs. The Warner Valley groundwater basin is a lowest priority (Tier E) basin for SNMP. See *Chapter 7, Regional Coordination,* for more information on basin SNMP prioritization.
Internal Boundaries and Land Uses The San Luis Rey Watershed resides almost entirely within San Diego County, although a small portion (0.2% of the total watershed) lies within Riverside County. Within San Diego County, the San Luis Rey Watershed is primarily within the jurisdiction of San Diego County (95.2% of the watershed), but is also within the jurisdiction of the City of Oceanside (4.4%), the City of Vista (0.2%), and the City of Escondido (<0.1%). Other governmental agencies residing within the watershed include the United States (USMC Base Camp Pendleton), the Forest Service (Cleveland National Forest), and State of California lands (parks, state roadways, etc.) (City of Oceanside et al, 2008). Furthermore, there are several tribal land holdings within the watershed, including the Pala Reservation (approximately 12,333 acres), the Pauma and Yuima Reservation (approximately 5,826 acres), the Rincon Reservation (approximately 3,918 acres), the La Jolla Reservation (approximately 8,798 acres), the San Pasqual Reservation (approximately 1,412 acres), the Santa Ysabel Reservation (approximately 15, 270 acres), and the Los Coyotes Reservation (approximately 24,762 acres) (University of San Diego, N.D.). Approximately 15% of the total area within the San Luis Rey Watershed contains tribal lands. The majority of the watershed is undeveloped (55%); agriculture and residential uses serve as the most dominant land uses in developed areas. The remaining 22% of the watershed contains residential, parks/open space, commercial/industrial, recreation, and schools (City of Oceanside et al, 2008).
Water Quality and Water Quality Impairments Several water bodies within the San Luis Rey Watershed are listed on the 303(d) list of impaired water bodies. Impaired water bodies include: • Guajome Lake for eutrophication • San Luis Rey River (lower) for chloride, TDS, *Enterococcus*, fecal coliform, phosphorus, nitrogen, and toxicity • San Luis Rey River (upper) for nitrogen • Keys Creek for selenium • Pacific Ocean Shoreline, Mouth of the San Luis Rey River for *Enterococcus* and total coliform Monitoring data suggests that nutrients entering Guajome Lake from residences, commercial nurseries, commercial horse facilities, and residential horse facilities could be the cause of eutrophication. Chloride and TDS within the San Luis Rey River may be due to salt water intrusion, and may also be due to natural causes. Foss Lake, one of the only inland salt water wetlands in San Diego County, has naturally elevated salt levels. The source of bacteria along the Pacific Ocean Shoreline within the San Luis Rey Watershed is unknown at this time. Nitrogen and phosphorous-containing compounds found in the local streams are known to originate from urban runoff, wastewater/sewage spills, septic tank leaks, and agriculture sources (City of Oceanside et al., 2011). The 2011-2012 Annual Report for the San Luis Rey River Watershed Urban Runoff Management Program (WURMP) noted that a number of activities aimed at improving water quality are underway in the watershed. For example, two pet waste removal projects removed an estimated 8,823 pounds of pet wastes from the watershed, reducing the bacteria entering the waterways. It also described the water quality in the upper part of the watershed as generally high (City of Oceanside et al., 2013). Furthermore, a Water Quality Improvement Plan will be developed for the entire San Luis Rey Watershed in accordance with the 2013 MS4 Permit, which

San Luis Rey Watershed

will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

The Basin Plan establishes specific water quality objectives for all hydrologic areas included within the San Luis Rey Watershed. For the three specific HAs included within the San Luis Rey Watershed, there are specific water quality objectives established for TDS, chlorides, sulfates, sodium, nitrates, nitrogen-phosphorus ratios, iron, manganese, methylene blue-activated substances (MBAS), boron, turbidity, color, and fluoride.

The Water Board has the authority to waive the requirements for a person to file a report of waste discharge and/or be issued waste discharge requirements (WDRs) and instead grant waivers for applicable discharges. One of the conditional waivers available, Discharges from Agricultural and Nursery Operations, is for discharges that contain pollutants that can percolate to groundwater or runoff to surface waters (Regional Board, N.D.).

Groundwater quality in the San Luis Rey Watershed is generally of low concern, except for the Pala/Pauma subbasin, which is a Tier B basin for SNMPs. To date, there has been no progress towards developing an SNMP for the subbasin, though is it anticipated that an SNMP will be developed in the future (Regional Board, 2013).

Stormwater and Flood Management

Major drainages within the watershed include Keys Canyon Creek, Moosa Canyon Creek, Pilgrim Creek, and San Luis Rey River, which encompass drainage areas of approximately 31.58, 34.7, 19, and 562 square miles, respectively. The peak discharges during a 100-year event for Keys Canyon Creek, Moosa Canyon Creek, and Pilgrim Creek are 22,911, 13,000, and 1,925 CFS, respectively. The peak discharges during a 100-year event for San Luis Rey River at three locations range from CFS41,000 to 51,000 CFS. Within the watershed, the acreage of land uses within mapped flood hazard zones total nearly 16,000 acres, and includes the following: agriculture, 2,382 acres; commercial and services, 917 acres; industrial, 264 acres; open space and recreation, 8,262 acres; residential, 1,953; and transportation, communications, and utilities, 1,012 acres (see Appendix 7-B, Integrated Flood Management Planning).

Stormwater and flood management within the San Luis Rey Watershed generally fall under the jurisdiction of the County of San Diego, the City of Oceanside, and the City of Vista. The County has jurisdiction over the 95.2% of the watershed. The cities of Oceanside and Vista are also responsible for implementing provisions included in the San Luis Rey River Watershed Urban Runoff Management Program (WURMP), which focuses on management activities that can be taken to reduce stormwater runoff and associated water quality concerns (City of Oceanside et al., 2008).

The U.S. Army Corps of Engineers (USACE) has been involved in flood control management associated with the San Luis Rey River since authorization of the San Luis Rey River Flood Control Project in 1970 (USACE, 2013). This project included design and construction of a flood control channel along portions of the San Luis Rey River to convey flood flows during a Standard Project Flood (89,000 CFS), and also includes vegetation and sediment removal operation and maintenance efforts to maintain the channel's flood control capacity (USACE, 2013). Due to funding limitations, the USACE and other jurisdictions have not consistently removed vegetation within the flood channel, which resulted in the establishment of riparian species within and along the San Luis Rey River. The presence of such species has complicated flood maintenance within the San Luis Rey River as agencies must balance vegetation removal efforts that may impact sensitive species with flood control maintenance that is required for flood protection.

Although the San Luis Rey Flood Control Project has a rated capacity of 89,000 CFS, local stakeholders are still concerned about future flooding and potential flood impacts. In 1916 the San Luis Rey River experienced a very large flood event that inundated the entire San Luis Rey Valley and had a stakeholder-reported flow rate of 96,000 CFS (USGS 1918). If a flood of this magnitude were to occur again there could be substantial damage to nearby properties and infrastructure as the flood control channel would be unable to handle flood flows greater than those modeled for a Standard Project Flood (89,000 CFS).

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Although much of the San Luis Rey River is unchannelized, within the City of Oceanside the river has been channelized by levees for flood control purposes. Flood flows within the San Luis Rey River are limited as this river is intermittent and perennial in nature; stream gage data suggests that flood flows have been substantially reduced within the river since construction of Henshaw Dam (City of Oceanside et al., 2008).

The County of San Diego conducts additional flood management efforts throughout the San Luis Rey Watershed to reduce and address flood flows associated with FEMA-designated flood areas, including a comprehensive flood forecast model to cover the entire San Luis Rey Watershed and its primary tributaries (County of San Diego, 2007). According to the County of San Diego, localized flooding occurs in several reaches of the San Luis Rey River, including:

- Between Lake Henshaw and the La Jolla Indian Reservation
- Along Cole Grade Road
- At Shearer Crossing (where the river meets Interstate 15)
- Along Pauma Valley Drive
- Along Wiskon Way
- Along Valley Center Road and in the vicinity of the Rincon Casino

Flooding and mudslide events during rain events have occurred in the San Luis Rey Watershed following fires. Wildfires compromise the stability of soils and create land disturbances that increase erosion processes during/after rain events. 55,000 acres of land in the San Luis Rey Watershed burned during the 2007 Rice and Poomacha wildfires. Rain events increased sediment runoff (high concentrations of TDS and Total Suspended Solids, and turbidity) and mudslide type events at and around the burned site (DFG, 2010).

Natural Resources

Due to relatively undeveloped nature of the San Luis Rey Watershed, the watershed contains intact habitat and wildlife areas comprised of 36 vegetation communities, the dominant of which area coastal sage scrub, chaparral, and grasslands. The San Luis Rey Watershed also contains defined freshwater fish communities including upland, lowland, and coastal lagoons (City of Oceanside et al., 2008).

The San Luis Rey Watershed had a historic population of native fish, including the Southern California Steelhead, which declined in the 1930's upon completion of the Henshaw Dam. In 2007, an adult steelhead trout (*Oncorhynchus mykiss*) was observed within the San Luis Rey River, and the northern area of the watershed continues to support a population of native rainbow trout (Coastal Watershed Planning and Assessment Program, 2008).

The San Luis Rey Watershed contains numerous protected and special-status species and vegetation communities, and is included in the North County Subarea of San Diego County's Multiple Species Conservation Program (MSCP) (City of Oceanside et al., 2008). Wetland habitats along the San Luis River are inhabited by endangered avian species; development in and around the river may be restricted due to the presence of such species. In 2006, stakeholders from the Santa Margarita Watershed and the San Luis Rey Watershed signed a Memorandum of Understanding that established a Weed Management Area and defined actions necessary to prevent the introduction, establishment, and spread of invasive non-native plants within the Santa Margarita and San Luis Rey Watersheds (Mission Resource Conservation District et al., 2006). Tribal nations located within the watershed have indicated concern that jurisdictional habitat conservation efforts such as the County's MSCP do not consider current or future tribal development plans, and tend to categorize tribal lands as open space.

San Luis Rey Watershed

Potential Climate Change Impacts

Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the San Luis Rey Watershed include but are not limited to:

- Decrease in imported water supply
- Decrease in groundwater supply
- Decrease in surface water availability
- Sea level rise
- Decrease in availability of necessary habitat
- Exacerbation of wildfires

Due to the complicated nexus between imported water, groundwater, and surface water (refer to Management Issues and Conflicts below), climate change could potentially impact water resources within the San Luis Rey Watershed if the availability or quality of any of these resources changes substantially due to climate change.

Because of the San Luis Rey Watershed's proximity to the coast, sea level rise has the potential to impact several municipalities and resources within the watershed. Saltwater intrusion has been a historic issue within the San Luis Rey River groundwater basin, and changes to the level of seawater could potentially exacerbate this issue.

Lastly, wildfires are an identified issue within the San Luis Rey Watershed, and several recent ones have occurred within the watershed (RWMG, 2009). If the frequency of wildfires increases due to climate change, local water quality and habitat within the watershed could be adversely impacted.

Management Issues and Conflicts

The San Luis Rey Watershed had a historical population of native fish, including the Southern California Steelhead, which declined in the 1930's upon completion of the Henshaw Dam (Coastal Watershed Planning and Assessment Program, 2008). Dams, water diversions, and flood control structures have had the most severe impacts on steelhead trout populations throughout California by cutting off access to upstream spawning and rearing habitats and reducing the flows necessary for immigration of adult and emigration of juvenile steelhead trout (Hunt and Associates, 2008).

Surface water and shallow aquifer issues within the San Luis Rey Watershed have been well documented and persistent for several decades. Prior to the 1960's, groundwater pumping in the western portion of the watershed led to lowering of groundwater levels, which led to seawater intrusion between two to six miles inland from the Pacific Coast. Delivery of imported water into the San Diego Region after completion of the first San Diego Aqueduct in 1947 led to reduced groundwater pumping. Over time, reduced groundwater pumping allowed groundwater levels to recover to historical levels, which also reduced effects associated with seawater intrusion. However, during this same time period, increased development and increased irrigation with imported water led to increased salt loading into the watershed, which affected groundwater quality to the point that groundwater use declined. As a result of severely reduced groundwater pumping, the depth of groundwater has risen such that perennial waters in the San Luis Rey River have moved upstream (City of Oceanside et al., 2008).

The San Luis Rey Watershed Council was created in 1997 to develop and implement a comprehensive resource management plan for the San Luis Rey River and its tributaries. In 2001, the San Luis Rey Watershed Council developed a list of priority issues identified for the watershed, including the following (San Luis Rey Watershed Council, 2001):

- Water Quality and Quantity – focusing on NPDES permits and TMDLs, water quality monitoring and analysis, and improving quality of surface water and groundwater.
- Heavy Industrial Uses – focusing on the proposed Gregory Canyon Landfill.
- Extractive Uses – focusing on sand and gravel mining.
- Invasive Plant Species Management – focusing on the San Luis Rey River Weed Management Area.

San Luis Rey Watershed
• Agricultural Uses – focusing on maximizing irrigation and fertilizer efficiency, maximizing pesticide efficiency/integrated pest management, and improving erosion control measures. • Fire Management – focusing on improving coordination between stakeholders. • Wildlife Management – focusing on the San Diego County MSCP, and City and SANDAG-based Multiple Habitat Conservation Plans. • Public Open Space Management – focusing on recreation and species habitat management. • Floodplain Management and Flood Warning – focusing on National Weather Service Flood Forecasting and San Diego County's ALERT Storm Warning System. • Recreational Uses – focusing on golf courses, parks, tourism, hiking, fishing, and camping. • Wetlands Protection and Restoration – focusing on the Wilderness Gardens Preserve and proposed mitigation sites. • Preserve Historical and Cultural Legacies Future water quality concerns over the proposed 300-acre Gregory Canyon Landfill two miles south of the community of Pala have been an issue in the San Luis Rey Watershed. Many believe the Gregory Canyon Landfill poses a major threat to local surface and groundwater resources (Save Gregory Canyon, N.D.). Potential impacts associated with the landfill could be costly to mitigate. Sand replenishment along the coast has also been an issue in the San Luis Rey Watershed due to upstream development preventing the transport and deposition of sand. The lower San Luis Rey River valley is channelized which prevents sand deposition in the alluvial plain (Coastal Morphology Group et al., N.D.).

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5.4 Carlsbad Watershed

The Carlsbad Watershed (Carlsbad Hydrologic Unit or Carlsbad HU (904)) features a significant number of the Region's coastal lagoons. The Carlsbad Watershed is comprised of six small hydrologic areas, including Loma Alta (904.1), Buena Vista Creek (904.2), Agua Hedionda (904.3), Encinas (904.4), San Marcos (904.5), and Escondido Creek (904.6). The aforementioned creeks all drain in a westerly direction, draining into one of four major coastal lagoons (Buena Vista Lagoon, Agua Hedionda Lagoon, Batiquitos Lagoon, and San Elijo Lagoon), the Loma Alta Slough, or the Pacific Ocean.

Figure 5-5 presents a map of the Carlsbad Watershed showing principal features and boundaries. Approximately half of the 211 square mile Carlsbad Watershed is urbanized, with a high percentage of the undeveloped land in private ownership. Urban and agricultural runoff is a critical concern within the Carlsbad Watershed, and can impact both the coastal lagoons and local beaches.

Water supply reliability is also critical issue within the Carlsbad Watershed, as some water agencies (e.g. City of Carlsbad) are currently 100% reliant on imported supply. Surface reservoirs within the Carlsbad Watershed include Lake Wohlford, Dixon Lake, Lake San Marcos, Olivenhain Reservoir, and San Dieguito Reservoir.

Only a limited quantity of groundwater exists within the Carlsbad Watershed, and groundwater salinity represents a limitation to its use as a potable supply.

Lake Wohlford is the largest surface water reservoir in the Carlsbad Watershed.

Photo credit: Craig Whitmore, City of Escondido

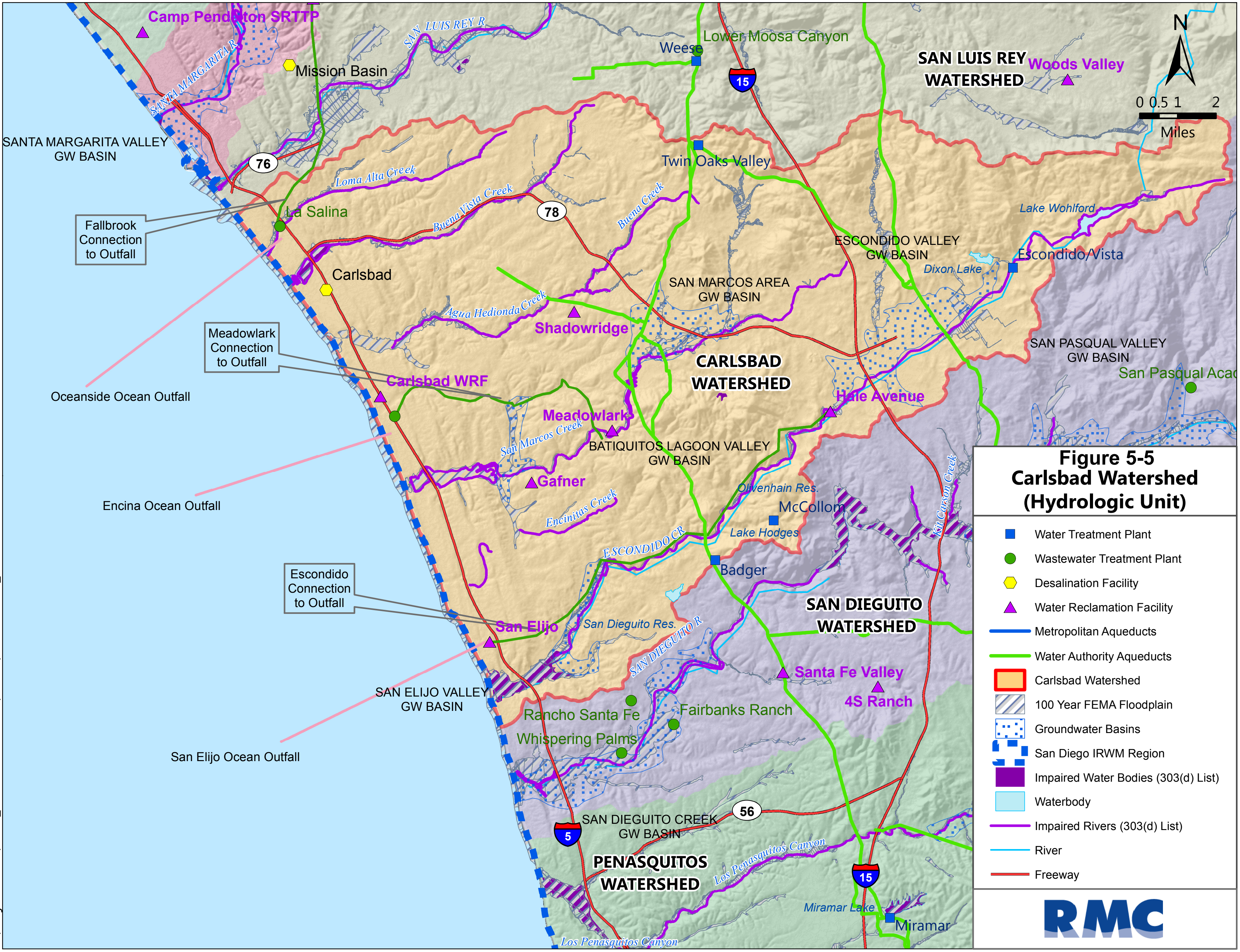

Figure 5-5
Carlsbad Watershed (Hydrologic Unit)

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Carlsbad Watershed

Hydrology

The Carlsbad Watershed contains several major stream systems that are each associated with the six small hydrologic areas (HAs), including:

- Loma Alta HA (904.1), which drains into Loma Alta Slough,
- Buena Vista Creek HA (904.2), which drains into Buena Vista Lagoon,
- Agua Hedionda HA (904.3), which drains into Agua Hedionda Lagoon,
- Encinas HA (904.4), which drains to the Pacific Ocean,
- San Marcos HA (904.5), which drains into Batiquitos Lagoon, and
- Escondido Creek HA (904.6), which drains into San Elijo Lagoon.

The other major surface water bodies within the Carlsbad Watershed include five reservoirs and storage lakes, described in *Water Systems* below.

Source water for Escondido Creek is from Lake Wohlford and Dixon Lake, which include waters transferred from the San Luis Rey Watershed via the Escondido Canal. San Marcos Creek drains into Lake San Marcos. Olivenhain Reservoir, created by the Olivenhain Dam, is located within the Carlsbad Watershed and is connected to Hodges Reservoir (within the San Dieguito Watershed) as part of the San Diego County Water Authority's Emergency Storage Project (OMWD, 2011). San Dieguito Reservoir, which is located on the border of the Carlsbad and San Dieguito Watersheds, stores raw water and is co-owned and operated by the Santa Fe Irrigation District and the San Dieguito Water District (SFID, 2011).

Water Systems

There are five major surface water bodies in the watershed, which are used to store surface water or imported water:

- Lake Wohlford, owned by City of Escondido and stores surface water
- Dixon Lake, owned by City of Escondido and stores surface water and imported water
- Lake San Marcos, a privately owned lake (Citizens Development Corporation) that stores surface water
- Olivenhain Reservoir: owned by Water Authority, stores natural runoff
- San Dieguito Reservoir: owned by San Dieguito Water District and Santa Fe Irrigation District, stores imported water from the Water Authority's Second Aqueduct and upstream releases

Water systems within the Carlsbad Watershed are complex, containing all or portions of seven cities (Carlsbad, San Marcos, Encinitas, Oceanside, Vista, Escondido, and Solana Beach), the County of San Diego, and a small portion of the San Pasqual Band of Indians' Reservation. In addition, the Carlsbad Watershed contains all or portions of ten water agencies (City of Escondido, City of Oceanside, Carlsbad Municipal Water District, Olivenhain Municipal Water District, Rincon del Diablo Municipal Water District, Santa Fe Irrigation District, San Dieguito Water District, Vallecitos Water District, Valley Center Municipal Water District and Vista Irrigation District) that are member agencies of the San Diego County Water Authority. The San Pasqual Band of Indians operates a Public Water System and also purchases water from the Valley Center Municipal Water District. As such, within the Carlsbad Watershed there is a large amount of imported water use and limited amounts of other water supplies.

Within the Carlsbad Watershed, local water sources include runoff that is collected within Lake Wohlford and Dixon Lake. The Carlsbad Watershed is home to three potable water treatment plants: Escondido/Vista (capacity of 65 MGD), McCollom (capacity of 34 MGD), and Badger (capacity of 40 MGD). Water produced at these plants come from storage or surface water in both the Carlsbad Watershed and the San Dieguito Watershed, and may be used outside the Carlsbad Watershed.

Groundwater basins underlying the Carlsbad Watershed include the Batiquitos Lagoon Valley (9-22), San Elijo Valley (9-23), San Marcos Area (9-32), and Escondido Valley (9-9) basins defined according to DWR Bulletin 118. According to DWR, major recharge areas within the aforementioned groundwater basins include

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corresponding rivers or creeks and their tributaries as well as infiltration of runoff (DWR (f), 2004; DWR (g), 2004; DWR (h), 2004; and DWR (i), 2004). As described in *Chapter 7, Regional Coordination*, Rincon del Diablo Municipal Water District is developing a Salt and Nutrient Management Plan (SNMP) for the medium priority (Tier B) Escondido Valley groundwater basin, in coordination with the Regional Board and the City of Escondido. The San Marcos Basin is also a Tier B groundwater basin, though no SNMP is currently under development for this basin. However, it is anticipated that a SNMP will be developed in the future (Regional Board, 2013). The Batiquitos and San Elijo basins are low priority (Tier D-2) basins, which are unlikely to require a SNMP.

In November 2012, the Water Authority's Board of Directors voted to approve a 30-year Water Purchase Agreement to purchase up to 56,000 acre-feet of water annually from Poseidon Water (Poseidon) (SDCWA, 2012). Poseidon is currently constructing a reverse-osmosis seawater desalination facility and 10 miles of pipeline in Carlsbad. Two Water Authority member agencies, Vallecitos Water District and Carlsbad Municipal Water District, will purchase a combined total of 6,000 acre-feet of the desalinated water as their own local supply under separate agreements with the Water Authority. The facility is expected to produce 50 MGD of water starting in 2016 and by 2020 will generate 7% of the region's water demand (SDCWA, 2011; SDCWA, 2012 and Poseidon 2013). The desalination facility will enhance the Region's water reliability through supply diversification. The plant will be located at the Agua Hedionda Lagoon next to the Encina Power Plant, a favorable location due to its proximity to the ocean and the available use of an existing intake and outfall (Poseidon, 2013).

Upper San Marcos Creek at Via Vera Cruz, San Marcos, CA.

Photo Credit: Erica Ryan, City of San Marcos

Since 2009, the City of San Marcos with oversight from the San Diego Regional Water Quality Control Board, has led a unique consortium of volunteer stakeholders that includes the County of San Diego, City of Escondido, California Department of Transportation, San Marcos Unified School District, and Vallecitos Water District to identify and implement a holistic solution to the estimated 18,000-acre watershed area of Upper San Marcos Creek and Lake San Marcos. In addition, the City of San Marcos has integrated its new downtown, per the San Marcos Creek Specific Plan, with the overall stakeholder effort for the Upper San Marcos Creek through implementing key watershed sustainability goals for water resource management, efficient water use, reduction in reliance on imported water through groundwater resources, creek restoration, improvements in water quality, and reduction of hydromodification effects from the Upper San Marcos Creek.

Internal Boundaries and Land Uses

The Carlsbad Watershed crosses multiple local jurisdictional boundaries including the cities of Carlsbad, San Marcos, Encinitas, Oceanside, Vista, Escondido, Solana Beach, and unincorporated portions of San Diego County (City of Carlsbad et al., 2008). A very small portion of the San Pasqual Reservation is located within the eastern portion of the Carlsbad Watershed, along the border of the San Luis Rey Watershed. Population growth is expected to increase in the aforementioned jurisdictional areas from existing levels of approximately 500,000 to over 700,000 by 2015, making the Carlsbad Watershed the third most populous watershed within San Diego County (PCW, N.D.).

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The majority of the Carlsbad Watershed is urbanized (69%), and is therefore dominated by urban-related land uses including residential (32%), commercial/industrial (13%), freeways and roads (10%), agricultural (6%), open space (11%), leaving a small portion of the watershed (18%) as vacant or undeveloped (Carlsbad et al., 2008). Population increases as described above are anticipated to occur largely on vacant or undeveloped lands, as the majority of these lands are in private ownership (PCW, N.D.). Therefore, as population increases in the watershed, the amount of vacant or undeveloped land is expected to decrease. Tribal lands are limited within the Carlsbad Watershed; less than 1% of the watershed contains tribal lands.

Water Quality and Water Quality Impairments

Multiple water bodies within the Carlsbad Watershed are listed on the 303(d) list of impaired water bodies. Impaired water bodies and the constituents for which they are listed are provided below:

- Agua Hedionda Creek for *Enterococcus*, fecal coliform, phosphorus, nitrogen, toxicity, manganese, selenium, and TDS
- Buena Creek for DDT (dichlorodiphenyltrichloroethane, an insecticide), nitrate, and nitrite
- Buena Vista Creek for sediment toxicity and selenium
- Buena Vista Lagoon for indicator bacteria, nutrients, and sedimentation/siltation
- Pacific Ocean Shoreline, Cardiff State Beach at Cardiff Lagoon for total coliform
- Cottonwood Creek for DDT, selenium, and sediment toxicity
- Encinitas Creek for selenium and toxicity
- Escondido Creek for *Enterococcus*, fecal coliform, DDT, manganese, nitrogen, phosphate, selenium, sulfates, toxicity, and TDS
- Lake San Marcos for ammonia as nitrogen and nutrients
- Loma Alta Creek for selenium and toxicity
- Pacific Ocean Shoreline, Loma Alta Creek mouth for indicator bacteria
- Loma Alta Slough for eutrophication and indicator bacteria
- Pacific Ocean Shoreline, Moonlight State Beach at Cottonwood Creek outlet for total coliform
- San Elijo Lagoon eutrophication, indicator bacteria, and sedimentation/siltation
- San Marcos Creek for DDE (dichlorodiphenyldichloroethylene, a byproduct of DDT), phosphorous, selenium, and sediment toxicity
- Pacific Ocean Shoreline, San Mateo Creek outlet for total coliform

The Basin Plan established specific water quality objectives for the Carlsbad Watershed, as well as beneficial uses for individual water bodies. Due to water quality impairments listed above, several water bodies within the watershed are also experiencing impairments to beneficial uses. Specifically, three of the four coastal lagoons within the watershed (Agua Hedionda, Buena Vista, and San Elijo) are impaired due to excessive bacteria and sediment loading from upstream sources (PCW, N.D.). A Water Quality Improvement Plan will be developed for the entire Carlsbad Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

In 1997 and 1998, the Carlsbad Watershed Network (CWN) was formed to protect, restore, and enhance water quality, habitat, and natural resources in the Carlsbad Watershed. The CWN is comprised of eleven member organizations that have developed a variety of projects or programs to support the goals of the CWN and benefit the Carlsbad Watershed (CWN, 2004). One of these projects is the Agua Hedionda Watershed Management Plan, developed by the City of Vista, which is a geographically focused plan to manage a smaller area within the watershed (City of Carlsbad et al., 2013). The Agua Hedionda Watershed Management Plan contains a series of recommendations to protect the watershed and improve water quality, such as stream restoration to manage

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sediment (City of Vista). For the Carlsbad Watershed, which contains multiple parallel watersheds, this approach taken by the Agua Hedionda Watershed Management Plan may be more appropriate than a more general, overarching watershed management plan.

Several stakeholders in the Carlsbad Watershed have worked together on successful efforts to reduce pollutant loading into Cottonwood Creek, which drains into Moonlight Beach in Encinitas (Rasmus and Weldon 2003). These efforts have resulted in implementation of upstream best management practices and development of plans to implement an urban runoff treatment facility to further reduce pollutant loading to the beach (Rasmus and Weldon 2003). Efforts associated with Cottonwood Creek and Moonlight Beach have resulted in improved beach water quality ratings for Moonlight Beach; the beach received poor water quality ratings by environmental groups in 2000 (Rasmus and Weldon 2003), but a revised 2012 scoring by the Natural Resources Defense Council showed that the beach received 4 out of 5 stars for water quality (NRDC 2012).

The SNMP currently under development for the Escondido Valley groundwater basin will identify sources of salts and nutrients in the basin, set goals and objectives for the basin, determine if any reduction in loading is necessary and potential ways to achieve load reduction. See Chapter 7, Regional Coordination for more information.

Various Total Maximum Daily Loads (TMDLs) are being developed for the Carlsbad Watershed to improve the water quality of Section 303(d) listed water bodies. TMDLs that are under investigative order or will be completed at a later date include Loma Alta and San Marcos. Loma Alta slough has been identified with bacteria and eutrophication pollutant/stressor (City of Carlsbad, 2011).

Stormwater and Flood Management

Major drainages within the watershed include Agua Hedionda Creek, Buena Vista Creek, Escondido Creek, and San Marcos Creek, which encompass drainage areas of 23.8, 20.8, 77.7, and 28.1 square miles, respectively. The peak discharges during a 100-year event for the above creeks are 9,850, 8,500, 22,000, and 15,700, respectively. Within the watershed, the acreage of land uses within mapped flood hazard zones total more than 5,000 acres, and includes the following: agriculture, 354 acres; commercial and services, 1,345 acres; industrial, 271 acres; open space and recreation, 2,474 acres; residential, 1,721; and transportation, communications, and utilities, 1,082 acres (see Appendix 7-B, Integrated Flood Management Planning Study).

Stormwater and flood management within the Carlsbad Watershed is complex due to multiple jurisdictional agencies involved in these activities, as well as urbanization, which presents unique stormwater and flood management issues. Several jurisdictions within the Carlsbad Watershed work together to jointly implement the Carlsbad Watershed Urban Runoff Management Plan (WURMP), which identifies and prioritizes water quality problems within the Carlsbad Watershed that can be potentially, attributed to discharges from municipal storm drain systems (City of Carlsbad et al., 2008).

Flood control within the Carlsbad Watershed often includes channelizing major surface water bodies to prevent private property flood damage. Major flood control projects were generally constructed from 1950-1980, including channelization of Escondido Creek, channelization of Reidy Creek (connected to Escondido Creek), and channelization of Buena Vista Creek. In addition, detention basins have been constructed within portions of the Buena Vista Creek to address 100-year flood flows. Despite channelization efforts, flooding continues to be a major concern for jurisdictions such as the City of Oceanside (Loma Alta Creek), the City of San Marcos (San Marcos Creek), and the City of Escondido (Escondido Creek) (CWN, 2002).

Natural Resources

Urbanization and development within the Carlsbad Watershed have led to habitat degradation and loss, as well as the introduction of invasive species within the watershed. Remaining native habitats within the watershed primarily include upland vegetation consisting of coastal sage scrub, chaparral scrub, and small areas of oak woodlands. In addition, the watershed contains native grasslands, riparian forests/woodlands, riparian scrubs, marsh/wetlands, and open water areas (CWN, 2002).

All four of the coastal lagoons located in the watershed (Agua Hedionda, Batiquitos, Buena Vista, and San Elijo)

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are important natural resources located within the Carlsbad Watershed. Agua Hedionda Lagoon is characterized as a salt water marsh; however, it is not extensive due to increased urbanization in the region. Most of the salt marsh vegetation can be found in the upper reaches of the lagoon. The lagoon was also recently identified as a critical habitat for the Tidewater Goby (*Eucyclogobius newberryi*), a federally listed endangered species. Much of Agua Hedionda Lagoon is now used for recreational boating and water sports (CWN, 2002). The western portion of the lagoon is used as a cooling water source for the Encina Power Plant as well as for two aquaculture facilities – a white sea bass research facility managed by Hubbs/Seaworld and California Department of Fish and Game and a commercial company cultivating shellfish for a wide-ranging market (City of Carlsbad, N.D. and San Diego Coast Life, N.D.). The power plant cooling intake system will be converted to serve as the intake for the under-construction Carlsbad Desalination Plant (planned for completion in 2016), when the Encina Power Plant is eventually retired (Carlsbad Desalination, N.D.). Batiquitos Lagoon, which is 600 acres in size, is considered one of the most important estuarine systems along the Southern California coast (CWN, 2002). The lagoon is owned by the California Department of Fish and Wildlife (formerly California Department of Fish and Game), and is maintained by the department as an Ecological Reserve (CWN, 2002). Buena Vista Lagoon is one of the largest areas of freshwater marsh habitat in San Diego County. In 1940, a weir was constructed at the mouth of Buena Vista Lagoon eliminating all tidal flow and converting it into a freshwater lake. Sedimentation is one of the most significant issues at Buena Vista Lagoon. This is due to the effects of urbanization, stream channel modification, and lack of tidal flushing of the lagoon system. Sedimentation poses a long-term threat to the freshwater marsh and open water mosaic that currently exists at the lagoon. If sedimentation in the lower portions of the watershed and lagoon are not slowed, Buena Vista Lagoon will be in danger of becoming a large freshwater marsh with no open water mosaic. Increased management of the lagoon is necessary to reduce many of the sedimentation issues. Efforts such as opening the mouth of the Buena Vista Lagoon to increase tidal exchange are currently underway (CWN, 2002). San Elijo Lagoon is the southernmost lagoon in the Carlsbad Watershed, and is noted for being surrounded by steep coastal bluffs that cause sediment issues in the lagoon due to erosion (CWN, 2002). The lagoon also contains the most extensive stands of freshwater marsh vegetation in the watershed (CWN, 2002). Similar to the Buena Vista Lagoon, the San Elijo Lagoon experiences excessive sedimentation associated with erosion; sedimentation and sand deposition require regular dredging of the lagoon to maintain its connectivity with the ocean (CWN, 2002). The Carlsbad Watershed contains numerous protected and special-status species and vegetation communities, and is partially included in the North County Subarea of San Diego County's Multiple Species Conservation Program (MSCP) (CWN 2002). Several of the city jurisdictions, including the City of Carlsbad, City of Encinitas, City of Oceanside, and the City of Escondido have individual habitat management or conservation plans such as Multiple Habitat Conservation Plans (MHCPs) that provide habitat management within the watershed. Special status plant and animal species in the watershed include six estuarine species, eight riparian species, and ten upland species. The Carlsbad Watershed also contains invasive exotic species that may cause water-related issues. Such species include *Arundo donax,* a species of eucalyptus (*Eucalyptus globulus*), Castor Bean (*Ricinus communis*), Pampas Grass (*Cortaderia selloana*), and Tamarisk (*Tamarix* spp.). Although the Agua Hedionda Creek previously experienced issues related to the invasive green algae *Caulerpa taxifolia,* this species was eradicated by the Southern California Caulerpa Action Team (part of the California Regional Water Quality Control Board, San Diego Region SDRWQCB) (CWN, 2002). Tribal nations in the Region have indicated concern that jurisdictional habitat conservation efforts such as those described above may not consider current or future tribal developments, and tend to categorize tribal lands as open space during habitat and conservation planning efforts.

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Potential Climate Change Impacts

Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the Carlsbad Watershed include but are not limited to:

- Decrease in imported water supply
- Decrease in groundwater supply
- Decrease in surface water availability
- Water quality concerns related to several factors
- Sea level rise
- Increased severity of storms (flooding)
- Exacerbation of wildfires

Due to the reliance on imported water supplies within the Carlsbad Watershed, decreases in imported water supply availability could have potentially large impacts within the watershed. However, the Water Authority's Emergency Storage Project will help to alleviate such impacts by facilitating water transport to the Carlsbad Watershed from other watersheds and water sources within the Region. Other water-supply related issues could occur due to the reduction of existing (albeit limited) groundwater and surface water sources.

Water quality concerns are already substantial within many water bodies in the Carlsbad Watershed. Climate change-related impacts could potentially exacerbate existing water quality issues due to increased pollutant concentrations (caused by reduced surface water flows and increased flood events) or increases in sedimentation (caused by increased wildfire occurrences and increased flood events). As such, increased wildfire occurrences and increased flood events due to climate change could potentially cause water quality-related issues in the Carlsbad Watershed.

Due to the Carlsbad Watershed's location along the coast, sea level rise could potentially impact this watershed and its coastal ecosystems and habitats (lagoons) or coastal municipalities and associated land uses.

Management Issues and Conflicts

The Carlsbad Watershed has particular water quality-related issues that are generally associated with urban development. Although other issues may exist within the watershed, the WURMP lists sedimentation, nutrient loading, and bacteria and pathogens as the primary management issues within the Carlsbad Watershed (City of Carlsbad et al, 2012).

Due to urban development, many of the surface water bodies that drain into the watershed's lakes and lagoons have been channelized or otherwise modified. Sedimentation has been linked to bacteria loading, as sediments may provide a breeding location for bacteria. Bacteria-related issues have led to temporary closures of recreational areas as well as impacts to natural resources.

Outside of specific sedimentation-related issues, the Carlsbad Watershed is also impacted by general water quality issues associated with bacteria and eutrophication. Agricultural runoff and construction-related runoff have been identified as major contributors to water quality impairments, and have therefore been targeted to address water quality issues. Although to a lesser degree, urban non-stormwater related runoff from pet wastes (bacteria) and excessive fertilizer usage (nutrients) have also been identified as contributors to water quality issues within the Carlsbad Watershed (CWN, 2002).

Potential Impacts to the watershed's water bodies and lagoons due to urbanization and highway development could pose future management issues (i.e. increased sedimentation, and water quality issues). Urbanization may also increase the amount of invasive species in the watershed, which can jeopardize native species and habitats (CWN, 2002).

As described above, Poseidon is in the process of developing an alternative local water supply source via the construction of a reverse-osmosis seawater desalination facility in the Carlsbad Watershed. Construction is underway on the desalination plant and associated pipeline. There have been concerns raised regarding the intake of 300 MGD of water from the Agua Hedionda Lagoon and its impact on fisheries and local habitats. (San

Carlsbad Watershed
Diego Coastkeeper, N.D.). Environmental permits that have been issued for the project include provisions to address the potential impacts. These concerns will continue to be addressed through ongoing compliance with permitting requirements during the construction and operation of the desalination facility. Erosion is a concern along coastal bluffs along various cities in the Carlsbad Watershed, and has the potential to impact the watershed's lagoon systems. Upstream development and urbanization along the coast has resulted in a loss of sediment and sand supply, narrowing beaches and exposing the public to potential bluff collapses. Ideas that have been considered to stabilize shorelines have included beach nourishment, shoreline armoring, and improved sediment management strategies (City of Encinitas, 2012).

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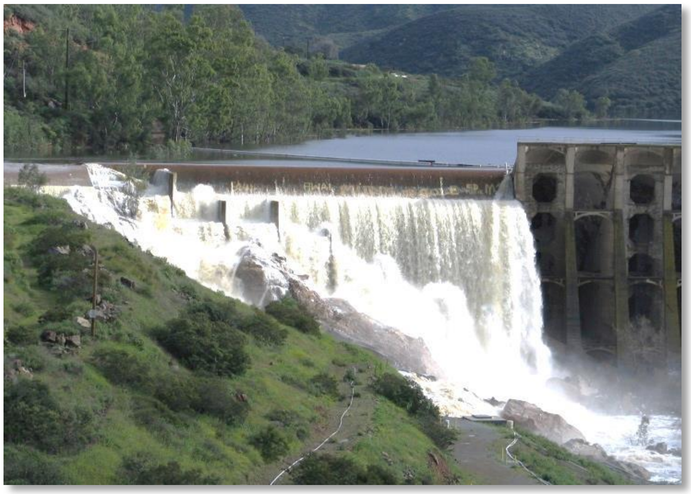
5.5 San Dieguito Watershed

The San Dieguito Watershed (San Dieguito Hydrologic Unit or San Dieguito HU (905)) covers 346 square miles. Eighty percent of the watershed is in the unincorporated portion of San Diego County. Figure 5-6 is a map that shows the principal watershed features and boundaries.

The watershed includes two major surface water reservoirs: Sutherland Reservoir and Hodges Reservoir. The City of San Diego owns a significant portion of the land in the immediate river valley between these two reservoirs and leases much of the land for agriculture. Lake Poway and Lake Ramona are two smaller water supply reservoirs in the watershed.

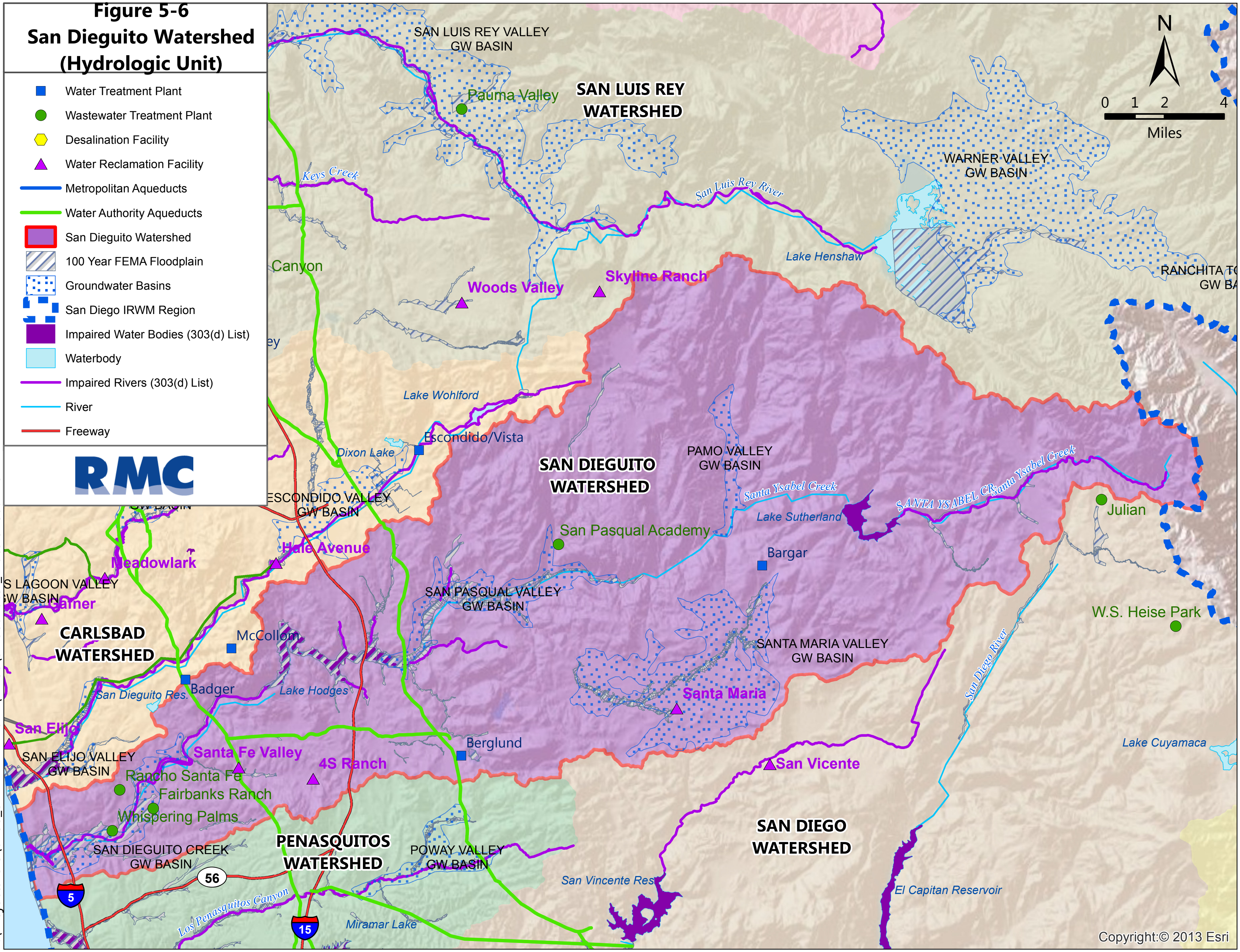
There are four distinct groundwater basins located in the San Dieguito Watershed: Pamo Valley, San Dieguito Valley, San Pasqual Valley and Santa Maria Valley. The majority of the San Pasqual Valley groundwater basin (in the middle watershed) is owned by the City of San Diego. While public water supply is not currently developed from the San Pasqual basin, the basin represents a potential source of local water supply. The San Dieguito Valley, San Pasqual Valley, and Santa Maria Valley basins all have high TDS levels, while the Santa Maria Basin also has high nutrients and selenium levels. According to DWR Bulletin 118, the Pamo Valley groundwater basin is suitable for domestic and irrigation uses, and does not have high TDS levels (DWR 2004).



The Lake Hodges (Hodges Reservoir) Water Quality and Quagga Mitigation Measures Project – funded by Proposition 84-Round 1 – will evaluate options to improve water quality and the ecosystem in Hodges Reservoir to maximize use of the reservoir.

Photo credit: Toby Roy, San Diego County Water Authority

Figure 5-6
San Dieguito Watershed
(Hydrologic Unit)



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San Dieguito Watershed

Hydrology

The San Dieguito Watershed is comprised of five Hydrologic Areas (HAs): Solana Beach (905.1), Hodges (905.2), San Pasqual (905.3), Santa Maria Valley (905.4), and Santa Ysabel (905.5). The major surface water bodies within the San Dieguito Watershed are the San Dieguito Lagoon, San Dieguito River, Hodges Reservoir, Santa Ysabel Creek, Santa Maria Creek, Sutherland Reservoir (also referred to as Lake Sutherland), Lake Poway, and Lake Ramona (City of Del Mar et al, 2008).

The San Dieguito River is the primary drainage in the watershed, with headwaters originating in the Witch Creek Basin. Drainage from the Witch Creek and the Sutherland Basins flows into the Sutherland Reservoir, a man-made reservoir that was created in 1954 with construction of the Sutherland Dam. From Sutherland Reservoir, the main drainage, Santa Ysabel Creek, continues westward to the San Pasqual Valley where it becomes San Dieguito River. San Dieguito River then flows into Hodges Reservoir, a water supply reservoir and recreation site located just west of Interstate 15. There are multiple tributaries that join the San Dieguito River below Hodges Reservoir, which all ultimately flow into the Pacific Ocean via the San Dieguito Lagoon (City of Del Mar et al, 2008).

Hydrology within the San Dieguito Watershed is diverse, as the watershed extends from the Pacific Ocean in the west to mountain areas in eastern San Diego County. As such, rainfall varies in the watershed from 10.5 inches along the coast to 31.5 inches in the inland mountain areas (City of Del Mar et al, 2008).

Water Systems

Water supply infrastructure within the San Dieguito Watershed is dominated by local reservoirs that store imported water and surface water runoff for multiple jurisdictions. There are four water supply reservoirs within the San Dieguito Watershed, which contain either imported water or surface water runoff, or a combination of both sources. Each reservoir is summarized below (City of Del Mar et al, 2008):

- Sutherland Reservoir: owned by the City of San Diego, contains natural runoff.
- Lake Ramona: owned by the Ramona Municipal Water District, stores imported water from the Water Authority's First Aqueduct.
- Lake Poway: owned by the City of Poway, stores imported water from the Water Authority's First Aqueduct.
- Hodges Reservoir: owned by the City of San Diego, stores imported water from the Water Authority's First Aqueduct and natural runoff.

Water supply agencies within the San Dieguito Watershed include the Santa Fe Irrigation District, San Dieguito Water District, Olivenhain Municipal Water District, City of San Diego, Rincon del Diablo Municipal Water District, City of Poway, and Ramona Municipal Water District. All of the aforementioned water supply agencies are member agencies of the San Diego County Water Authority, and therefore receive imported water from the Water Authority via the First and Second Aqueducts. Two potable water treatment facilities are located in the San Dieguito Watershed: Bargar, which can treat up to 4 MGD potable water and Berglund, which can produce up to 24 MGD. The Bargar filtration plant is not currently in operation.

Groundwater basins underlying the San Dieguito Watershed include the following four basins as defined according to DWR Bulletin 118:

- San Pasqual Valley: Recharge in the San Pasqual Valley Basin occurs from infiltration of precipitation and percolation of excess irrigation waters. In normal years all surface runoff within the San Pasqual Valley becomes groundwater recharge (DWR (j), 2004).
- Santa Maria Valley: Santa Maria Valley Basin recharge occurs from infiltration of precipitation. In addition, because a large portion of the population within this area is not connected to municipal sewer systems, some recharge likely comes from septic systems (DWR (k), 2004).

San Dieguito Watershed

- San Dieguito Valley: Recharge within the San Dieguito Valley Basin comes from many sources, including recharge by percolation of flows in the San Dieguito River, precipitation to the valley floor, underflow beneath Hodges Reservoir, and underflow through other nearby sediments (DWR (l), 2004).
- Pamo Valley: The Pamo Valley Basin has recharge from percolation of ephemeral stream flow in Temescal and Santa Ysabel Creeks (DWR (m), 2004).

A preliminary Salt and Nutrient Management Plan (SNMP) is being developed by the City of San Diego Public Utilities Department for the high priority (Tier A) San Pasqual groundwater basin. The draft SNMP has been completed and characterizes the basin, identifies sources of salts and nutrients, and calls for increased monitoring of well and surface waters and agricultural runoff. The Santa Maria groundwater basin is a medium priority (Tier B) basin, but no progress has yet been made on SNMP development. It is anticipated that a SNMP will be developed in the future (Regional Board, 2013). More information can be found in *Chapter 7, Regional Coordination*. The San Dieguito Valley groundwater basin is a low priority (Tier D-2) basin, and is not anticipated to require a SNMP. Although the Pamo Valley Basin is recognized in this Plan, it is not a designated groundwater basin in the Salinity/Nutrient Management Planning guidance document (Water Authority, 2010).

The San Dieguito Watershed also has facilities that are part of the County Water Authority's Emergency Storage Project. The Hodges Reservoir Projects of the Emergency Storage Project connects Hodges Reservoir to Olivenhain Reservoir (located in the Carlsbad Watershed) through pipelines and pump stations, which provides multiple benefits. First, this connection allows the City to access runoff captured in Hodges Reservoir that the City did not previously have access to. This is in addition to the historical use by Santa Fe Irrigation District and San Dieguito Water District. Second, this connection allows for water conveyance between Olivenhain Reservoir and Hodges Reservoir, which will keep Hodges Reservoir at a more constant level during dry seasons, allowing for more water to be captured during rainy seasons, and reducing spills over Hodges Reservoir (City of San Diego, 2011). Lastly, the Hodges Reservoir Project will make water in Hodges Reservoir potentially available to the Region if needed, because the Olivenhain Reservoir is connected to the Water Authority's Second Aqueduct (San Diego County Water Authority, 2011).

Internal Boundaries and Land Uses

The San Dieguito Watershed resides entirely within San Diego County, and contains multiple land use and water-related agencies. The San Dieguito Watershed includes portions of the cities of Del Mar, Escondido, Poway, San Diego, and Solana Beach, as well as unincorporated County areas. The majority of land within the San Dieguito Watershed (80%) is within the County's jurisdiction. There are seven water-related agencies in the San Dieguito Watershed, which are listed in the section above regarding water systems.

The San Dieguito Watershed also contains lands that are owned and managed by the San Dieguito River Valley Regional Open Space Park Joint Powers Authority (San Dieguito River Park), an agency that was formed in 1989 by the County of San Diego and cities of Del Mar, City of Escondido, City of Poway, City of San Diego, and City of Solana Beach. The San Dieguito River Park's mission is to preserve and restore land within the San Dieguito River Park, a 55- mile long area that extends from the Volcan Mountains in the east to the ocean at Del Mar, focusing on the San Dieguito River corridor and including both Lake Sutherland and Hodges Reservoir (San Dieguito River Park JPA 2002).

Land use within the San Dieguito Watershed is classified primarily as vacant and undeveloped land (39%), and other major land uses are open space/parks and recreation (22%), residential and spaced rural residential (18%), and agriculture (14%) (Copermittees, 2012). Transportation, commercial, industrial, public facility, under construction, and water land use classifications combined comprise the remaining 7% of the watershed (San Diego Association of Governments (SANDAG), 2009). Undeveloped and open space areas reside largely within the eastern portion of the watershed; the developed portion of the western watershed is generally typical of urbanized coastal areas in Southern California (City of Del Mar et al, 2008). The San Dieguito Watershed also contains a variety of land uses that support recreational activities, including Lake Poway, Sutherland Reservoir, and Hodges Reservoir, which support fishing and boating. In addition, there are many hiking trails within the San Dieguito Watershed, including a vision to develop the "Coast to Crest Trail" (City of San Diego, 2006).

San Dieguito Watershed

Residential development is expected to increase, along with an equitable loss in undeveloped and agricultural lands, in the San Dieguito Watershed. The 2030 SANDAG Land Use Plan projects almost a 300% increase in residential developed land, while the County of San Diego General Plan 2020 forecasts less residential development (City of San Diego, 2011). A comparison of the 2003 SANDAG and 2030 SANDAG Land Use Plans indicates the largest increase in residential developed land will occur in the middle portion of the watershed (50%) (City of San Diego, 2011).

Tribal lands make up approximately 5% of the San Dieguito Watershed. The watershed contains two tribal nations: the Santa Ysabel Reservation and the Mesa Grande Reservation (City of San Diego, 2011). The Santa Ysabel reservation was founded in 1893 and consists of 15,270 acres. The Mesa Grande Reservation was founded in 1875 and consists of 1,820 acres (University of San Diego, N.D. and Pritzker, 2000).

Water Quality and Water Quality Impairments

Several water bodies within the San Dieguito Watershed are listed on the Clean Water Act 303(d) list of impaired water bodies. Impaired water bodies include (PCW, N.D.):

- Pacific Shoreline, San Dieguito Lagoon Mouth for total coliform
- San Dieguito River (19 Miles) for *Enterococcus*, fecal coliform, nitrogen, phosphorus, TDS, toxicity
- Cloverdale Creek for phosphorus and TDS
- Felicita Creek for aluminum and TDS
- Green Valley Creek for chloride, manganese, PCP (pentachlorophenol), and sulfates
- Hodges Reservoir for color, manganese, nitrogen, pH, phosphorous, mercury, and turbidity
- Kit Carson Creek for PCP and TDS
- Sutherland Reservoir for color, manganese, iron, nitrogen, and pH
- Santa Ysabel (above Southerland Reservoir) for toxicity

Runoff from residential, commercial, industrial, and transportation land uses generally contribute higher pollutant loading within the San Dieguito Watershed. Pollutants of concern and stressors within the watershed include nutrients, pathogens, salinity, pesticides, metals/metalloids, toxicity, and other organics and inorganics (Copermittees, 2012).

The sources of these impacts are agriculture, dairies, urban runoff/storm sewers, flow regulation/modification, natural sources, and unknown point and non-point sources (SDRWQCB, 2010). Runoff from open space has the ability to contribute sediment to the watershed, and agricultural uses may impart nutrients and pesticides (City of Del Mar, et al 2008). Further, increased development and agricultural and turf related activities have been identified as the main threats to water quality in the San Dieguito Watershed (City of San Diego, 2006).

Water quality threats from agricultural runoff are of particular concern related to the San Pasqual groundwater basin, which is being considered for development as a drinking water supply. Because of this, the City of San Diego is developing a preliminary SNMP, as described in *Chapter 7, Regional Coordination*.

The City of San Diego has begun work on developing the 2015 Water Quality Improvement Plan for the San Dieguito Watershed through invitations to stakeholders to attend workshops, join the consultation committee, comment on deliverables when they become available, and provide data for use in the plan. The Watershed Urban Runoff Management Program (WURMP) Annual Report described18 water quality activities that were implemented in 2011-2012, such as the drop-off clean-up event held by the City of San Diego where 112,000 pounds of junk, appliances, mattresses, tires, and other large waste items were collected, and 44,000 pounds recycled (City of Del Mar et al., 2013).

The Basin Plan (SDRWQCB, 2007) establishes specific water quality objectives for all hydrologic areas included within the San Dieguito Watershed. For the five specific HAs included within the San Dieguito Watershed, there are specific water quality objectives established for TDS, nutrients, iron, chlorides, and color. A summary of the TMDLs are provided in *Chapter 3, Region Description*.

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Stormwater and Flood Management

Major drainages within the watershed include Hatfield Creek, San Dieguito River, Santa Maria Creek, and Santa Ysabel Creek, which encompass drainage areas of approximately 20.8, 60, and 290 square miles (no information available for San Dieguito River), respectively. The peak discharges during a 100-year event for the above rivers are 13,700, 41,800, 19,000, and 62,000 CFS. Within the watershed, the acreage of land uses within mapped flood hazard zones total more than 9,800 acres, and includes the following: agriculture, 2,352 acres; commercial and services, 953 acres; industrial, 44 acres; open space and recreation, 4,326 acres; residential, 853; and transportation, communications, and utilities, 344 acres (see Appendix 7-B, Integrated Flood Management Planning).

Stormwater and flood management within the San Dieguito Watershed are the responsibility of all of the municipal jurisdictions within the watershed, including the City of San Diego, the City of Poway, the City of Del Mar, Solana Beach, and the City of Escondido, as well as the County of San Diego. The majority of the watershed lies in unincorporated San Diego County, and fall under the jurisdiction of the County, though the cities of San Diego, Solana Beach, Del Mar, Escondido, and Poway are also responsible for implementing provisions included in the San Dieguito Watershed Urban Runoff Management Program. This program focuses on management activities that can be taken to reduce stormwater runoff and associated water quality concerns (City of Del Mar et al, 2008).

The County of San Diego conducts flood management efforts throughout its jurisdiction, including within the San Dieguito Watershed, to reduce and address flood flows associated with FEMA-designated flood areas (County of San Diego, 2007). According to the County of San Diego, localized flooding occurs in several reaches of the San Dieguito River, including:

- San Dieguito River downstream from Hodges Reservoir to Del Mar
- Santa Maria Creek in Ramona (along Rangeland Road)
- Hatfield Creek in Ramona (along Magnolia Avenue)

Despite two surface water reservoirs along the San Dieguito River, flood control issues remain a key concern in the watershed. Hodges Reservoir spilled 13 times during the period 1955-2005, representing a once-in-four-years period of recurrence. In addition to flooding in the lower San Dieguito basin associated with the Hodges Reservoir spills, local flood threats to developed areas exist within the Escondido and Ramona portions of the watershed. The ESP (described above in Water Systems) that connects Hodges Reservoir to the Olivenhain Reservoir is anticipated to reduce spills from occurring at Hodges Reservoir (City of San Diego, 2011).

Natural Resources

Due to relatively undeveloped nature of the San Dieguito Watershed, the watershed contains a diverse array of habitats that range from Volcan Mountain in the east to the San Dieguito Lagoon and Pacific Ocean in the west. There are several natural areas within the watershed, including the 55-mile long, 80,000 acre San Dieguito River Park, the 150 acre San Dieguito Lagoon, and natural areas associated with the watershed's surface water reservoirs (Project Clean Water, N.D.). Currently, the San Dieguito Lagoon Restoration project is restoring 116 acres of coastal tidal wetland to restore aquatic functions of the lagoon through a permanent inlet and expansion of the tidal basin, as well as create sub-tidal and intertidal habitats (San Dieguito River Park, N.D.).

Plant communities within the San Dieguito Watershed include chaparral (27%), coastal sage scrub (10%), oak woodlands (12%), and grasslands (11%) (City of San Diego 2006). Wetland areas including riparian habitats, marsh, meadows and seeps, and open water constitute approximately 2.5% of the watershed (City of San Diego, 2006).

The San Dieguito Watershed contains numerous protected and special-status species and vegetation communities, and is partially included in the North County Subarea of San Diego County's Multiple Species Conservation Program (MSCP) (City of San Diego 2006). Special status species, including species considered to be of special importance in California, identified in the San Dieguito Watershed include: San Diego horned lizard, orange-throated whiptail, common loon, brown pelican, white-faced ibis, osprey, northern harrier, sharp-

San Dieguito Watershed

shinned hawk, Western snowy plover, long-billed curlew, California gull, elegant tern, California least tern, black skimmer, tricolor blackbird, Belding's Savannah sparrow, and California gnatcatcher (City of Del Mar et al, 2008).

Invasive and non-native plants and animals may impact the lower, middle, and upper segments of the San Dieguito Watershed. Such invasive species include but are not limited to bullfrogs, crayfish, sunfish, and bass (City of San Diego, 2006).

Tribal nations in the Region have indicated concern that jurisdictional habitat conservation efforts such as those described above may not consider current or future tribal developments, and tend to categorize tribal lands as open space for habitat and conservation planning purposes.

Potential Climate Change Impacts

Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the San Dieguito Watershed include but are not limited to:

- Decrease in imported water supply
- Decrease in groundwater supply
- Decrease in surface water availability
- Impacts to water quality
- Sea level rise
- Decrease in availability of necessary habitat
- Increased flooding
- Exacerbation of wildfires

Due to the reliance on imported water supplies within the San Dieguito Watershed, decreases in imported water supply availability could have potentially large impacts within the watershed. However, the ESP will help to alleviate such impacts by facilitating water transport to the San Dieguito River Watershed from other watersheds and water sources within the Region.

Flooding within the San Dieguito Watershed could be exacerbated due to climate change if the frequency and intensity of storms overwhelm the ability of local reservoirs to capture runoff. Historically there have been spills over Hodges Reservoir due to excessive runoff, and although this issue will be alleviated due to the ESP, it is possible that flood impacts could increase due to climate change.

Further, due to the San Dieguito Watershed's proximity to the coast, sea level rise has the potential to impact several municipalities and resources within the watershed. Lastly, wildfires are an identified issue within the San Dieguito Watershed, and several recent wildfires have occurred within the watershed (RWMG, 2009). If the frequency of wildfires increases due to climate change, local water quality and habitat within the watershed could be adversely impacted.

Management Issues and Conflicts

Due to the diverse nature of the San Dieguito Watershed, management issues and conflicts are also diverse. Stakeholders within the San Dieguito Watershed have identified a number of major issues and concerns, including physical and hydrologic modifications, water quality, invasive species, and flooding associated with local surface waters (City of San Diego, 2006).

The San Dieguito River Park's Concept Plan notes that one of the common planning themes among groups associated with the San Dieguito River Park is to preserve and enhance the rich resources and qualities that make the San Dieguito River Park Focused Planning Area (FPA) unique. One of the purposes of creating the FPA boundary is to identify areas where improper development could significantly impact the existing character of the river valley (San Dieguito River Park JPA, 2002). These statements indicate that one of the key management issues within the San Dieguito Watershed is how to reconcile potentially conflicting land uses and

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ensure that development does not negatively impact the river. Fires are a threat to the biological resources in the San Dieguito Watershed because they are a source of surface water contamination and habitat disturbances. In 2003, fires burned approximately 13% of the San Dieguito Watershed impacting the native vegetated communities. Post-fire concerns in the watershed include loss of habitat, increased erosion/sedimentation, and the establishment of non-native plant species (City of San Diego, 2006). Over-grazing has also been a concern in the San Dieguito Watershed. Over-grazing has reduced tree regeneration, reduced vegetative cover, caused streambank destabilization, water quality degradation, and spread non-native weeds. With proper management and timed grazing, exotic species can be reduced in the Watershed (City of San Diego, 2006). Stormwater runoff containing pesticides, herbicides, fertilizers, and sediment have been an issue in the San Dieguito Watershed (City of del Mar et al 2008). High nutrient levels in runoff have been impacting surface water quality of several water bodies in the watershed, including Hodges Reservoir (City of del Mar et al 2008). Impacts to Hodges Reservoir from urban and agricultural runoff as well as permitted upstream wastewater discharges and rural development have resulted in poor quality water requiring downstream water agencies to incur additional treatment costs. The agencies involved in managing Hodges Reservoir are committed to finding cost-effective and science-based solutions to addressing water quality concerns for the reservoir. A Water Quality Improvement Plan will be developed for the entire San Dieguito Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into water bodies such as Hodges Reservoir and determine actions that can be taken to improve water quality. In addition, several IRWM-funded projects have been directed toward watershed-based solutions and in-reservoir remedies for water quality concerns in Hodges Reservoir. Efforts associated with the 2013 MS4 Permit and the IRWM-funded projects will be coordinated to ensure that the efforts are integrated to achieve maximum benefits.

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5.6 Peñasquitos Watershed

The Peñasquitos Watershed (Peñasquitos Hydrologic Unit or Peñasquitos HU (906)) is a 162 square mile watershed that is comprised of five Hydrologic Areas (HAs): Miramar Reservoir (906.1), Poway (906.2), Scripps (906.3), Miramar (906.4), and Tecolote (906.5). The 2013 NPDES permit (Regional Board) divides this watershed into two Watershed Management Areas (WMAs). The northern Peñasquitos WMA (Miramar Reservoir and Poway) drains to the Peñasquitos Lagoon and ultimately to the Pacific Ocean, while the southern Mission Bay WMA (Scripps, Miramar, and Tecolote) drains to Mission Bay. A map of the major features of the watershed is presented in Figure 5-7.

The Peñasquitos WMA has a drainage area of 94 square miles. There are several water features in the WMA including Carmel Canyon Creek, Los Peñasquitos Creek and Carroll Canyon Creek. It also contains one water storage facility, Lake Miramar, located in the Poway HA. The WMA has a population of 258,331 people. The Peñasquitos Watershed encompasses portions of three cities (San Diego, Poway and Del Mar) and the County of San Diego. The Peñasquitos Watershed has a total population of 490,433 people (2010 Census).

The Mission Bay WMA has a drainage area of 68 square miles. There are several water features in the WMA including Rose Creek and Tecolote Creek. The Scripps HA is included in the Mission Bay WMA although it technically drains to both WMAs and to the Pacific Ocean as well. The WMA has a population of 232,102 people, and is entirely within the jurisdiction of the City of San Diego.

Two small groundwater basins exist within the Peñasquitos Watershed. Except for a small amount of local runoff that enters Miramar Reservoir (a small reservoir used to store imported supply), no water supply is developed within the Peñasquitos Watershed.

The Sustainable Landscapes Program – funded by Proposition 84-Round 1 – aims to increase water efficiency in urban landscapes and improve water quality by reducing runoff associated with excessive irrigation.

Photo credit: Kyrsten Burr-Rosenthal, City of San Diego

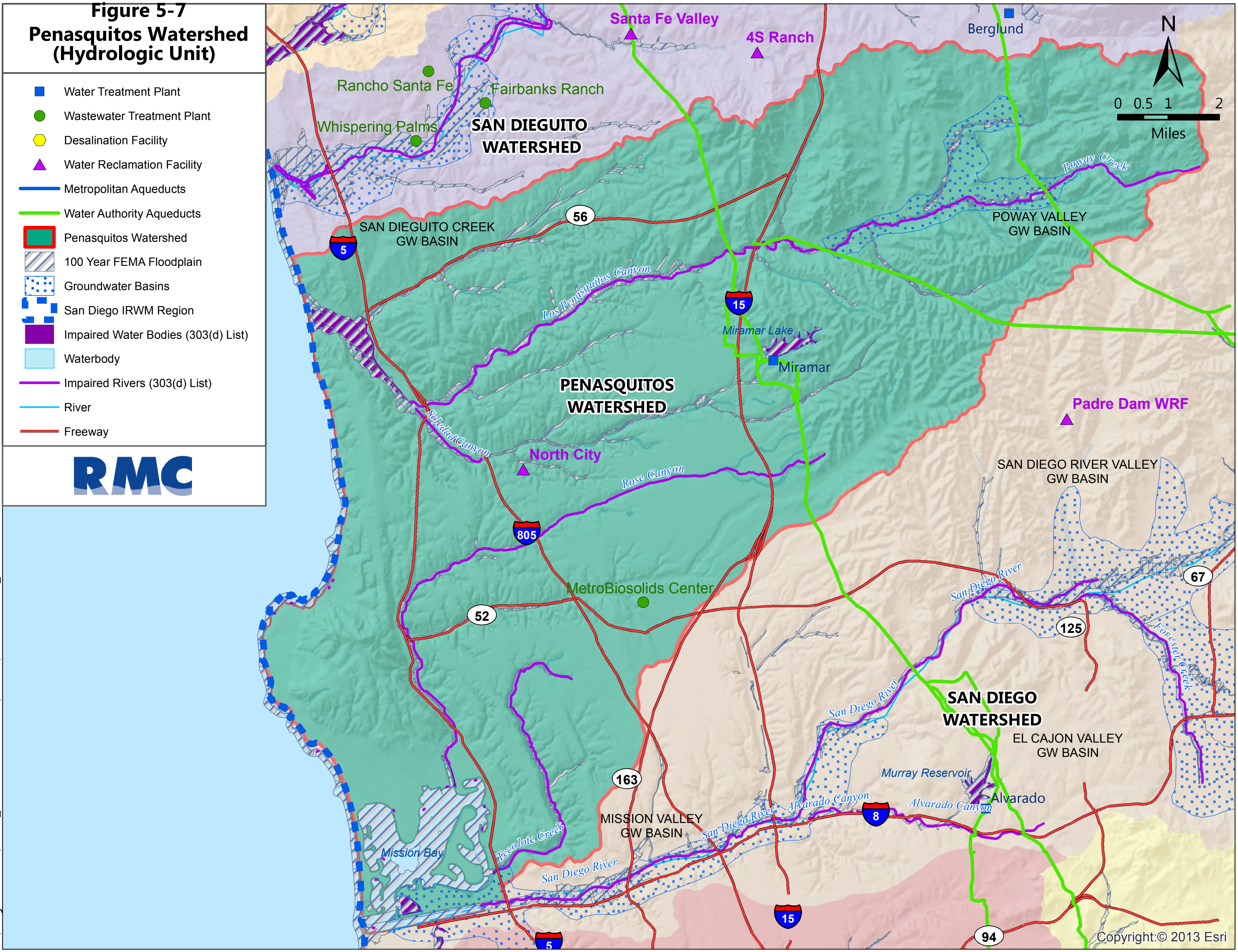

Figure 5-7
Penasquitos Watershed
(Hydrologic Unit)

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Peñasquitos Watershed

Hydrology

The Peñasquitos Watershed is comprised of five HAs: Miramar Reservoir (906.1), Poway (906.2), Scripps (906.3), Miramar (906.4), and Tecolote (906.5). Within the Peñasquitos Watershed are two WMAs: Los Peñasquitos Creek/Lagoon and Mission Bay. Both drain highly urbanized areas with a combined drainage area of 162 square miles. The major water bodies (receiving waters) within the Peñasquitos Watershed are Carmel Valley Creek, Los Peñasquitos Creek, Carroll Canyon Creek, Los Peñasquitos Lagoon, Rose Creek, Tecolote Creek, Mission Bay, and Miramar Reservoir, and the Pacific Ocean (PCW (a), N.D.).

Los Peñasquitos Lagoon receives fresh water flows from the Los Peñasquitos Canyon, and during periods of high rainfall from the Carmel Valley and the Sorrento Valley (Torrey Pines State Natural Reserve (a), 2010). Mission Bay receives fresh water flows from Rose Creek and Tecolote Creek (PCW (b), N.D.).

The watershed discharges into two Areas of Special Biological Significance (ASBS): (1) La Jolla Ecological Reserve (ASBS # 29); and (2) San Diego-Scripps (ASBS #31) (SWRCB (a), 2006). The La Jolla Ecological Reserve ASBS is approximately 1.7 miles of shoreline adjacent to the City of San Diego and contains 453 acres of marine habitat, including the La Jolla State Marine Conservation Area (SWRCB (a), 2006). Just north of the La Jolla Ecological Reserve is the San Diego-Scripps ASBS. This ASBS consists of 0.6 miles of shoreline in the City of San Diego and includes the San Diego-Scripps State Marine Conservation Area (SWRCB (b), 2006).

The two WMAs drain from as far east as the Iron Mountain to Los Peñasquitos Lagoon and into the Pacific Ocean (PCW (a), N.D. and County of San Diego (d), 2008). Due to increasing impervious surface cover, stream channelization, and flows from excess irrigation, the Los Peñasquitos Creek now carries surface water year-round (AMEC, 2005). Due to these excess runoff flows, Carmel Creek and Carroll Creek have changed from seasonal to perennial flow creeks (AMEC, 2005).

Annual precipitation in the Mission Bay WMA within the Peñasquitos Watershed ranges from 10.5 inches near the coast to 13.5 inches in the eastern portion of the watershed (Copermittees 2012).

Water Systems

Imported water is purchased from the San Diego County Water Authority and stored in local reservoirs (CSD (b), 2012). The Peñasquitos Watershed has one drinking water reservoir:

- Miramar Reservoir: in the Scripps Ranch community, 18 miles north of downtown San Diego. Capacity of 2,341 MG (5,700 AF) (2010 Watershed Sanitary Survey, City of San Diego Sanitary Survey). Stores imported water and is self-contained receiving little runoff from the watershed (AMEC, 2005).

Adjacent to the reservoir is the Miramar Water Treatment Plant (MWTP) operated by the City of San Diego. The MWTP produces 140 million gallons of drinking water a day, but has a 215 MGD total capacity (CSD (c), 2010).

The Los Peñasquitos Watershed Management Plan (AMEC, 2005), identifies two small groundwater basins in the watershed: Los Peñasquitos Canyon and Poway Valley. The Poway Valley Groundwater Basin (9-13) has two water bearing formations: the Alluvium and Residuum, and the Poway Group (DWR (a), 2004)). Recharge in the basin is mainly from direct precipitation on the valley flow and infiltration along Poway Creek, which flows into the basin from the east. Other sources of recharge include septic tank effluent and irrigation waters. It is estimated the Poway Valley Groundwater Basin contains 23,000 acre feet (AF) and is mainly used for agriculture and domestic uses (AMEC, 2005). The Poway Valley basin is a medium priority (Tier B) basin for a Salt and Nutrient Management Plan (SNMP); however no SNMP has yet been developed for the basin. It is anticipated that progress towards an SNMP will occur in the future (Regional Board, 2013). For more information on SNMPs and basin prioritization, see *Chapter 7, Regional Coordination*.

Most of the wastewater in the Peñasquitos Watershed is treated at Point Loma Wastewater Treatment Plant (Pt. Loma WWTP) operated by the City of San Diego. Pt. Loma WWTP is located on the bluffs of Point Loma and treats approximately 175 MGD (CSD (a), 2012). Wastewater is also treated at the North City Water Reclamation Plant (NCWRP), operated by the City of San Diego. The NCWRP is located within Peñasquitos Watershed and can treat up to 30 MGD. Reclaimed water produced by NCWRP is distributed to Mira Mesa, Miramar Ranch North, Scripps Ranch, Torrey Pines, Santaluz, Black Mountain Ranch, and the City of Poway (CSD (d), 2012).

Peñasquitos Watershed

Internal Boundaries and Land Uses

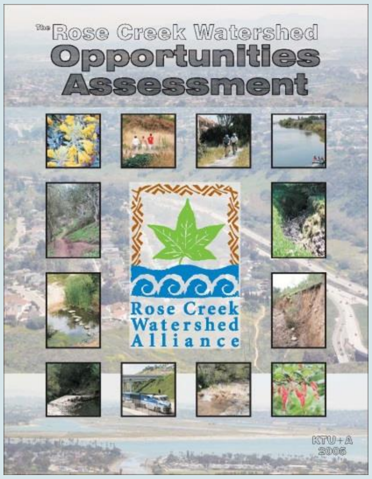
The Peñasquitos Watershed encompasses an area of 94 square miles and covers 60,418 acres (PCW (a), N.D. and County of San Diego (d), 2008). The Peñasquitos Watershed is bordered by the San Dieguito Watershed on the north, San Diego Watershed to the east and south, and the Pacific Ocean to the west. This watershed is centrally located within San Diego County and represents about 4% of the County's land area, making it one of the County's smallest watersheds (KTU+A, 2005).

The Peñasquitos Watershed is mostly within the City of San Diego jurisdiction, with the small remaining areas in the County of San Diego and the cities of Poway and Del Mar (Los Peñasquitos Watershed Copermittees, 2012). Municipal water supply, wastewater collection, and storm drainage are provided to residents by the cities of San Diego, Poway, and Del Mar.

Land use within the Los Peñasquitos Creek WMA is classified as follows: open space/parks and recreation (31%), residential and spaced rural residential (27%), vacant and undeveloped land (12%), transportation (13%), and industrial (7%). Other agriculture, commercial, commercial recreation, military, public facility, under construction, and water uses comprise 3% or less of the total land use (San Diego Association of Governments (SANDAG), 2009).

Land use within the Mission Bay WMA is classified as follows: open space / parks and recreation (26%), residential (26%), and transportation (16%). Other land use classifications include vacant and undeveloped land (6%), water (5%), public facility (5%), military (5%), industrial (4%), commercial (4%), and commercial recreation (3%) (Copermittees, 2012). Less than 1% of the land use acreage is made up by agriculture and under construction uses (SANDAG, 2009). There are no tribal lands located within the Peñasquitos Watershed.

The Rose Creek Watershed is a subset of the Peñasquitos Watershed that includes ten community planning areas, including portions of Scripps Ranch, La Jolla, Mira Mesa, Kearny Mesa, Pacific Beach, Claremont Mesa, and University City. The Rose Creek Watershed Alliance was formed by San Diego Earthworks, and includes members from a variety of business, community, and environmental organizations. The Rose Creek Watershed Alliance has created a vision for the watershed, and working with the California Coastal Conservancy, the County of San Diego, the City of San Diego, and San Diego Earthworks, developed a Rose Creek Watershed Opportunities Assessment. The Rose Creek Watershed Opportunities Assessment is a comprehensive analysis of the needs of the watershed, and provides recommended management solutions to address the issues and achieve the Rose Creek Watershed Vision. The Opportunities Assessment presents a positive example of partnership integration that involves multiple stakeholders from different sectors working together to create a balanced solution to a complex watershed-based issue.



Water Quality and Water Quality Impairments

Eleven water bodies within the Peñasquitos Watershed are listed on the 303(d) list of impaired waters (Los Peñasquitos Watershed Copermittees, 2012 and CSD (e), 2011):

- Los Peñasquitos Creek for *Enterococcus*, fecal coliform, selenium, TDS, nitrogen, and toxicity
- Los Peñasquitos Lagoon for sedimentation/siltation
- Miramar Reservoir for nitrogen
- Mission Bay shoreline for *Enterococcus*, fecal coliform, and total coliform

Peñasquitos Watershed

- Mission Bay mouth of Tecolote Creek for eutrophication and lead
- Mission Bay mouth of Rose Creek for eutrophication and lead
- Pacific Ocean Shoreline (Los Penasquitos River mouth, Scripps hydrologic area at Children's Pool, La Jolla Shores Beach, La Jolla Cove, Pacific Peach, and Ravina for total coliform, *Enterococcus*, or fecal coliform
- Poway Creek for selenium and toxicity
- Rose Creek for selenium, and toxicity
- Soledad Canyon for sediment toxicity and seleniumTecolote Creek for cadmium, copper, indicator bacteria, lead, nitrogen, phosphorus, selenium, toxicity, turbidity, and zinc

Pollutants of concern and stressors impairing water quality within the watershed include eutrophic conditions, nutrients, pathogens, salinity, metals/metalloids, sedimentation/siltation, and toxicity (Copermittees, 2012). The sources of these pollutants in the Peñasquitos WMA are largely unknown point and nonpoint sources, along with urban runoff and storm sewers (SDRWQCB, 2010). Potential sources of these constituents in the Mission Bay WMA may include urban runoff/storm sewers, concentrated animal feeding operations, highway/road/bridge runoff, landfills, nurseries, natural sources, and unknown point and nonpoint sources (SDRWQCB, 2010).T The major impacts from these pollutants/stressors consist of surface water quality degradation, beach closures, sedimentation, eutrophication, and habitat degradation (PCW(a), N.D.). Several of the sources/activities responsible for listed water quality issues consist of urban runoff, sewage spills, dredging, and landfill leachate.

Water quality in the Mission Bay WMA has been impacted through urban runoff diversions, irrigation return flows, cleaning practices, and waste disposal (City of San Diego, 2012). As the receiving water body, Mission Bay and ultimately the Pacific Ocean are also impacted by these water quality issues.

The key pollution threats to La Jolla Ecological Reserve ASBS and San Diego-Scripps ASBS are from urban and stormwater runoff from development, roadways, and parking lots. There are 184 direct discharges of urban runoff into La Jolla Ecological Reserve ASBS. Nine are naturally occurring streams or gullies with the majority of discharges coming from pipes or holes through seawalls, draining bluffs, and landscaped areas. There are 92 direct discharges into San Diego-Scripps ASBS with most discharges coming from pipes and or holes through seawalls, draining bluffs and urban landscaped areas (SWRCB (b), 2006).

There are efforts by groups in the watershed to protect and improve water quality, such as the Rose Canyon Watershed Alliance, which focuses on protecting Rose Creek and its watershed (*see call-out box*). Furthermore, a Water Quality Improvement Plan will be developed for the entire Peñasquitos Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

Specific water quality objectives have been established in the Basin Plan for the Peñasquitos Watershed (SDRWQCB, 2007). The inland surface water quality objectives established are for TDS, chlorides, sulfates, sodium, nitrates, nitrogen phosphorous ratios, iron, manganese, methylene blue-activated substances (MBAS), boron, odor, turbidity, color units and fluoride. Ground water quality objectives were only established for the following HAs: Miramar Reservoir, Poway, and Miramar. The groundwater water quality objectives established consists of TDS, nutrients, and turbidity. Several TMDLs have also been developed within the watershed. In 2006, a TMDL for sedimentation/siltation at Los Peñasquitos Lagoon was adopted. Since then, monitoring has been conducted in support of the TMDL in the lagoon as well as the watersheds that drain to the lagoon. An amendment for this TMDL was adopted in 2012 and set a numeric target for sediment loading of 12,360 tons of sediment per wet period or 58.6 tons per day, requiring a 67% sediment load reduction from the watershed. An additional Beaches and Creeks TMDL for indicator bacteria adopted in 2010 and included the Pacific Ocean Shoreline at Torrey Pines State Beach, the Pacific Ocean Shoreline in the Scripps HA, and Tecolote Creek (Copermittees 2012). A summary of TMDLs are provided in *Chapter 3, Region Description*.

Peñasquitos Watershed

Stormwater and Flood Management

Major drainages within the watershed include Carmel Valley Creek, Los Peñasquitos Creek, Poway Creek, Rose Canyon Creek, San Clemente Canyon Creek, Soledad Canyon, and Tecolote Creek, which encompass drainage areas of approximately 15.7, 101, 31.2, 37, 18.4, 95.5, and 9.29 square miles, respectively. The peak discharges during a 100-year event for Carmel Valley Creek, Poway Creek, Rose Canyon Creek, San Clemente Canyon Creek, Soledad Canyon, and Tecolote Creek are 9,800, 14,000, 12,000, 6,900, 23,000, and 4,900 CFS, respectively. The peak discharges during a 100-year event for Los Peñasquitos Creek at two locations are 16,800 and 15,400 CFS. Within the watershed, the acreage of land uses within mapped flood hazard zones total more than 7,300 acres, and includes the following: agriculture, 38 acres; commercial and services, 461 acres; industrial, 356 acres; open space and recreation, 2,953 acres; residential, 637; and transportation, communications, and utilities, 2,309 acres (see Appendix 7-B, Integrated Flood Management Planning).

Stormwater runoff has been a significant source of pollution in local water bodies as a result of urban runoff from rain or excessive irrigation. Storm drains in the Peñasquitos Watershed convey urban runoff and rainwater from streets, driveways, parking lots, and other impervious surfaces ending up directly in the creeks and eventually into the Pacific Ocean (Los Peñasquitos Watershed Copermittees, 2012).

Significant changes in the natural hydrology and geomorphology in the watershed have led to sedimentation issues. Sources of sediment include erosion of canyon banks, exposed soils, bluffs, scouring of stream banks, and tidal influx which have been exacerbated by land development in the watershed. Sedimentation issues in the watershed have affected the Los Peñasquitos Lagoon and Mission Bay. During rain events, impervious surfaces increase the volume and velocity of runoff resulting in scouring of sediment. This sediment is then transported downstream and deposited on the salt flats, lagoon channels, creek beds, and into Mission Bay. For the Los Peñasquitos Lagoon, sediment loading has affected the lagoon functions and salt marsh characteristics (SDRWQCB, 2012). Sediment loading has also created a flooding vulnerability to the surrounding urban and industrial developments.

Stormwater and flood management within the Peñasquitos Watershed falls under the jurisdictions of the City of Poway, the City of San Diego, the City of Del Mar, and the County of San Diego. The three cities and the County share responsibility for implementation of the stormwater programs and flood management identified in the Peñasquitos Watershed Urban Runoff Management Plan.

All of the stormwater copermittees within Peñasquitos Watershed have Jurisdictional Urban Runoff Management Plans (JURMPs) which are used to show compliance with the jurisdictional component of the NPDES Permit. Additionally, Watershed Urban Runoff Management Plans (WURMP) have been written for the Peñasquitos Watershed (one for each WMA) to outline projects and activities that are planned to protect the watershed from storm water pollution (CSD (e), 2012). For example, the City of San Diego has implemented various outdoor water conservation programs. One of these programs is the outdoor water conservation rebate program which provides commercial and residential customers with rebates to promote outdoor water conservation. This program conserves potable water while helping reduce pollutant-laden dry weather urban runoff flows from entering the local water bodies. In FY2011, it's estimated the program help increase water savings by 4,355 gallons per day and it is estimated the program will continue to grow in FY2012 as multiple applications were in process at the end of FY2011 (CSD (f), N.D.). The 2013 MS4 Permit has divided the Peñasquitos Watershed into two distinct watershed management areas (WMA); Peñasquitos and Mission Bay. The Mission Bay WMA includes the La Jolla Ecological Reserve Area of Special Biological Significance (ASBS) and San Diego-Scripps ASBS.

Natural Resources

The Peñasquitos Watershed contains areas of diverse and undeveloped habitat. These habitats consist of maritime succulent and coastal sage scrubs, coastal salt and brackish water marshes, southern maritime, southern mixed and chemise chaparrals, oak woodlands and oak riparian forests, riparian scrubs and woodlands, marshes and wet meadows, grasslands, and vernal pools. A large block of these habitats provides significant habitat connections between open space, coastal, and inland areas (AMEC, 2005).

The Peñasquitos Watershed is home to over 180 sensitive plant and animal species, many of which are listed as state and federally endangered (County of San Diego (d), 2008). Several of these sensitive species include the

Peñasquitos Watershed
Salt marsh daisy, Quino checkerspot butterfly, American peregrine falcon, California gnatcatcher, California least tern, Cooper's hawk, Orange-throated whiptail, Western spadefoot toad, and the San Diego back-tailed jackrabbit. The Peñasquitos Watershed is also home to several invasive vegetation species such as pampas grass, giant reed, salt cedar, and Germany ivy (County of San Diego (d), 2008). The watershed is also home to two ASBS (1) La Jolla Ecological Reserve (ASBS # 29); and (2) San Diego-Scripps (ASBS #31) (SWRC (d)). These ASBS support an unusual variety of aquatic life and are considered the building blocks for a sustainable, resilient coastal environment and economy (SWRCB (c), 2012). Therefore these ocean areas are highly monitored and protected for water quality by the State Water Resources Control Board.
Potential Climate Change Impacts Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the Peñasquitos Watershed include but are not limited to: • Decrease in imported water supply • Decrease in groundwater supply • Decrease in surface water availability • Impacts to water quality • Sea level rise • Decrease in availability of necessary habitat • Increased flooding • Exacerbation of wildfires Due to the reliance on imported water supplies within the Peñasquitos Watershed, decreases in imported water supply availability could have substantially large impacts within the watershed. Flooding within the Peñasquitos Watershed could be exacerbated due to climate change if the frequency and intensity of storms overwhelm the ability of local creek channels to contain runoff. In contrast, climate change also has the potential to create changes in precipitation which can decrease seasonal stream flows. Decreased seasonal stream flows will create stream flows with irrigation/dry weather flows, thus increasing the concentration of constituents and requiring stream flows to receive a greater level of treatment. Further, due to the Peñasquitos Watershed's proximity to the coast, sea level rise has the potential to impact several municipalities and resources within the watershed. The Peñasquitos Watershed has a widespread beach community and sea level rise has the potential to damage coastal infrastructure, recreation, and negatively impact tourism. Lastly, if the frequency of wildfires increases due to climate change, local water quality and habitat within the watershed could be adversely impacted.
Management Issues and Conflicts Most management issues within the Peñasquitos Watershed revolve around urbanization. In the last 50 to 80 years rapid urbanization has affected the natural drainage and hydrologic characteristics of the watershed (AMEC, 2005). These changes have led to increased pollutants loads within the watershed, increased erosion, and subsequent downstream sedimentation. Sedimentation has been an issue in the lower portions of the watershed including Los Peñasquitos Lagoon. In the Los Peñasquitos WMA increased sediment management is needed to minimize sediment loads and aid in meeting the Los Peñasquitos Lagoon water quality objective for sediment. The buildup of sediments in the Los Peñasquitos Lagoon has and is altering the natural exchange of freshwater and seawater leading to destructive changes of the sensitive salt marsh habitat (Torrey Pines State Natural Reserve (a), 2010). Additionally, addressing the effects of past wildfires can also aid in addressing sediment loads in the watershed. During rain events, the frequency of flash floods has increased after wildfires exacerbating the sediment load issue in the downstream portion of the watershed. A stormwater management plan must be implemented to address the effects of past wildfire events such as sedimentation and associated flood risks.

Peñasquitos Watershed
Mission Bay Park is one of San Diego's principal tourism and leisure destinations. However, Mission Bay has had a series of issues with, water quality, and loss of marsh land which need to be addressed to ensure Mission Bay's diversity, quality of recreation, and continued protection and enhancement of the Bay environment (CSD (g), 1994). Sediments enter Mission Bay from various sources, including Rose Creek, which impact water quality. The Kendall-Frost Marsh is located on the northern side of Mission Bay and receives flows containing urban runoff, pollutants, and sediments (Rose Creek Watershed Alliance (a), 2013). Rose Creek flows, among other urban development pressures, have contributed to the loss of marsh land at Mission Bay Park including at Kendall-Frost Marsh (Rose Creek Watershed Alliance (a)). To help expand and create marsh land, stakeholders in the watershed have expressed an interest in converting camp lands at Mission Bay Park to marsh land. The landfill site at Mission Bay, which operated as a municipal landfill from 1952 to 1959, was primarily a site for municipal refuse but was also used for industrial waste some of which is now regulated as hazardous waste. The discovery of detectable concentrations from contaminants of potential concern has led to concerns on the impacts these would have to groundwater, surface water, soil, and sediments. The landfill site at Mission Bay, which operated as a municipal landfill from 1952 to 1959, was primarily a site for municipal refuse, but records indicate some industrial waste may have been deposited there. Trace contaminants of potential concern have been discovered in groundwater, soils, and sediments. The presence of these trace contaminants has led to concerns regarding their impact to the environment and human health. In September 2006, the City of San Diego conducted a human health and ecological risk assessment of the Mission Bay Landfill. The conclusion from this assessment reported, "the total Hazard Index (HI) for each ecological receptor was less than 1, indicating no significant likelihood of adverse terrestrial ecological effects (SCS Engineers 2006)." The City of San Diego continues to assess and perform semi-annual groundwater and surface water monitoring at the site. Despite the City of San Diego's monitoring efforts, stakeholders in the watershed continue to express concerns regarding toxicity and potential groundwater and soil contamination from the landfill site.

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5.7 San Diego River Watershed

The San Diego River Watershed (San Diego Hydrologic Unit or San Diego HU (907)) covers 440 square miles and supports the largest population among the Region's watersheds. This population (approximately 509,000 people), however, is largely confined to the urbanized downstream portion of the watershed in the cities of San Diego, El Cajon, La Mesa, Poway and Santee. Figure 5-8 is a map showing the watershed boundaries and principal features.

Approximately 60% of the San Diego River Watershed is currently undeveloped, with most of this undeveloped land being in the eastern upstream portion of the watershed in unincorporated County lands. Cleveland National Forest, Mission Trails Regional Park, and the river floodplain near the community of Lakeside within unincorporated San Diego County represent important undeveloped areas that support intact habitat and endangered species.

Water rights have governed resource development in this watershed since the region was part of Mexico in the early 19th century. Additional development of water resources will have to take into account issues pertaining to water rights and requires coordination among watershed stakeholders. The Mission Valley basin and the Santee-El Monte basin are part of the San Diego River system. The San Diego River Watershed features two large water supply reservoirs: San Vicente and El Capitan. El Capitan Reservoir is an important feature in the watershed and in the Region; regionally, the reservoir provides a large amount of locally sourced water (runoff), locally the reservoir has a large impact on the San Diego River Watershed because it creates a distinct break in the San Diego River.

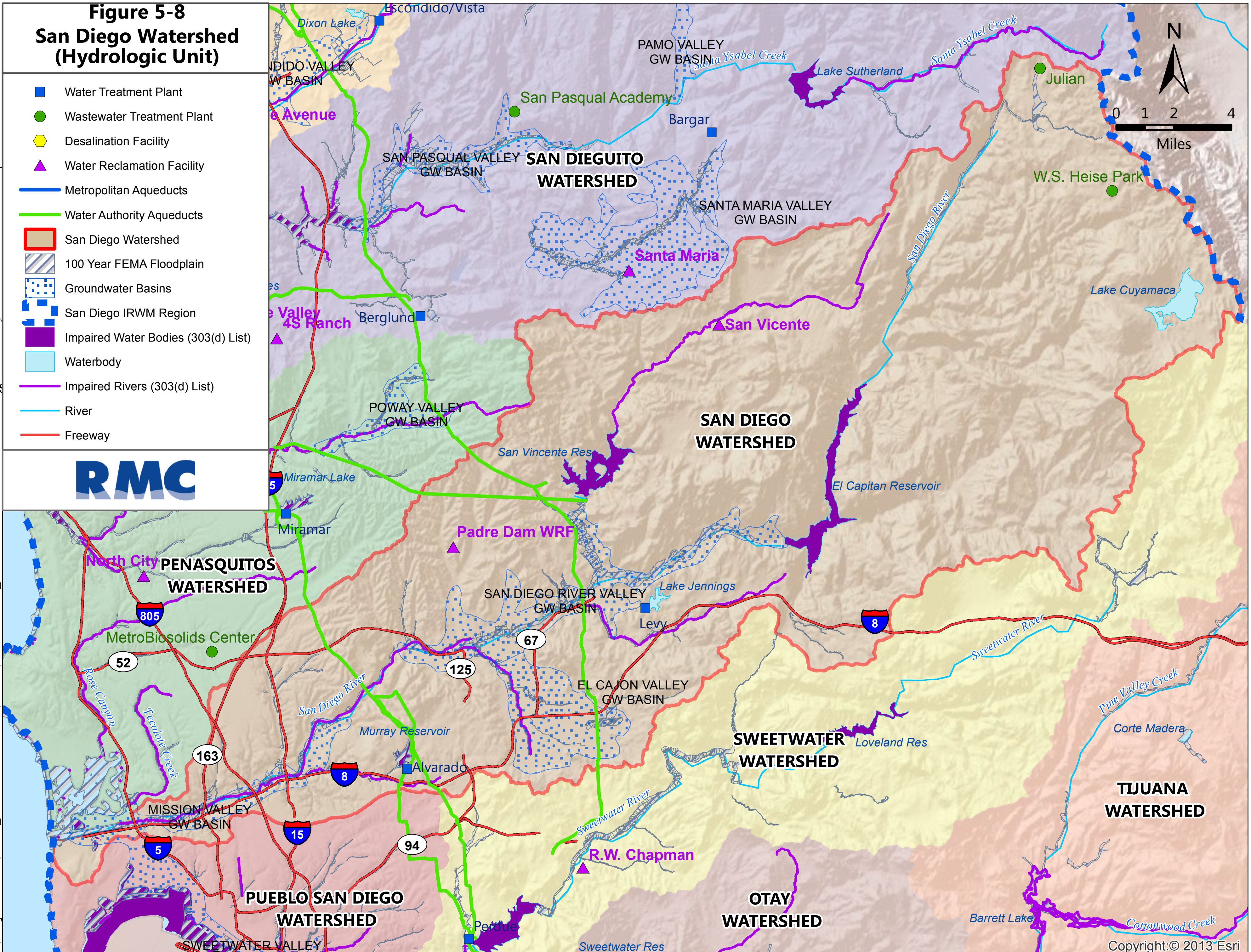
The San Vicente Reservoir is considered to be a key reservoir in the Region because it:

- is a key terminus of the San Diego Aqueduct,
- will be the largest reservoir in the County, totaling 242,000 AF following completion of the ESP,
- can receive diverted supplies from both El Capitan Reservoir and Sutherland Reservoir,
- is connected to one of the Region's largest water filtration plant (the 200 MGD capacity City of San Diego Alvarado Water Treatment Plant), and
- can be used to divert stored supplies to South County water agencies.

Some flood protection within Mission Valley is provided by the First San Diego River Improvement Project (FSDRIP); however, due to the limited nature of the FSDRIP, flooding continues to be an issue in Mission Valley and nearby Grantville. Flooding issues also exist within the middle portions of the watershed (in the communities of Lakeside and Alpine) and in the upper portion of the watershed (in and around the community of Ramona).

Significant groundwater resources exist within the watershed, but groundwater use is limited in downstream portions of the watershed due to high TDS concentrations. Additionally, a petroleum plume underneath Qualcomm Stadium and its parking lot impacts groundwater in Mission Valley.

Figure 5-8
San Diego Watershed (Hydrologic Unit)



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San Diego River Watershed

Hydrology

The San Diego River Watershed is comprised of four hydrologic areas (HAs): Lower San Diego (907.1), San Vicente (907.2), El Capitan (907.3), and Boulder Creek (907.4) (PCW (a), N.D.). Major water bodies include the San Diego River, El Capitan Reservoir, San Vicente Reservoir, Lake Murray, Boulder Creek, and Santee Lakes. Surface water in the San Diego River Watershed is primarily governed by precipitation, stream flow, and flow control structures (dams).

The San Diego River flows through the entire San Diego River Watershed originating near the town of Julian and flowing southwest before entering El Capitan Reservoir. Downstream of El Capitan Reservoir, the San Diego River runs westward through the cities of Santee and San Diego, then through to the San Diego River Estuary and finally discharges into the Pacific Ocean (Anchor, 2005). The San Diego River discharges approximately 32,780 AFY of water. Major San Diego River tributaries consist of Boulder Creek, Cedar Creek, Conejos Creek, Chocolate Creek, Los Coches Creek, San Vicente Creek, and Forrester Creek (Anchor, 2005). The Famosa Slough is a tidally influenced area located near the mouth of the San Diego River.

Water Systems

Imported water is purchased from the local wholesaler San Diego County Water Authority. Imported water is brought into the region by massive aqueduct systems from the Colorado River (approximately 240 miles away) and from the State Water Project carrying water from the Sacramento-San Joaquin Bay Delta (approximately 700 miles away) (SWA (a), 2012). The imported water that is applied to the land as irrigation water (for agriculture and domestic irrigation) contributes to the groundwater supply in the form of return flows and may be a resource for agencies that have usable aquifers. The San Diego River Watershed contains five water supply reservoirs:

- El Capitan Reservoir owned by City of San Diego and stores 112,800 AF of primarily local surface water.
- San Vicente Reservoir, owned by the City of San Diego and will store 242,000 AF of both imported and surface water following completion of the ESP
- Cuyamaca Reservoir, owned by Helix Water District and stores 8,200 AF of surface water
- Lake Jennings, owned by Helix Water District and stores 9,800 AF of both imported and surface water
- Lake Murray, owned by the City of San Diego and stores 4,800 AF of both imported and surface water

Most surface runoff from the eastern portion of the watershed is impounded by El Capitan, San Vicente, and Cuyamaca Reservoirs. Most surface water flows from the western portion of the watershed flow into the Pacific Ocean. Surface water flows also enter Lake Jennings and Lake Murray from relatively small drainage areas; however these are mainly supplied with imported water (Anchor, 2005). Adjacent to Lake Murray is the Alvarado Water Treatment Plant which has a capacity to treat up to 120 MGD of drinking water supply (CSD (c), 2012). Adjacent to Lake Jennings is the Helix Water District R.M. Levy Water Filtration Plant which has a capacity to treat up to 106 MGD of drinking water supply. Water stored in Lake Murray and Lake Jennings does not normally flow downstream on the watershed.

The five reservoirs in the San Diego River Watershed supply water to as many as 760,000 residents in the region (PCW (a), N.D.). The El Capitan Dam impounds primarily surface water, while the San Vicente Dam impounds both surface water and imported water. The El Capitan Reservoir has a water storage capacity of 112,800 AF (CSD (a) (b), 2012). The capacity of the El Capitan Reservoir is important, because it allows this reservoir to capture a large amount of local runoff, which is an important source of local water. The reservoir is also an important feature of the San Diego River Watershed, because it essentially creates a break in the San Diego River, separating the lower river from the upper river entirely.

The San Vicente Reservoir is a key reservoir in the region because it:

- is a key terminus of the San Diego Aqueduct,
- will be the largest reservoir in the County following completion of the ESP,

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- can receive diverted supplies from both El Capitan Reservoir and Sutherland Reservoir,
- is connected to the Region's largest water filtration plant (the 120 MGD City of San Diego Alvarado plant), and
- can be used to divert stored supplies to South County water agencies.

Groundwater use in the uppermost portion of the watershed is limited to private wells and small water systems. Recharge is mainly from streamflow infiltration, percolation of precipitation, and applied waters. However, not much characterization of groundwater in the uppermost portion of the watershed has been completed. The lowermost portion of the watershed is characterized by three large groundwater basins: Mission Valley (9-14), San Diego River Valley (9-15), and El Cajon (9-16). The Santee-El Monte Basin is a subset of the San Diego River Valley groundwater basin.

The Mission Valley groundwater basin (9-14) underlies an east-west trending valley which is drained by the San Diego River. The principle water bearing formation is the Quaternary age alluvium with an average well production of 1,000 gpm (DWR (a), 2004)). Recharge in the groundwater basin is primarily from stream flow infiltration from the San Diego River. In an effort to reduce imported water demands, the City of San Diego plans to develop a potable groundwater supply from the Mission Valley groundwater basin. However, due to petroleum contamination in the Mission Valley aquifer, the City of San Diego's ability to implement these plans has stalled. The proposed project (Brackish Groundwater Desalination project) would extract and desalinate native groundwater using reverse osmosis. The approximate sustainable yield and storage capacity of the basin would be 2,000 to 4,000 acre-feet per year (AFY) and 42,000 AF respectively (CSD (d), 2009). The Mission Valley groundwater basin is a low priority (Tier D-1) basin for Salt and Nutrient Management Plans (SNMP), and is not anticipated to require a SNMP in the near future. For more information on SNMPs and basin prioritization, see *Chapter 7, Regional Coordination*.

The San Diego River Valley groundwater basin's (9-15) principle water bearing formation is the Quaternary alluvium. The most productive portions of the groundwater basin have wells that can yield up to 2,000 gpm (DWR (b), 2004). Before the El Capitan and San Vicente Dams were built, the San Diego River and San Vicente Creek used to be the primary recharge sources. Groundwater recharge sources for the San Diego River Valley groundwater basin consist of flows from Forrester Creek and other smaller creeks, precipitation, discharge from municipal wastewater treatment plants, underflow below the dam, and return flow from applied imported water and recycled water. The Santee-El Monte Basin is an unconfined groundwater basin located in the eastern portion of the San Diego River watershed near the cities of Santee, La Mesa, El Cajon, and Lemon Grove. The groundwater basin is comprised of commingling alluvial valleys of the San Diego River, San Vicente Creek, Forrester Creek, Los Coches Creek, and Sycamore Canyon Creek. The alluvial aquifer ranges in thickness up to 230 feet or more and is thickest in the eastern portion of the basin. In Santee, the alluvium thickness ranges from less than 10 feet to approximately 150 feet (USBR, 2012).

Various agencies have evaluated the potential for groundwater recharge with advance treated recycled water, including Helix Water District that previously conducted a study in the upper Santee-El Monte Basin and Padre Dam Municipal Water District that is currently studying the lower Santee-El Monte Basin. Lakeside Water District is the largest municipal pumper of groundwater in the basin and currently uses approximately 700 AFY from the mid-Santee-El Monte Basin. The Lakeside Water District's wells in Lakeside are treated to remove iron and manganese (Lakeside Water District, 2011). Further development of the basin will require addressing water rights issues that may impede beneficial uses. The Santee-El Monte Basin is a high priority for a Salt and Nutrient Management Plan (SNMP). The Padre Dam Municipal Water District is developing an SNMP for the Santee portion of the basin, and to date has collected water quality data, coordinated a project approach with the Regional Board, and met with stakeholders. More information can be found in *Chapter 7, Regional Coordination*.

The El Cajon groundwater basin (9-16) is located in the south central part of San Diego County. The groundwater basin has three water bearing formations: Pleistocene alluvium, Poway conglomerate, and Sandy siltstone. Recharge in the groundwater basin is primarily from precipitation. Other sources of recharge consist of underflow from underlying crystalline rocks, return of applied irrigation water, and percolation of septic tank effluent (DWR (c), 2004). The El Cajon groundwater basin is a low priority (Tier D-2) basin for a SNMP, and is

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not anticipated to require a SNMP in the near future.

The Regional Board's Basin Plan includes the San Vicente/Gower groundwater basin as a subbasin the San Diego Watershed. This basin is considered a lower priority SNMP basin. Ramona Municipal Water District is developing an SNMP for this groundwater basin, as described in *Chapter 7, Regional Coordination*.

In January 2004, the San Diego City Council authorized a comprehensive evaluation of all viable options to maximize the usage of recycled water (to reduce the City's dependence on imported water) (CSD (g), 2013). The effort resulted in the City recognizing Indirect Potable Reuse/Reservoir Augmentation (IPR/RA) as the preferred alternative. The City is currently pursuing the Water Purification Demonstration Project, which would determine the feasibility of a full-scale reservoir augmentation project (CSD (h), 2013). As part of this Project, the 1 MG of purified water produced by the Advanced Water Purification Facility would be tested; in parallel, a study of the San Vicente Reservoir would test the key functions of reservoir augmentation and to determine the viability of a full-scale project (no purified water has been sent to the reservoir during the demonstration phase). If the Demonstration Project is successful, the City would construct a full-scale advanced water treatment plant that treats recycled water from the NCWRP and conveys the advanced-treated recycled water through a new transmission pipeline to San Vicente Reservoir where it would blend with imported, untreated water and reside for several months prior to being sent to water treatment plants for additional treatment and distribution as potable water (CSD (i), 2013)

Internal Boundaries and Land Uses

The San Diego River Watershed encompasses an area of 440 square miles, making it the second largest watershed in San Diego County (PCW (a), N.D.). The watershed contains the highest population of the Region's watersheds at approximately 509,000 (Anchor, 2005). The San Diego River Watershed ranges from sea level at the mouth of the San Diego River to 6,512 ft at the eastern edge of the watershed (Anchor, 2005).

The San Diego River Watershed is within the jurisdiction of the cities of San Diego, El Cajon, La Mesa, Poway, and Santee as well as several unincorporated jurisdictions. Water supply agencies within the watershed include: City of San Diego, Helix Water District, Padre Dam Municipal Water District, Lakeside Water District, and Ramona Municipal Water District. Wastewater agencies include: City of San Diego, Padre Dam Municipal Water District, City of La Mesa, and City of El Cajon. The tribal nations of the Barona Band of Mission Indians, the Capitan Grande Group of Mission Indians, and the Inaja-Cosmit Band of Indians are located within the upper San Diego River Watershed. The upper portion of the watershed also contains several small mutual water agencies that provide water services to rural areas. In total, approximately 9% of the San Diego River Watershed contains tribal lands.

Within the San Diego River WMA, undeveloped land makes up the primary use (44%). Open space / parks and recreation (23%), residential and spaced rural residential (19%), and transportation (6%) uses are also represented. Agriculture, commercial, commercial recreation, industrial, military, public facility, and water land uses each make up less than 2% of the land use acreage (San Diego Association of Governors (SANDAG), 2009). The majority of undeveloped land is located in the upper and eastern portion of the watershed, while the lower reaches of the San Diego River Watershed are highly urbanized with residential, freeways and roads, and commercial/industrial land uses predominating (Anchor, 2005 and PCW (a), N.D.). The undeveloped lands mainly include Cleveland National Forest and Mission Trails Regional Park.

Water Quality and Water Quality Impairments

Ten water bodies within the San Diego Watershed are listed on the Clean Water Act 303(d) list of impaired water bodies:

- Alvarado Creek for selenium
- El Capitan Lake for color, manganese, pH, phosphorus, and nitrogen
- Famosa Slough and Channel for eutrophication
- Forester Creek for fecal coliform, pH, selenium, and TDS

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- Murray Reservoir for nitrogen and pH
- Pacific Ocean Shoreline, San Diego River at Dog Beach for and total coliform
- San Diego River (lower) for *Enterococcus*, fecal coliform, dissolved oxygen (DO), nitrogen, phosphorus, TDS, manganese, and toxicity
- Los Coches Creek for selenium
- San Vicente Creek for ammonia as nitrogen, benthic community effects, nitrogen, and toxicity
- San Vicente Reservoir for chloride, color, sulfates, total nitrogen, and pH.

The pollutants/stressors of concern in the watershed are color, manganese, pH, eutrophication, fecal coliform, DO, phosphorus, TDS, chloride, color, and sulfates. The major impacts from these pollutants/stressors consist of surface water quality degradation, sedimentation, eutrophication, and habitat degradation. However, some of the 303(d) listings may be due to natural lake conditions. Further study is needed to determine if the existing basin plan objectives can be met or if they need to be changed to reflect natural lake conditions. Several of the sources/activities responsible for the listed water quality issues consist of urban runoff, agricultural runoff, mining operations, sewage spills, and sand mining (PCW (a), N.D.). Surface water quality in the undeveloped upper portion is of higher quality than the developed lower portion of the watershed due to human development (Anchor, 2005). In terms of river water quality, the lower San Diego River system has the highest water quality in the winter months with greatest streamflow and lowest water quality during the summer with minimum flows (SDRPF (a), 2011). A Water Quality Improvement Plan will be developed for the entire San Diego River Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

Water quality in the lower San Diego River is considered poor by the San Diego River Park Foundation. Low summer and fall river flows in ponded sections, combined with excess nutrients, can accelerate the growth of the aquatic plant water primrose and in other ways decrease DO levels. Trash removal activities by the Foundation are concentrated in areas which receive water from storm drains and which have high concentrations of encampments (SDRPF (b), 2011). Despite the water quality issues in the lower San Diego River, the waters in the upper San Diego Watershed, such as those upstream of El Capitan Reservoir, are considered healthy as indicated by their cold water that is an important habitat for trout and other species. Given the high quality of headwaters in the San Diego River Watershed and their connectivity to regional reservoirs such as El Capitan, development of projects to provide for the continued protection of these waters and their high water quality is of regional importance.

Groundwater quality in the uppermost portion of the watershed is generally of good quality. Only one site near Julian is known to have contaminated groundwater by gasoline from leakage of an underground tank. Groundwater quality in the lowermost region of the watershed varies by groundwater basin. The San Diego River Valley groundwater basin is of bicarbonate character in the east and chloride character in the west (DWR (b), 2004). TDS content in the San Diego River Valley groundwater water basin is high on the western portion of the watershed. The El Cajon groundwater basin is generally of sodium chloride character and is known to have high nitrate, chloride, and TDS content (DWR (c), 2004). The Mission Valley groundwater basin is known to have high magnesium and sulfates for domestic use. Chloride and TDS concentrations are also high for irrigation and domestic use. Seawater intrusion is also a possible impairment. (DWR (a), 2004).

Portions of the Santee-El Monte Basin are contaminated with nitrates, TDS and methyl tertiary butyl ether (MTBE). Lakeside Water District at one time provided treatment for removal of MTBE and blending for nitrate compliance in the groundwater supply, but has not used this supply since 2007 (Lakeside Water District, 2011). The SNMPs under development by Padre Dam MWD and Ramona MWD will identify salt and nutrient sources, loading estimates, and establish goals, objectives, and mitigation measures to protect and improve water quality in the basin (see *Chapter 7, Regional Coordination*).

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Since 1986, petroleum products have been discharged from an above storage tank facility resulting in a groundwater contamination plume in the Mission Valley groundwater basin (SDRWQCB, 2012). The groundwater contamination plume extends approximately 2,000 feet to the south and southwest beneath Friars Road and the Qualcomm Stadium parking lot. In 1992, the California Regional Water Quality Control Board-San Diego Region (SDRWQCB) issued a clean-up order to the discharger Kinder Morgan Energy Partners, L.P. The City of San Diego intends to develop a potable water supply from the Mission Valley groundwater basin to reduce demands from imported water once clean-up has been completed. Currently the cleanup is focused on two gasoline constituents in groundwater, MTBE, and tertiary butyl alcohol (TBA) and cleanup of contaminated soil (SDRWQCB, 2012). Specific water quality objectives have been established in the Basin Plan for the Lower San Diego, San Vicente, El Capitan, and Boulder Creek HAs (SDRWQCB, 2007). The Inland surface water quality objectives established are for TDS, chlorides, sulfates, nutrients, manganese, turbidity, and color. In 2010, the development of a nutrient TMDL for Famosa Slough was initiated by SDRWQCB Order No R9-2006-0076. Additionally, Forrester Creek and the lower San Diego River were included in the Beaches and Creeks TMDL for indicator bacteria, adopted in 2010 (Copermittees 2012). A summary of TMDLs that have been adopted or are in progress are provided in *Chapter 3, Region Description.*
Stormwater and Flood Management Major drainages within the watershed include Forrester Creek, Murphy Canyon, San Diego River, and San Vicente Creek, which encompass drainage areas of 22.7, 12.1, 710, and 83 square miles, respectively. The peak discharges during a 100-year event for Forrester Creek, Murphy Canyon, and San Vicente Creek are 12,450, 3,500, and 16,000 CFS, respectively. The peak discharges during a 100-year event for San Diego River at two locations are 36,000 and 31,000 CFS. Within the watershed, the acreage of land uses within mapped flood hazard zones total more than 8,300 acres, and includes the following: agriculture, 508 acres; commercial and services, 1,414 acres; industrial, 600 acres; open space and recreation, 2,576 acres; residential 1,577; and transportation, communications, and utilities, 1,272 acres (see Appendix 7-B, Integrated Flood Management Planning). Stormwater and flood management within the San Diego Watershed falls under the jurisdiction of the County of San Diego, and the Cities of San Diego, El Cajon, La Mesa, Poway, and Santee. Each of whom share responsibility for flood control and drainage system facilities as well as maintaining storm drains, channels and debris basins, with the exception of the City of Poway, whose portion of the watershed is protected open space and is not expected to produce urban runoff (City of El Cajon et al., 2008). Stormwater management within the San Diego River Watershed also involves stormwater transfers from other watersheds (namely the Pueblo Watershed) to the San Diego River Watershed. Particularly in the western portion of the watershed near Morena Boulevard (just north of the San Diego River Watershed), stormwater flows are diverted from the Pueblo Watershed to the San Diego River Flood Control Channel, where they are ultimately conveyed to the Pacific Ocean. Flood protection within the Mission Valley area is primarily provided by the San Diego River Flood Control Channel near Mission Bay that was built by the Army Corps of Engineers beginning in 1850. Due to the complexity of flood flows and flood control protection along the San Diego River, it took approximately 100 years of work to configure the flood control channel to its present day configuration. Since the 1940s the San Diego River Flood Control Channel has redirected flows from the San Diego River to the San Diego Bay. In addition, the First San Diego River Improvement Project (FSDRIP) is located in the San Diego River Watershed and provides additional flood control protection. The FSDRIP is a 45-acre flood control and mitigation project along a 7,000 linear flood section of the San Diego River developed by the City of San Diego. The mitigation site was developed as a 100-year flood control project, but due to the limited nature of the FSDRIP (covering only a short portion of the San Diego River), flooding continues to be an issue in Mission Valley and nearby Grantville (CSD (f), 2004). Flooding is a larger issue in the lowermost portion of the watershed due to its highly urbanized landscape. An increase in impervious surfaces has increased urban runoff, pollutant loading, and poor natural pollutant

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assimilation, which has led to poor water quality. Impervious surfaces have also made stormwater flows larger and more frequent, with high sediment loads degrading the stability of the watershed channels. Further, stakeholders have reported that pollution from trash causes flooding issues as trash may impede natural hydrologic flows. Since the uppermost portion of the watershed is undeveloped, the flood potential is generally considered insignificant. Flood hazards and water quality problems associated to urbanized landscapes are not primary issues of concern in the uppermost portion of the watershed (Anchor, 2004). However, repetitive flood losses have been reported in the community of Ramona, which is located in the upper portion of the watershed (County of San Diego 2007). Recent fire events (namely the Cedar Fire of 2003) have resulted in sedimentation; subsequent storms have resulted in sediment-laden runoff flooding numerous homes and causing deposition in and around the community of Ramona (County of San Diego 2007).

Natural Resources

The San Diego Watershed supports a diversity of biological resources. The San Diego River supports habitats essential for species dispersal and providing species access to adjacent habitats and resources along the watercourse. Though the riparian vegetation along the River is fragmented, it still provides essential habitat for reproduction, nesting, roosting and foraging (Anchor, 2004).

Important undeveloped lands in the San Diego Watershed are the Cleveland National Forest, Mission Trails Regional Park and the river floodplain near Lakeside. These undeveloped lands are home to a variety of habitats and endangered species (PCW (a), N.D.).

Since 2002 there has been a formal vision and plan (*San Diego River Park Conceptual Plan*) to establish a connected river park along the length of the San Diego River from El Capitan Reservoir to the Pacific Ocean (San Diego River Park Foundation 2002). The overall goal of this planning effort, which has involved many stakeholders, jurisdictions, and interested parties throughout the Region, is to preserve and celebrate the San Diego River's historic resources, to support the natural stream processes, to preserve and enhance riparian habitat, and to provide recreation access and activities (San Diego River Park Foundation 2002).

The easternmost portion of the watershed has notable vegetation communities such as meadows and montane forests of coniferous and Jeffrey pine trees which are rare and localized vegetation in the watershed (Anchor, 2004). These are communities are home to species such as the Mountain Lion, Long-legged Myotis, Fringed Myotis as well as threatened and endangered species such as the Red-legged frog (which is believed no longer survives in the upper most portion of the watershed), Beldings Savannah Sparrow, Southwestern Willow Flycatcher, California Gnatcatcher, and Bald Eagle (Anchor, 2004). The eastern portion of the watershed also contains wild rainbow trout, which is an important species due to its status as a sensitive species; this species is also considered an indicator species, indicating that water bodies in the eastern watershed contain healthy cold water habitat.

The central portion of the watershed is dominated by chaparral and sage scrub with a few isolated patches of Oak woodlands and extensive areas of rock outcrops. Important species that occur in this portion of the watershed include the Western Spadefoot Toad, San Diego Banded Gecko, San Diego Ringneck, Prairie Falcon, Ferragunous Hawk, Golden Eagle, Northwestern San Diego Pocket Mouse, Stephen's Kangaroo Rat, Ringtail and Mountain Lion (Anchor, 2004).

The lower portion of the watershed is limited to native and semi-native habitats as it consists of mostly developed lands. The most extensive vegetation type in this portion of the watershed consists of coastal sage scrub. Patches of disturbed wetland, native riparian forest and scrub can also be found in the lower watershed. Also of importance is the Famosa Slough, a 37-acre wetland located near the mouth of the San Diego River, which is home to productive wetland habitats and contains detention basins and other features that help with stormwater and flood control. The slough is flushed with salt water from the river channel and collects rainwater from the surrounding urbanized area (Friends of Famosa Slough (a), 2012). The San Diego River Estuary, also located within the lower portion of the watershed is over 300 acres in size and provides important estuarine habitat in the watershed. Species unique to this portion of the watershed include Western Snowy Plover, California Least Tern, Light-footed Clapper Rail, California Brown Pelican, Silvery Legless lizard, two-striped Garter Snake (Anchor, 2004).

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Threatened and endangered species within the San Diego Watershed include San Diego ambrosia, San Diego thorn-mint, San Diego button celery, arroyo toad, southwestern willow flycatcher, least bell's vireo, Encinitas baccharis, California gnatcatcher, bald eagle, San Diego fairy shrimp, quino checkerspot butterfly, California brown pelican, peregrine falcon, western snowy plover, California least tern, Belding's savannah sparrow, and the light-footed clapper rail. The San Diego watershed also supports non-native fishes such as green sunfish, largemouth bass, black bullhead and mosquito fish. The San Diego Estuary supports native fish species such as the killifish and striped mullet (Anchor, 2005). Despite its importance, the San Diego Estuary is highly susceptible to flooding; the estuary was severely impacted by storm events that took place in 2005 and caused over $120 million of damage in the Mission Valley area (County of San Diego 2007).

Invasive species, particularly *Arundo donax* are considered an issue throughout the watershed, and can cause threats to native species and may also exacerbate flood-related issues.

Tribal nations in the Region have indicated concern that jurisdictional habitat conservation efforts such as those described above may not consider current or future tribal developments, and tend to categorize tribal lands as open space for habitat and conservation planning purposes.

Potential Climate Change Impacts

Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the San Diego Watershed include but are not limited to:

- Decrease in imported water supply
- Decrease in groundwater supply
- Decrease in surface water availability
- Impacts to water quality
- Sea level rise
- Decrease in availability of necessary habitat
- Increased flooding
- Exacerbation of wildfires

Due to the reliance on imported water supplies within the San Diego Watershed, decreases in imported water supply availability could have substantially large impacts within the watershed. Flooding within the San Diego Watershed could be exacerbated due to climate change if the frequency and intensity of storms overwhelm the ability of local reservoirs to capture runoff.

Further, due to the San Diego Watershed's proximity to the coast, sea level rise has the potential to impact several municipalities and resources within the watershed. Wildfires in the San Diego Watershed are a common occurrence, particularly in the undeveloped regions of the watershed such as in Cleveland National Forest. If the frequency of wildfires increases due to climate change, local water quality and habitat within the watershed could be adversely impacted. Rain events after wildfires are also known to create flash floods in the San Diego Watershed. Increased frequency of wildfires will increase the frequency of flash floods which current stormwater infrastructure in the San Diego Watershed may not have the capacity to withstand.

Post-fire rain events in the watershed cause erosion, mudslides, and sedimentation which create negative water quality issues. Stormwater runoff from post-fire rain events in the watershed have shown to carry high levels of turbidity, nutrients, and TDS. An increased wildfire season can increase erosion and sedimentation process in the watershed, negatively impacting water quality in streams and local reservoirs. The potential effects on El Capitan, San Vicente, Cuyamaca reservoirs include increased sedimentation with loss of storage, temporary increase in turbidity, and increased water treatment needs and costs.

Climate change also has the potential to add stress on ecological systems in the San Diego Watershed. The rapid rate of climate change can pose a problem to many of the watersheds sensitive species, such as endangered and threatened species, that will be unable to adapt fast enough to habitat shifts and increasing temperatures. Species that are unable to adapt fast enough can face potential extinction. Additionally, changes

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in climate can make conditions much more favorable for invasive species in the watershed reducing available habitat space for native species.

Management Issues and Conflicts

Major issues in the San Diego Watershed consist of urbanization and its effects on water quality, hydromodification, loss of habitat, and the presence of non-native species. Increased urban development has increased the impervious surface area in the watershed leading to increased urban runoff impacting surface water quality. Urbanization has and will likely continue to affect the watershed hydrology and sediment transport patterns without proper management. Also at risk are the loss of native habitat in the watershed due to increased development and the presence of non-native invasive species (Anchor, 2005). Ongoing efforts in the watershed such as efforts to establish a river park from the El Capitan Reservoir to the Pacific Ocean along the length of the San Diego River can potentially reduce urbanization and its impacts on the watershed. Conservation efforts such as the San Diego River Park present additional issues associated with private land ownership in the watershed; conservation efforts are therefore complex due to multiple conflicting interests within the watershed.

Invasive non-native plant species has been a significant problem of concern in the San Diego Watershed for many years. Many of the invasive non-native plants contribute to flooding, are a fire risk, and degrade native habitats (San Diego River Conservancy (a), N.D.). Therefore, projects and programs have been created by various private, non-profit, and government agencies to remove invasive non-natives throughout the watershed and along the San Diego River (San Diego River Conservancy (a), N.D.).

The City of San Diego Public Utilities Department and Helix Water District are required to conduct a watershed sanitary surveys for their surface water sources within the watershed to identify actual or potential sources of contamination and any other watershed related factors that are capable of producing adverse effects on the quality of water used for domestic water supply (CSD (j), 2011). Within the San Diego Watershed, the City of San Diego and Helix Water District monitor local water supply reservoirs consistent with the requirements of the Safe Drinking Water Act. Though no significant major water quality issues were detected water quality monitoring will continue and expand to include long-term watershed monitoring for water quality, land use, and land conditions. Centralizing and strengthening relationships among all agencies and jurisdictions within the watershed will be essential to establishing successful inter-jurisdictional coordination for drinking water quality monitoring.

The need to reduce imported water demands in the San Diego Watershed has led water managers to consider using previously unused local groundwater supplies. However, the Mission Valley groundwater basin has a documented contamination plume (see discussion in Water Quality above) and most of the San Diego coastal plain is underlain with brackish (2,000 parts per million dissolved solids) groundwater as coastal aquifers are subject to recurring intrusion of saline water from the Pacific Ocean. The challenge for water managers in the San Diego Watershed will consist of capturing fresh groundwater flowing towards the ocean and extracting brackish groundwater for treatment using reverse osmosis (USGS (a), N.D.). This will require further characterization of the coastal plains geologic, hydrologic, and geochemical systems as well as monitoring of seawater intrusion, land deformation, and effects on the coastal riparian system.

Padre Dam Municipal Water District is interested in using the lower Santee-El Monte Basin for groundwater recharge with advanced treated recycled water. Padre Dam Municipal Water District also has interest in recovering return flows from application of imported water and recycled water by its customers. The City of San Diego also maintains an interest in the basin due to their Pueblo rights in the San Diego River and associated groundwater basins. These agencies will need to coordinate to ensure full use of the groundwater basin, while at the same time balancing protection of historical water rights with the maximization of beneficial uses.

Conflicts between resource protection and flood control in the lower watershed often prevent vegetation control in floodplains. Delayed removal of vegetation that blocks flood flows can then result in channel overflows and flood damage. Conversely, removal of vegetation within flood control channels can fragment habitat, especially riparian habitat that can contain important protected species.

To diversify the water portfolio, water managers are considering maximizing water reuse. The City is currently running a water purification demonstration project that examines the use of advanced water purification

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technology to provide safe and reliable water (CSD (g) (h) (i), 2013). If the demonstration project is successful, the full-scale reservoir augmentation, which would involve advance treatment of existing recycled water supply and conveyance into the San Vicente Reservoir for storage and later potable use, would be implemented. The viability of this strategy to produce safe and reliable water that meets all regulations has yet to be determined. Portions of the San Diego River have been altered and constrained due to heavy mining operations. Sand mining has impacted portions of the San Diego River from accumulated sand in the River which creates ponding of water (SDRPF (b), 2001). Ponded water rapidly decreases its DO levels negatively impacting aquatic life. Mining operations along the River have limited the communities' ability to access and enjoy walking, biking or kayaking/canoeing along the river – particularly the community surrounding Lakeside. Many mining operations in the San Diego River valley, however, are currently being phased out and restoration projects are currently underway. Continued restoration and habitat preservation efforts will be needed to restore and enhance the impacted San Diego River areas (Lakeside River Park Conservancy (b), N.D.).

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5.8 Pueblo Watershed

The Pueblo Watershed (Pueblo Hydrologic Unit or Pueblo HU (908)) is contained within the San Diego Bay WMA, and covers 60 square miles of urbanized land along San Diego Bay within the cities of San Diego, La Mesa, Lemon Grove and National City. Figure 5-9 is a map showing the boundaries and principal features of the watershed.

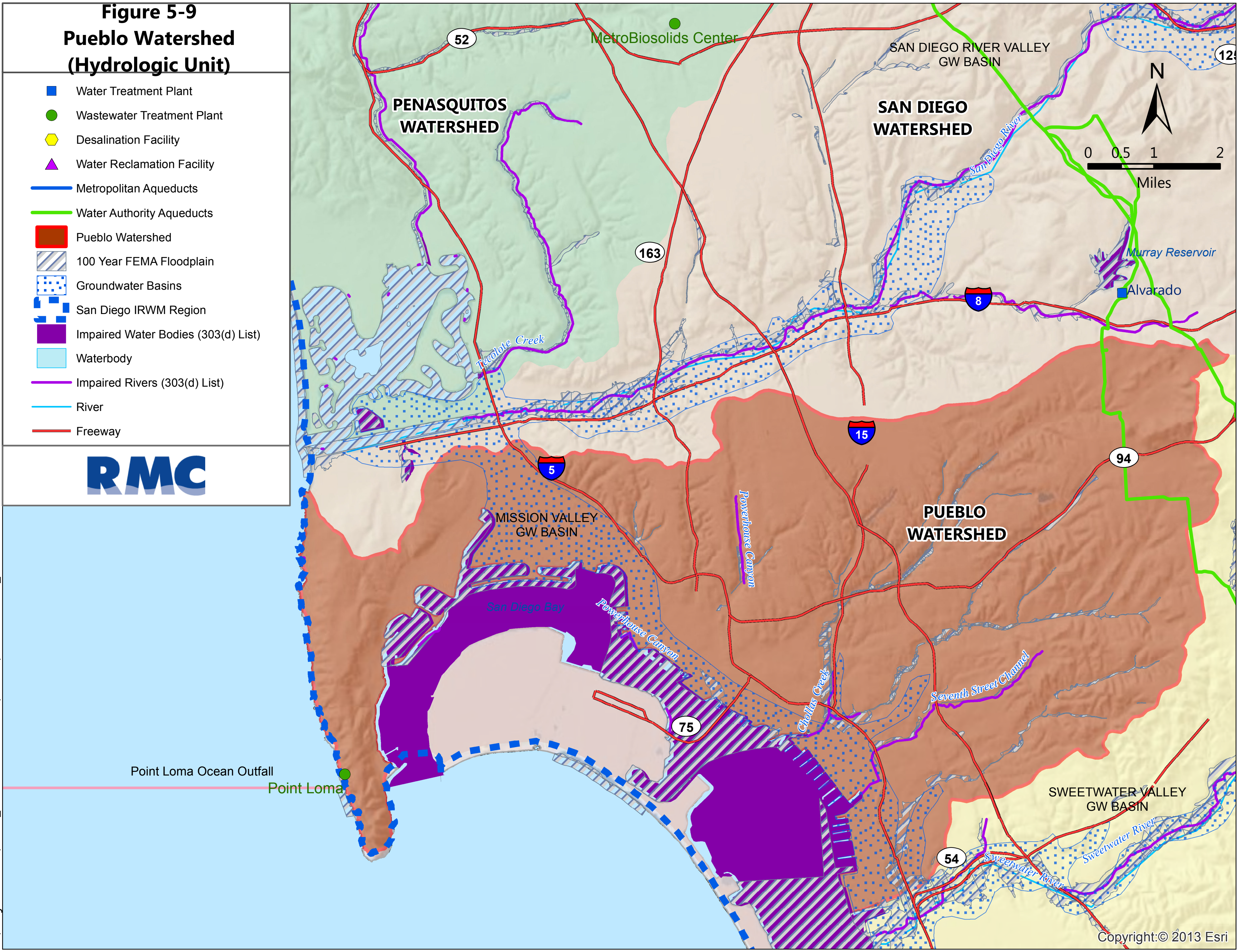
With a population of approximately 520,300, the Pueblo Watershed is the most densely populated watershed in the County (SDBC, 2008). While the primary land use within the watershed is residential, a relatively large percentage of the Pueblo Watershed land is used for transportation corridors and highways. Due to the high level of existing urbanization in the watershed, only small amounts of additional land are projected for development over the next 15 years.

No water supply is currently developed within the Pueblo Watershed, but portions of the San Diego Formation (a deep confined groundwater aquifer) underlie portions of the Pueblo Watershed. Chollas Creek is the largest of several drainage courses within the Pueblo Watershed.

The Chollas Creek Integration Project – funded by Proposition 84-Round 1 – will reduce flooding and improve water quality along Chollas Creek.

Photo credit: Charles Davis, Jacobs Center for Neighborhood Innovation

Figure 5-9
Pueblo Watershed
(Hydrologic Unit)



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Hydrology

The Pueblo Watershed is comprised of three Hydrologic Areas (HAs): Point Loma HA (908.1), San Diego Mesa HA (908.2), and National City HA (908.3) (SDBC, 2008). The major water bodies within the three HAs include Switzer Creek, Paleta Creek, and Chollas Creek.

The Pueblo Watershed's major water feature is San Diego Bay. The Pueblo Watershed is one of three watersheds that drain into San Diego Bay. The majority of the surface water from the Pueblo HAs drains to San Diego Bay, except for a small portion of the Point Loma HA which drains directly to the Pacific Ocean (CSD (a), 2012). The major waterway in this watershed that drains into San Diego Bay is Chollas Creek; other waterways of importance include Paleta and Switzer Creeks.

Water Systems

Imported water is the largest source (~80%) of water supplied throughout the San Diego Region (SDCWA (a), N.D.). Imported water is currently purchased from the local wholesaler San Diego County Water Authority (SDCWA) (CSD (b), 2012). Imported water is brought into the region by massive aqueduct systems from the Colorado River (240 miles away) and from the State Water Project carrying water from the Sacramento-San Joaquin Bay Delta (700 miles away). Local supplies make up the remaining 20% of water supply for San Diego County (SDCWA (a), N.D.). Surface water is collected as runoff and stored in reservoirs outside the Pueblo Watershed. Surface water is used to maximize local water supplies in conjunction with imported water.

Groundwater production in the Pueblo Watershed is limited due to lack of storage capacity in the basin, availability of groundwater recharge, and degraded water quality (SDCWA (b), N.D.). The Sweetwater Valley Groundwater Basin (9-17) is a large groundwater basin that empties into the San Diego Bay underlying the Pueblo Watershed. The Sweetwater Valley Groundwater Basin consists of two water bearing formations, the Sweetwater Alluvium and the San Diego Groundwater Formation. Recharge of the basin is derived from runoff of seasonal precipitation from the Sweetwater River Valley, Sweetwater Reservoir discharge and underflow, and possible subsurface flows (DWR (a), 2004). A portion of the Mission Valley Groundwater Basin (9-14) also underlies the Pueblo Watershed.

The Metropolitan (Metro) Sewerage System, owned by the City of San Diego and operated by the San Diego Metro Wastewater Joint Powers Authority [JPA]), serves the majority of the Pueblo Watershed (SDCWA (a), N.D. and San Diego Metro Wastewater JPA, 2012). National City has its own wastewater division that maintains the City's sanitary sewer main and lines, closed storm collection systems, and pump stations. The Metro Sewerage System is responsible for treating wastewater from cities located in the Pueblo Watershed. The Wastewater Collection division is responsible for the collection and conveyance of wastewater. Major wastewater infrastructures within the Pueblo Watershed consist of Pump Stations 1 and 2, Pt. Loma Ocean Outfall, and the Pt. Loma WWTP. The Pt. Loma WWTP is located on the bluffs of Point Loma and treats approximately 175 million gallons of wastewater per day (CSD (a), 2012).

Internal Boundaries and Land Uses

The Pueblo watershed is within the jurisdictions of the Cities of San Diego, La Mesa, Lemon Grove, National City, the Port of San Diego, the Regional Airport Authority and a small portion of the County of San Diego (0.3%).The Pueblo Watershed is primarily within the jurisdiction of the City of San Diego. Other jurisdictions in the Pueblo Watershed include National City, Lemon Grove, La Mesa, Port of San Diego, the Regional Airport Authority, and a small portion of the County of San Diego (0.3%) (SDBC, 2008).

The dominant land use within the Pueblo Watershed is residential uses followed by transportation, commercial business/public facilities/schools/parks, military uses, and open spaces/preserves (SDBC, 2008). The Pueblo Watershed is highly developed and one of the most densely populated watersheds in the San Diego Bay Watershed. There are no tribal lands located within the Pueblo Watershed.

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In Chollas Creek, Groundworks San Diego-Cholas Creek has led recent efforts to organize watershed stakeholders in integrating watershed management activities and funding proposals. Stakeholder coordination activities have included the City of San Diego, Jacobs Center for Neighborhood Innovation, San Diego CoastKeeper, Urban Corps of San Diego, EPA, National Parks Service, UCSD, and IRWM Program representatives. From this coordination, the Chollas Creek Integration Project was established as a multi-phased community-driven effort to restore Chollas Creek and provide a safe community recreation space in the neighborhood near Euclid Avenue and Market Street. Continuing the theme of community involvement, the Chollas Creek project aims to conduct outreach to community members about the value of creek water quality and habitats.

Habitat restoration activities along Chollas Creek
Photo Credit: Jacobs Center for Neighborhood Innovation

Water Quality and Water Quality Impairments

The Pueblo Watershed is highly impacted by pollutants carried by urban runoff from residential areas, streets and roadways, commercial and industrial areas, and construction. Such pollutants include metals, bacteria, oil and grease, pesticides, sediment, and trash. The 303(d) list includes the three creeks, a section of San Diego Bay shoreline, and the Point Loma Hydrologic Area within the Pueblo watershed (PCW (a), N.D. and SDBW, N.D.):

- Chollas Creek for copper, lead, zinc, indicator bacteria, phosphorus, nitrogen, diazinon, and trash.
- Switzer Creek for copper, lead, and zinc
- Paleta Creek for copper and lead
- Shelter Island Yacht Basin for dissolved copper
- San Diego Bay shoreline for benthic community effects, sediment toxicity, Enterococcus, fecal coliform, total coliform, copper, chlordane, PAHs
- Pacific Ocean Shoreline, Point Loma hydrologic area at Bermuda Avenue for total coliform

Additionally, there are 303(d) listing for areas of San Diego Bay for copper, benthic community effects, sediment toxicity, bacteria, chlordane, and PAHs. The sources of pollutants are primarily from stormwater discharges, shipyard operations, and dry weather nuisance flows. The bay bottom provides habitat for many aquatic organisms and functions as an important component of aquatic ecosystems. However, the bay bottom sediment serves as a repository for persistent and toxic chemicals causing toxicity to marine life and benthic community impairments.

The major pollutant sources are from residential and street/roadway runoff, followed by runoff from businesses, parks, and construction. All major water bodies, including the San Diego Bay, in the Pueblo Watershed are highly impacted by urban runoff which causes surface water degradation, habitat degradation, and sediment toxicity. The heavily urbanized nature of the watershed contributes to its poor water quality, though neighborhood groups, such as the Jacobs Center for Neighborhood Innovation, are pursuing projects to improve water quality in Pueblo Watershed creeks (*see call-out box*). Furthermore, a Water Quality Improvement Plan will be

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developed for the entire Pueblo Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

Bulletin 118 reports that groundwater quality of the San Diego Formation (Sweetwater Valley Groundwater Basin (9-17)) has been historically brackish, with TDS, chloride, and sodium content at concentration levels that exceed the recommended limits for drinking (DWR (a), 2004). Treatment of the groundwater is necessary for use as potable supply. High TDS concentrations in the groundwater basin are a characteristic of the groundwater when it was deposited in the formation, not from over-pumping (SWA (a), 2012).

Specific water quality objectives have been established in the Basin Plan for the Point Loma, San Diego Mesa, and National City HAs (SDRWQCB (c), 2007). The inland surface water quality objectives established are for odor, turbidity, and color units. The groundwater water quality objectives established are only for National City HA which consists of TDS, chlorides, sulfates, sodium, nitrates, iron, manganese, methylene blue-activated substances (MBAS), boron, odor, turbidity, color units and fluoride.

TMDL projects have been put in place to assess the impacts of pollutants/toxics at each of the sites for implementation of the most appropriate Best Management Practices (BMPs) for reduction of these pollutants/toxics. TMDLs have been developed and are in the process of being developed to minimize current water quality issues within the Pueblo Watershed as discussed in *Chapter 3, Region Description*. For example, a TMDL has been developed for the Shelter Island Yacht Basin (SIYB) to address dissolved Copper water quality impairments that can have toxic effects on aquatic organisms (SDRWQCB (a),). Other TMDLs that have been adopted that fall within the Pueblo Watershed jurisdiction are Chollas Creek Diazinon, Chollas Creek dissolved metals, Chollas Creek indicator bacteria, and Shelter Island indicator bacteria (UCSD (a), N.D.).

Stormwater and Flood Management

Several major drainages within the watershed include Chollas Creek, Paleta Creek, South Chollas Creek, and Switzer Creek, which encompass drainage areas of approximately 54.4, 2.8, 10.9, and 4.3 square miles, respectively. The peak discharges during a 100-year storm event for Chollas Creek range from 7,100-10,000 CFS at three different locations. The peak discharges during a 100-year storm event for Paleta Creek, South Chollas Creek, and Switzer Creek are 1,400, 5,300, and 2,600 CFS, respectively. Within the watershed, the acreage of land uses within mapped flood hazard zones total more than 1,500 acres, and includes the following: commercial and services, 217 acres; industrial, 165 acres; open space and recreation, 330 acres; residential, 306 acres; and transportation, communications, and utilities, 555 acres (see Appendix 7-B, Integrated Flood Management Planning).

Stormwater and flood management within the Pueblo Watershed falls under the jurisdiction of the City of San Diego, the City of La Mesa, the City of Lemon Grove, the City of National City, the San Diego County Regional Airport Authority, the San Diego Unified Port District, and the County of San Diego (County). These jurisdictions are responsible for flood control and drainage system facilities as well as maintaining storm drains, channels and debris basins, though the County has minimal lands in the watershed, and is therefore only minimally involved in stormwater management in the Pueblo Watershed. Chollas Creek is one of the natural waterways and drainage systems that runs through the Pueblo Watershed that is used for flood control maintenance activities. Portions of the Chollas Creek are equipped with flood walls and flood dividers to protect the watershed from flood risk (CSD (c), ND). Most natural drainages, such as Chollas Creek, have been channelized for flood control however there have been efforts to restore natural flows in the watershed (CSD (d), 2009).

Stormwater runoff is a significant source of pollutants entering San Diego Bay. Pollutants entering San Diego Bay from urban runoff include trash, litter, sand, sediment, petroleum products leaking from motor vehicles, heavy metals from motor vehicle brake pads and diesel exhaust, animal feces, excess fertilizers and pesticides, among other pollutants (Port (b), N.D.). As one of the most developed and populated watersheds, Pueblo Watershed is a significant contributor of urban runoff entering the San Diego Bay. Some of the major inputs of stormwater into San Diego Bay within the Pueblo Watershed are Chollas Creek, Switzer Creek, and all surface runoff from downtown San Diego and surrounding urbanized areas (Port (a), N.D.).

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The County, the Unified Port of San Diego (Port), the San Diego County Regional Airport Authority, the Cities of San Diego, La Mesa, Lemon Grove, and National City, the California Department of Transportation, and the United States Navy have implemented programs to reduce pollutants in urban runoff and stormwater. As part of this effort, the County, two cities, and Port have developed Jurisdictional Urban Runoff Management Plans (JURMP) to reduce stormwater pollution and improve the water quality of rivers/creeks, the San Diego Bay, and ocean.

Natural Resources

Only small pockets of riparian and wetland communities are present in the Pueblo Watershed due to heavy development, such as that along Chollas Creek. Some of these riparian and wetland communities include riparian scrub, freshwater marsh, disturbed wetlands, ornamental riparian woodlands, upland communities, and rural communities. Several non-native species located within these communities include giant cane, Spiny cocklebur, white sweet clover, Bermuda grass, castor bean, and sweet fennel (County of San Diego (a) 1998).

The San Diego Bay is an ecosystem of concern within the highly developed Pueblo Watershed. San Diego Bay is characterized by salt marshes, tidal flats, bird nesting and foraging sites, essential fish habitats such as eelgrass beds, and diverse wildlife. Several plant and animal species of San Diego Bay are federally protected under the ESA, such as the Salt Marsh Bird's Beak, California Least Tern, Western Snowy Plover, and Eastern Pacific Green Sea Turtle (Port (c)(d), N.D. and Portand NAVFAC, 2011).

Invasive species in the San Diego Bay's ecosystem poses a series threat to native species. The following invasive species are present in the San Diego Bay: one species of marine algae, one marine protozoan, 47 marine invertebrates, five marine fish, and 28 species of invasive coastal plants (Port (c), N.D.). There at least 82 non-native species that can be found along the San Diego Bay (Port (c)), N.D.

Potential Climate Change Impacts

Climate change has the potential to impact the Pueblo Watershed via potential decrease in freshwater supplies, sea level rise, and changes to the vital San Diego Bay habitats (Port (d), N.D. and CCCC, 2009).The Pueblo Watershed is highly dependent on imported water supplies from the State Water Project and the Colorado River. Climate change is expected to pose challenges to imported water sources to the region as snowmelt is expected to decrease with increasing temperatures. Climate change can have potential effects on water demands; increases in temperature can increase industrial and residential water demands, impacting companies' decisions to locate business within the Pueblo Watershed.

Sea level rise along the San Diego Bay and the Pacific Ocean coast will have a significant impact on shoreline structures and for the intertidal and subtidal habitats. Sea level rise has the potential to damage coastal infrastructure, minimize existing intertidal habitat, and negatively impact tourism and recreation in the Pueblo Watershed. Tidal habitats in the San Diego Bay are home to a large diversity of wildlife that is strongly influenced by climate regime shifts (CCCC, 2009). Increases in temperature could shift vital eelgrass beds due to changing water clarity, depth and temperatures. Increased high tides and storm surges may deplete and/or destroy vital tidal habitat for avian species that live and feed in the area. Marginal bay habitats would be at risk as these require special salinity conditions, intermittent inundation, and light penetration. Changes in sea temperature could affect coastal ecosystems dynamics sensitive to temperature changes. With the predicted rapid changes in climate, it is expected the list of species at risk in the Pueblo Watershed region will increase.

Management Issues and Conflicts

Major issues in the Pueblo Watershed consist of surface water quality degradation, habitat degradation, sediment toxicity in San Diego Bay (SDBW, N.D.). Potential management related issues within the Pueblo Watershed include coordination amongst the multiple jurisdictions to reduce pollutants currently found in the watershed and successfully removing water bodies from the 303(d) list. Anthropogenic pollution has created various surface water quality issues in the Pueblo Watershed and successful implementation of TMDLs is essential to meeting water quality standards. TMDLs are issued on a watershed basis and could be assigned to various government agencies. Coordination with all agencies involved needs occur to ensure TMDLs within the

Pueblo Watershed
Pueblo Watershed are met (Port (a), N.D.). The high costs of remediating contaminated sediment sites in San Diego Bay has been an issue for the watershed. Eight remediated sites have been completed to-date resulting in the removal of 230,000 cubic yards of contaminated sediment at a cost of $25 million (SWRCB (a), 2009). At the moment there are 21 additional contaminated sediment sites that need to be remediated. Presently, the estimated total cost of cleanup at the Shipyard sediment site would be approximately $96 million (SWRCB (a), 2009). Sea level rise due to climate change has also been identified as a potential threat to San Diego Bay. It is projected that in this century the average high tide could increase in elevation by as much as five feet (ICLEI, 2012). Though the timing and severity of sea level rise is highly uncertain, it is recommended local jurisdictions implement climate mitigation and adaptation plans.

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5.9 Sweetwater Watershed

The Sweetwater Watershed (Sweetwater Hydrologic Unit or Sweetwater HU (909)) is contained within the San Diego Bay WMA, and covers 230 square miles in an area extending from the Laguna Mountains in the east to San Diego Bay. Figure 5-10 is a map showing the watershed boundaries and principal features. The Sweetwater River is the primary watercourse within the watershed, and two major reservoirs (Loveland and Sweetwater, both operated by Sweetwater Authority) exist along the river.

The downstream portion of the watershed below Sweetwater Reservoir is urbanized, approximately 20% of the watershed is dedicated open space or used for agriculture, and an additional 50% is undeveloped. Much of the undeveloped land is in the upper one-third of the watershed and is within the unincorporated county, the Cleveland National Forest, and Cuyamaca Rancho State Park. The middle portion of the watershed (between Loveland and Sweetwater Reservoirs) includes the unincorporated communities of Jamul, Dehesa, and Harbison Canyon.

Significant groundwater resources exist in the Middle Sweetwater River Basin (between Loveland and Sweetwater Reservoirs) and the Lower Sweetwater River Basin (downstream from Sweetwater Reservoir). Sweetwater Authority develops potable supply from brackish groundwater from the Lower Sweetwater River Basin.

Sweetwater Reservoir, owned by the Sweetwater Authority, stores natural runoff.

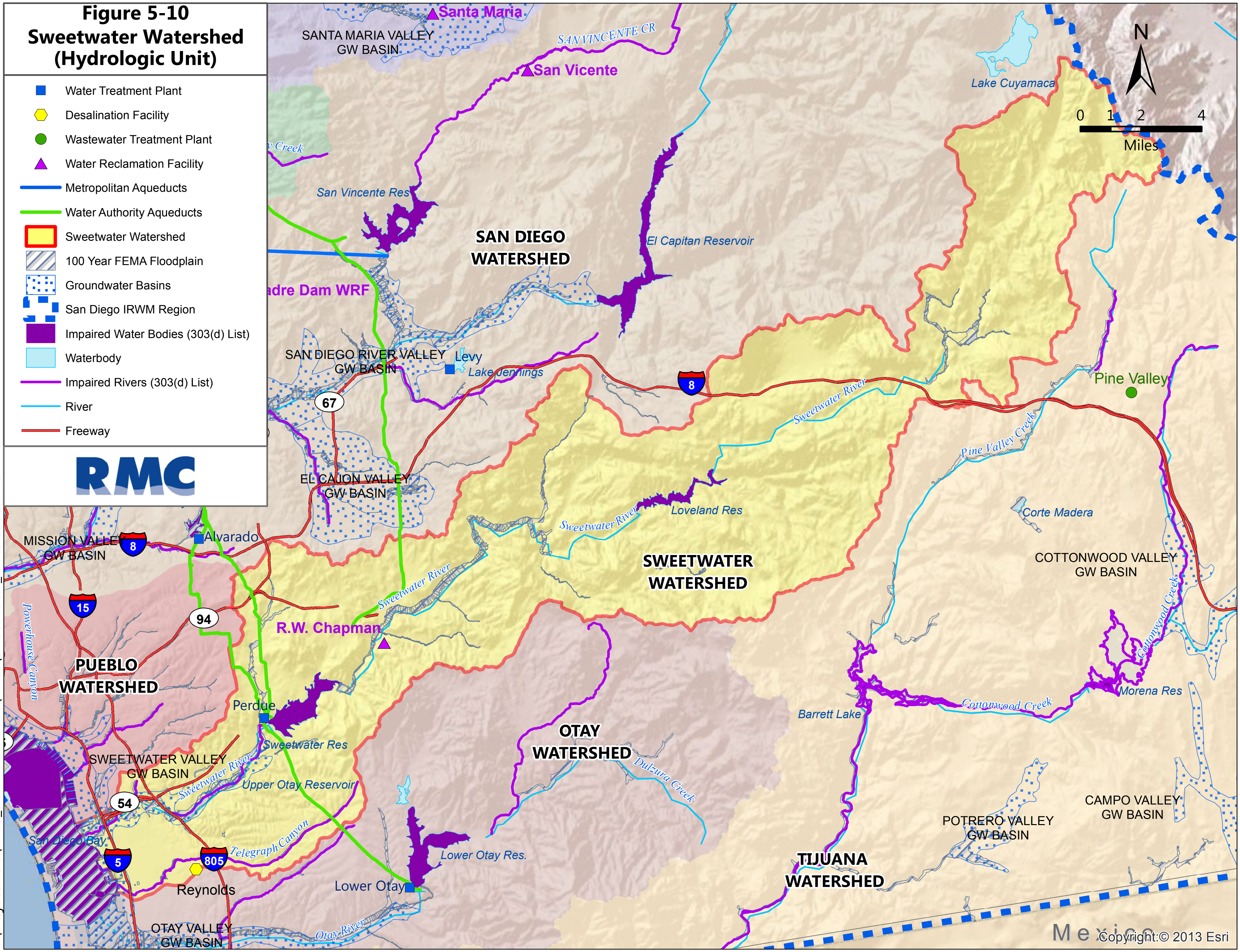

Figure 5-10
Sweetwater Watershed
(Hydrologic Unit)

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Sweetwater Watershed

Hydrology

The Sweetwater Watershed is comprised of three Hydrologic Areas (HAs): Lower Sweetwater HA (909.1), Middle Sweetwater HA (909.2), and Upper Sweetwater HA (909.3) (SDBC, 2008). The major water bodies within the three HAs include the Sweetwater River, Sweetwater Reservoir, Loveland Reservoir, and San Diego Bay.

The Sweetwater Watershed's major water feature is the San Diego Bay. The Sweetwater Watershed is one of three watersheds that drain into the San Diego Bay, along with the Pueblo and Otay watersheds. All surface water from Sweetwater Watershed drain into the San Diego Bay (SDBC, 2008). The major waterway that drains into the San Diego Bay is the Sweetwater River which traverses the watershed and enters the bay between the City of National City and the City of Chula Vista.

Water Systems

Two major water supply reservoirs reside in the Sweetwater Watershed:

- Loveland Reservoir: owned by the Sweetwater Authority, stores natural runoff.
- Sweetwater Reservoir: owned by the Sweetwater Authority, stores natural runoff.

Both reservoirs trap rainfall and melting snow from the surrounding mountains. Reservoir water is used to maximize local water supplies in conjunction with imported water. Combined, both reservoirs can store approximately 52,200 AF of water (SWA (b), 2012).

The Sweetwater Valley Groundwater Basin (9-17) is a large groundwater basin that empties into the San Diego Bay underlying the Sweetwater Watershed. The Sweetwater Valley Groundwater Basin consists of two water bearing formations, the Sweetwater Alluvium and the San Diego groundwater formation. Recharge of the basin is derived from runoff of seasonal precipitation from the Sweetwater River Valley, Sweetwater Reservoir discharge and underflow, and possible subsurface flows (DWR (a), 2004). Groundwater in the Sweetwater Watershed is pumped from both the Sweetwater alluvium and the San Diego groundwater formation by the Sweetwater Authority. The Sweetwater Authority pumps fresh water from the San Diego Formation in its National City Wells. Brackish water is extracted from the alluvium of the Sweetwater River and the San Diego Formation and then treated at the Richard A. Reynolds Groundwater Desalination Facility (SWA (c), 2012). It is anticipated that a Salt and Nutrient Management Plan will be developed for the middle portion of the Sweetwater basin, though this effort is not yet underway (Regional Board, 2013).

The Richard A. Reynolds Groundwater Desalination Facility uses reverse osmosis treatment to remove dissolved solids and microscopic particles (such as bacteria and other contaminants) that could be found in alluvial groundwater to produce drinking water (SWA (d) 2012). Four alluvial wells and six deep formation wells along the north side of the Sweetwater River provide source water to the Richard A. Reynolds Groundwater Desalination Facility. The facility can produce 4.0 MG of drinking water per day (MET, 2007). The Robert A. Perdue Treatment Plant at Sweetwater Reservoir treats surface water supplies to produce drinking water. The Robert A. Perdue Treatment Plant processes approximately 30 MG of water each day (SWA (e), 2012).

The Sweetwater Authority also manages the Urban Runoff Diversion System which captures first flush storm flows and low flow runoff before entering the Sweetwater Reservoir. Water containing high salt loads (TDS) is diverted downstream into the Sweetwater River to join the underground alluvium to become a source supply for the Richard A. Reynolds Groundwater Desalination Facility. Water with acceptable TDS concentrations is routed to the Sweetwater Reservoir where water is then treated at the Robert A. Perdue Water Treatment Plant. The urban runoff diversion system reduces the need to add costly treatment to the water treatment plant (SWA (f), 2012).

Sweetwater Authority currently purchases 30% of its water supply as imported water from the Water Authority (CSD (b), 2012; SWA (g), 2012). Imported water is brought into the region by massive aqueduct systems from the Colorado River (approximately 240 miles away) and the State Water Project carrying water from the Sacramento-San Joaquin Bay Delta (approximately 700 miles away) (SWA (a), 2012). During wet years, Sweetwater Authority may not have to purchase imported water to supplement local supplies; however, during

Sweetwater Watershed
dry years imported water is purchased and stored in the reservoirs in the fall/winter months (SWA (g), 2012). The Viejas Reservation and Sycuan Reservation located within the Sweetwater Watershed both operate onsite water systems. The Viejas Reservation operates a municipal water system to American Water Works Association water standards, including domestic water supply and wastewater compliance with Title 22 of the California Code of Regulations. The Sycuan Reservation receives basic water resources from onsite resources, although the tribe has investigated the possibility of connecting to the Otay Water District and Padre Dam Municipal Water District water systems.
Internal Boundaries and Land Uses The Sweetwater Watershed is the largest of the three San Diego Bay watersheds encompassing 230 square miles and covering over 148,000 acres (SDBC, 2008). The Sweetwater Watershed stretches from Cleveland National Forest to the San Diego Bay as an elongated northeasterly trending strip. The Sweetwater Watershed is bordered on the north by Pueblo Watershed and on the south by the Otay Watershed. The Sweetwater Watershed is largely (86%) within unincorporated jurisdictions. Other jurisdictions include: Port of San Diego, City of Chula Vista, La Mesa, Lemon Grove, National City and San Diego.. The most urbanized parts in Sweetwater Watershed include portions of the City of Chula Vista, City of Lemon Grove, National City, and the unincorporated communities of Spring Valley and Rancho San Diego. Unincorporated communities include Jamul, Pine Valley, Descanso, Alpine, the Cleveland National Forest, Cuyamaca Rancho State Park, and the Viejas Indian Reservation. Most of the unincorporated communities consist of undeveloped land, with 41% of the land administered by state and federal agencies or controlled by Indian Tribes (SDBC, 2008). There are 2 tribal reservations located within the Sweetwater Watershed: Viejas and Sycuan; in total, tribal lands account for approximately 2% of the total area within the watershed. The dominant land uses in the Sweetwater Watershed vary by the three HAs (SDBC, 2008). The Lower Sweetwater HA's dominant land use consists of residential followed by transportation, open spaces/preserves, and undeveloped/vacant land. The Middle Sweetwater HA's dominant land use consists of undeveloped/vacant land followed by residential, open spaces/preserves, and transportation. The Upper Sweetwater HA's dominant land use consists of undeveloped/vacant land followed by open space/preserve, residential, and agriculture.
Water Quality and Water Quality Impairments Six water bodies within the Sweetwater Watershed are listed on the 303(d) list (SDBW (b), N.D.e and PCW (c), N.D.e): • Telegraph Canyon for selenium • Sweetwater River for *Enterococcus*, fecal coliform, phosphorus, selenium, TDS, nitrogen, and toxicity • Sweetwater Reservoir for dissolved oxygen (DO) • San Diego Bay Shoreline near Bayside Park (J Street) for *Enterococcus and total coliform* • San Diego Bay Shoreline near Chula Vista Marina for copper • Loveland Reservoir for aluminum, DO, manganese, and pH Impacts on water quality within the Sweetwater Watershed include surface and groundwater quality degradation, habitat degradation, and invasive species (Copermittees, 2012). The main pollutants/stressors of concern in the watershed are DO, copper, indicator bacteria, aluminum, and manganese. Water quality in the Sweetwater Watershed is mainly impacted by agricultural and urban runoff. In particular, pesticides have been identified as a high priority water quality problem in the Middle Sweetwater HA. Though the lower portion of the watershed is heavily developed, and suffers from poor water quality, particularly where it drains to the San Diego Bay, the upper portion of the watershed is largely undeveloped or parkland, and relatively healthy. The San Diego Bay Watershed Urban Runoff Management Program (WURMP) provides an assessment of water quality and presents implementation actions designed to address the identified issues for watersheds draining to the San Diego Bay. This includes the Sweetwater Watershed, whose urbanized lower section is addressed by the San Diego Bay WURMP. Furthermore, a Water Quality Improvement Plan will be

Sweetwater Watershed

developed for the entire Sweetwater Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

Based on DWR's Bulletin 118, groundwater quality of the San Diego Formation (Sweetwater Valley Groundwater Basin (9-17)) is brackish, with TDS, chloride, and sodium content at concentration levels that exceed the recommended limits for drinking (DWR (a), 2004). Treatment of the groundwater is necessary for use as potable supply.

Specific water quality objectives have been established in the Basin Plan for the Sweetwater Watershed (SDRWQCB, 2007). The inland surface water quality objectives established are for TDS, chlorides, sulfates, sodium, nitrates, nitrogen phosphorous ratios, iron, manganese, methylene blue-activated substances (MBAS), boron, odor, turbidity, color units and fluoride. The groundwater water quality objectives established consists of TDS, chlorides, sulfates, sodium, nitrates, iron, manganese, MBAS, boron, odor, turbidity, color units and fluoride.

Stormwater and Flood Management

Major drainages within the watershed include Spring Valley Creek and Sweetwater River, which encompass drainage areas of 7.1, and 434 square miles, respectively. The peak discharge during a 100-year event for Spring Valley Creek is 3,600 CFS. The peak discharges during a 100-year event for Sweetwater River at three locations are 29,500, 35,000, and 20,300 CFS, respectively. Within the watershed, the acreage of land uses within mapped flood hazard zones total more than 5,000 acres, and includes the following: agriculture, 273 acres; commercial and services, 1,204 acres; industrial, 371 acres; open space and recreation, 1,815 acres; residential, 825; and transportation, communications, and utilities, 751 acres (see Appendix 7-B, Integrated Flood Management Planning).

Stormwater and flood management within the Sweetwater Watershed falls primarily under the jurisdiction of the County of San Diego (County). The County is responsible for maintaining the flood control and drainage system facilities as well as maintaining storm drains, channels and debris basins. Specifically, the County is responsible for removing trash and debris and other maintenance activities within the engineered section of the Sweetwater River; several other municipalities are responsible for storm drain maintenance within other portions of the watershed. In general, stormwater and flood management is limited to developed regions in the County due to most lands within the Sweetwater Watershed consisting of undeveloped and agricultural lands, and State and Federal parks. The major input of stormwater to San Diego Bay is via the Sweetwater River. The San Diego Bay Watershed Urban Runoff Management Program (WURMP) includes portions of the Sweetwater Watershed, along with portions of the Pueblo and Otay watersheds. The San Diego Bay WURMP guides efforts to decrease sources and reduce discharge of pollutants to the San Diego Bay from the separate storm sewer system (MS4).

Loveland Dam (which forms the Loveland Reservoir) and Sweetwater Dam (which forms the Sweetwater Reservoir) are both used to capture rainfall for flood protection purposes as well as for water supply purposes (SWA (a), 2012). Post-wildfire rain events in the Sweetwater Watershed can impact the quality of flows in the Sweetwater River and the local reservoirs. Total organic carbon (TOC) levels in the Sweetwater River normally increase significantly during rain events after a wildfire (Placencia and Starr, 2007).

Natural Resources

The Sweetwater River, Sweetwater Reservoir, Loveland Reservoir, and San Diego Bay support important wildlife habitat in the Sweetwater River Watershed. Between the headwaters and the outlet to San Diego Bay, the watershed contains a variety of habitat types including oak and pine woodlands, riparian forest, chaparral, coastal sage scrub, and coastal salt marsh (PCW (c), N.D.e). The upper watershed contains large sections of the Cleveland National Forest and Cuyamaca Rancho State Park.

The Sweetwater River estuary, located on the border of National City and the City of Chula Vista, is a broad, straight, deep channel that forms that mouth of the Sweetwater River. The mouth of the Sweetwater River is the Estuary's primary source of fresh water subject to tidal influences. The outer portion of the Estuary is surrounded

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by commercial and industrial lands uses to the north, whereas the southern side is bordered by the Sweetwater Marsh Unit of the National Wildlife Refuge (SDBW (b). N.D.e). The Sweetwater Marsh National Wildlife Refuge is 316 acres of diverse marshland that supports populations of light-footed clapper rail, California least terns, Belding's savannah sparrows, salt marsh bird's beak, and Palmer's frankenia (USFWS (a), 2011). The Sweetwater Marsh Unit is part of the San Diego National Wildlife Refuge Complex, a series of national wildlife refuges that were established to preserve and protect coastal habitat marshes, as is the San Diego National Wildlife Refuge which lies inland along the middle portion of the Sweetwater Watershed (USFWS (b), 2012). This inland Refuge protects riparian habitat for the endangered least Bell's vireo, southwestern willow flycatcher, and arroyo toad along the Sweetwater River (USFWS 1997). Adjacent uplands support coastal sage scrub, chaparral, vernal pools, and oak woodlands that support rare species such as California gnatcatcher, quino checkerspot butterfly, San Diego fairy shrimp, San Diego ambrosia, and San Diego thorn-mint.

The San Diego Bay is characterized with salt marshes, tidal flats, bird nesting, foraging sites, essential fish habitats such as eelgrass beds and home to a diverse wildlife and important species of plants and animals. Several plant and animal species of the San Diego Bay are federally protected under the ESA, including the Salt Marsh Bird's Beak, California Least Tern, Western Snowy Plover, and Eastern Pacific Green Sea Turtle (Port (a), N.D.e and Port (b), 2008). Invasive species in the San Diego Bay's ecosystem poses a serious threat to native species. The following invasive species are present in the San Diego Bay: one species of marine algae, one marine protozoan, 47 marine invertebrates, five marine fish, and 28 species of invasive coastal plants (Port (a), N.D.e). There at least 82 non-native species that can be found along the San Diego Bay (Port (a), N.D.e).

Tribal nations in the Region have indicated concern that jurisdictional habitat conservation efforts such as those described above may not consider current or future tribal developments, and tend to categorize tribal lands as open space for habitat and conservation planning purposes.

Potential Climate Change Impacts

Climate change has the potential to impact the Sweetwater Watershed via potential decrease in freshwater supplies, sea level rise, changes to the vital San Diego Bay habitats, and increased wildfire frequency (Port (a), N.D.e and CCCC, 2009).The Sweetwater Watershed is highly dependent on imported water supplies from the State Water Project and the Colorado River. Climate change is expected to pose challenges to imported water sources to the region as snowmelt is an important contributor to the region's imported supplies; snowmelt is expected to decrease with increasing temperatures. Climate change can have potential effects on the watersheds water demands; increases in temperature can increase industrial and residential water demands, impacting companies' decisions to locate business within the Sweetwater watershed.

Sea level rise in the Sweetwater Watershed along the San Diego Bay will have a significant impact on shoreline structures and intertidal and subtidal habitats. The Sweetwater Watershed has a widespread beach community and sea level rise has the potential to damage coastal infrastructure, recreation, and negatively impact tourism. Tidal habitats in the San Diego Bay are home to a large diversity of wildlife that is strongly influenced by climate regime shifts (CCCC, 2009). Increases in temperature could shift vital eelgrass beds due to changing water clarity, depth and temperatures. Increased high tides and storm surges may deplete and/or destroy vital tidal habitat for avian species that live and feed in the area. Marginal bay habitats would be at risk as these require special salinity conditions, intermittent inundation, and light penetration. Changes in sea temperature could affect coastal ecosystems dynamics sensitive to temperature changes.

The rapid rate of climate change can pose a problem to many of the watershed's endangered and threatened species, which may be unable to adapt fast enough to habitat shifts and increasing temperatures. With the predicted rapid changes in climate, it is expected the list of species at risk in the Sweetwater Marsh National Wildlife Refuge will only increase. Additionally, changes in climate can make conditions much more favorable for invasive species in the watershed reducing available habitat space for native species.

Climate change also has the potential to create changes in precipitation patterns, which can decrease seasonal stream flows in the Sweetwater River Watershed. Decreased seasonal stream flows will create stream flows with irrigation/dry weather flows, thus increasing the concentration of constituents and requiring stream flows to receive a greater level of treatment.

Sweetwater Watershed
Wildfires in the Sweetwater Watershed are a common occurrence, particularly in the undeveloped regions of the watershed. Climate change has the potential to impact the wildfire season in the watershed. Research suggests Santa Ana conditions, dry hot winds which blow from the mountains to the deserts in the east, may increase earlier in the fire season (September) and decrease later in the season (December). A shift to earlier Santa Ana wind occurrences could mean an increase frequency in Santa Ana related wildfires (CCCC, 2009). Longer wildfire seasons can create large scale damage to many residential homes particularly with the increased level of ongoing urbanization in the Sweetwater River Watershed. Post-wildfire rain events in the watershed cause erosion, mudslides, and sedimentation which create negative water quality issues. Stormwater runoff from post-wildfire rain events have been shown to carry high levels of turbidity, nutrients, and TDS. The potential effects on the Loveland and Sweetwater reservoirs include increased sedimentation with loss of storage, temporary increase in turbidity, and increased water treatment needs and costs. Rain events after wildfires are also known to create flash floods in the Sweetwater Watershed. Increased frequency of wildfires will increase the frequency of flash floods which current stormwater infrastructure in the Sweetwater Watershed may not have the capacity to withstand.
Management Issues and Conflicts The Sweetwater Watershed's management issues are mainly related to the protection of municipal water supplies and the protection and restoration of sensitive wetland and wildlife habitats. Because a portion of the watershed's water supply is locally-captured water, it is important to protect the quality of water entering local creeks, Sweetwater River, and the reservoirs. At the mouth of the Sweetwater River is the Sweetwater Marsh, a sensitive marshland that is currently under the management of the San Diego National Wildlife Refuge Complex (USFWS (a), 2011). Continued management of the Sweetwater Marsh is necessary to ensure it remains protected and preserved. Additionally, habitat degradation and loss due to increased development is a growing issue within the Sweetwater River Watershed. Given water quality concerns in this watershed, it is also a notable issue that there are no adopted TMDLs in this watershed; resource limitations such as funding to implement water quality protection and improvement programs are considered a barrier to implementation of such measures. The Sweetwater River is now nearly dry most of the year except during the winter when releases are made from the Loveland Reservoir. The changes to the Sweetwater River flows have had an impact on the arroyo toad, a federally listed endangered species and a state species of special concern. Releases from the Loveland reservoir have been timed by the Sweetwater Authority (SWA) to minimize the impact on the arroyo toad as they use the Sweetwater River and stream habitats for reproduction (Placencia and Starr, 2007). There is also high demand for recreational spaces such as parks and trails within the Sweetwater Watershed. Projects such as the Sweetwater River Trail System by the County of San Diego are helping create more accessible recreation trails for resident of Bonita, Spring Valley, Chula Vista, National City and unincorporated San Diego County (California State Coastal Conservancy, 2011). Existing trails do not reliably support all-season and multiple-use access that is compatible with the surrounding sensitive habitat and species (California State Coastal Conservancy, 2011). Current trail conditions create access interruptions for cyclists and other trail users due to areas of loose sand. The Sweetwater Watershed was historically an inland seabed therefore many of the soils contain naturally occurring salts. From the Loveland Reservoir to the Sweetwater River influent and reservoir, the salt (mineral) concentrations increase significantly which could be caused by the Jamacha landfill, urban runoff, groundwater upwelling, erosion of natural sources, and/or the sand mines located near the reservoir (Placencia and Starr, 2007). These water quality issues at the Sweetwater Reservoir are being addressed by the SWA and will need continued management of the source water quality to the reservoir.

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5.10 Otay Watershed

The Otay Watershed (Otay Hydrologic Unit or Otay HU (910)) is contained within the San Diego Bay WMA, and covers 160 square miles. Figure 5-11 presents a map showing the boundaries and principal features of the Otay River Watershed.

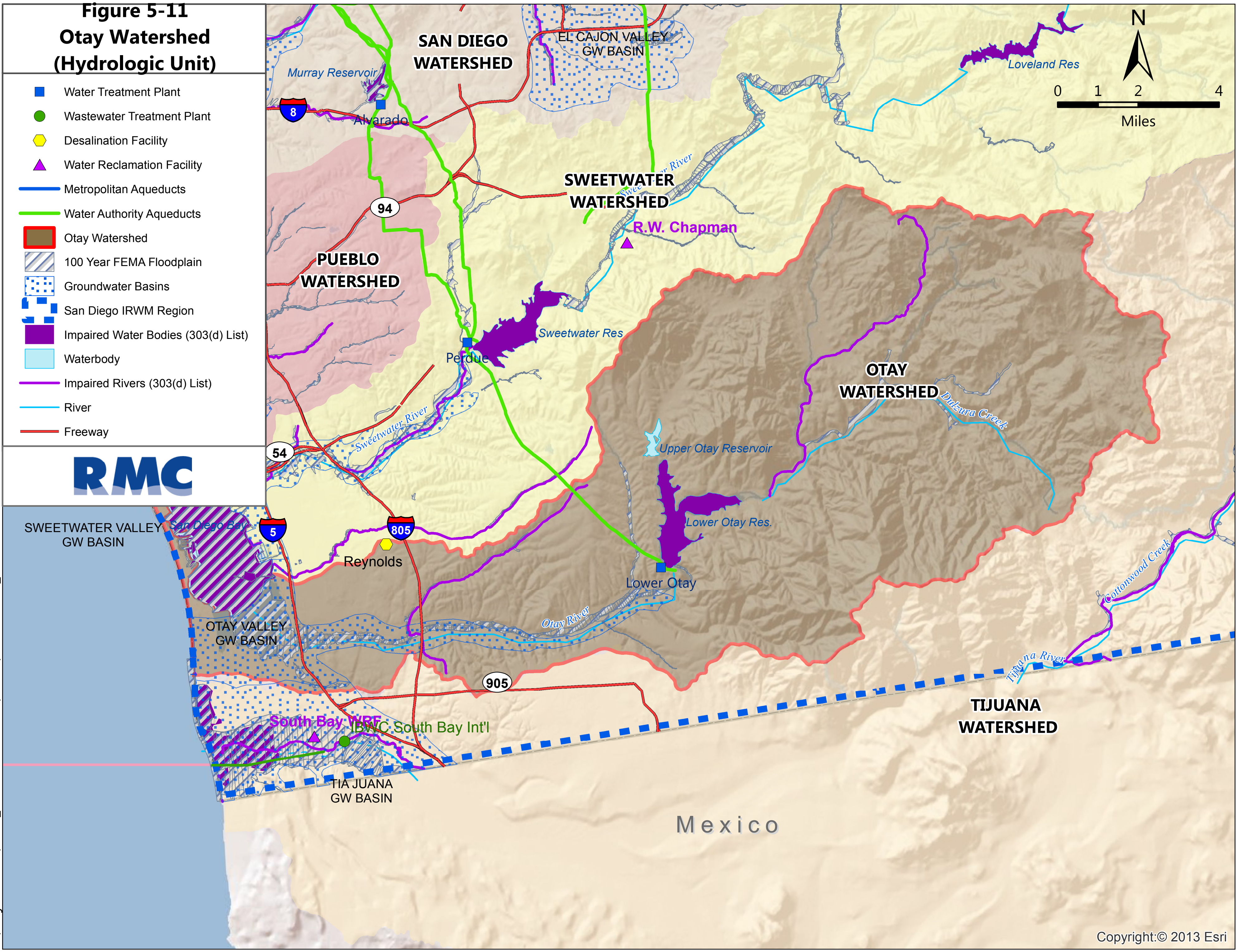
The Otay River (which flows to San Diego Bay) is the primary watercourse in the watershed. Upper and Lower Otay Reservoirs (owned and operated by the City of San Diego), are the other major water bodies of the watershed and represent the southernmost terminus of the San Diego Aqueduct. Lower Otay Reservoir impounds imported water and local runoff diverted from the Otay River Watershed. Upper Otay Reservoir impounds only local runoff. Approximately two-thirds of the watershed is currently preserved as open space. The downstream portion of the watershed within the City of Chula Vista is rapidly developing. Urban and residential land use comprises approximately 20% of the watershed. The watershed has a population of approximately 150,000 people.

Thirty-six square miles of the watershed is within the MSCP Plan area. Other important conservation areas within the watershed include the San Diego National Wildlife Refuge, the Rancho Jamul Ecological Reserve, and vernal pool lands.

Lower Otay Reservoir stores raw water from the Water Authority aqueducts.

Photo credit: Jeff Pasek, City of San Diego

Figure 5-11
Otay Watershed (Hydrologic Unit)



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Otay Watershed

Hydrology

The Otay Watershed is comprised of three HAs: Coronado (910.1), Otay (910.2), and Dulzura (910.3) (SDBC, 2008). The major water bodies include the Upper and Lower Otay Reservoirs, Otay River, and San Diego Bay.

The Otay Watershed is one of the three watersheds that discharge into San Diego Bay. Otay Watershed's major water features are the San Diego Bay and the Upper and Lower Otay Lakes. The Otay River is the central drainage system and major stream system traversing the Otay Watershed. The Otay River flows east to west from its headwaters near the Cleveland National Forest, through the valley, and emptying into the San Diego Bay. Significant tributaries on the Otay River include Poggi Canyon Creek, Salt Creek, O'Neal Canyon, Johnson Canyon, Wolf Canyon, and Dennery Canyon (Aspen, 2006). The principal aquifer in the watershed is the San Diego Formation.

Rainfall in this watershed is typically light with an average rainfall ranging from 8.25 inches in coastal areas to 19.5 inches in the eastern portion of the watershed (Copermittees, 2012).

Water Systems

The Otay Watershed contains two major water supply reservoirs, which are part of the City of San Diego municipal drinking water supply system and serve the San Diego Region including the City of Chula Vista:

- Upper Otay Reservoir: Formed by the Upper Otay Dam and is one of the smallest impounding reservoirs in the City of San Diego (CSD (g), 2012).
- Lower Otay Reservoir: Formed by Savage Dam, and has a storage capacity of approximately 49,800 AF. Receives raw water from the San Diego Aqueduct, as well as from the Morena and Barrett reservoirs in the Tijuana Watershed (CSD (h), 2012).

The lower reaches of the Otay River have habitat areas that have been preserved, but most of the riparian habitat along the Otay River in the upper reaches has been altered. The natural flow of the Otay River has been altered since the early part of the twentieth century to accommodate development and for flood control purposes (i.e. constriction of the Otay River into a channel). The Upper and Lower Otay Reservoirs now control 69% of the Otay River flows and have reduced the frequency of flows in the river (USFWS, 2006). Additionally, the Otay River has been subject to past and current sand and gravel mining operations that have altered the characteristics of the river. The mining operations that involved open pit mining in the streambed created a series of ponds that now act as sediment traps which now capture sediments that should be carried downstream by the river.

Otay Water Treatment Plant is located near Savage Dam and is the only water treatment plant in the Otay Watershed. The Otay Water Treatment Plant is a conventional water treatment plant with a capacity to treat up to 40 MGD, though it currently produces approximately 34 MGD (CSD (i), 2012; CSD(j) , 2011). The Otay Water Treatment Plant receives local water (runoff) from the Barrett Reservoir and the Morena Reservoir, which are located in the Tijuana Watershed (Aspen 2006).

Developed cities within the Otay Watershed, including portions of Chula Vista, San Diego, and Imperial Beach, are connected to the sewer system (Aspen, 2006). The few developments in the unincorporated areas in the north, south, and east portion of the Otay Reservoir are all connected to septic systems (Aspen, 2006).

Sweetwater Authority currently purchases 30% of its water supply as imported water from the Water Authority (SWA (g), 2012). Imported water is brought into the region by massive aqueduct systems from the Colorado River (approximately 240 miles away) and the State Water Project carrying water from the Sacramento-San Joaquin Bay Delta (approximately 700 miles away) (SWA (a), 2012).

The Otay Valley Groundwater Basin (9-18) is bounded on the east by the San Ysidro Mountains, on the north and south by semi-permeable marine deposits, and on the west by the Pacific Ocean (DWR (b), 2004). The Otay Valley Groundwater Basin consists of three water bearing formations: the Otay alluvium, the San Diego formation, and the Otay formation. Though groundwater is from private wells in the eastern portion of the

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watershed, the Otay Valley Groundwater Basin is characterized as a groundwater basin that is presently unused. Groundwater production in the Otay Watershed is mostly all from private wells for domestic use and irrigation in the unincorporated eastern portions of the watershed. Groundwater production on the western portion of the watershed is mainly derived from the San Diego Formation. Recharge in the basin is derived from percolation of precipitation, stream-flow originating in the valley highlands, return of applied water, and from the rare releases from the Lower Otay Reservoir during flood conditions (DWR (b), 2004). The Otay Valley groundwater basin is a low priority basin for Salt and Nutrient Management Planning (SNMP), and it is not anticipated that it will require a SNMP. For more information on SNMPs and basin prioritization, see *Chapter 7, Regional Coordination*.

Internal Boundaries and Land Uses

The Otay Watershed encompasses an area of 180 square miles and covers 98,500 acres (SDBW (a), N.D.). The Otay Watershed is bordered by the Sweetwater Watershed on the north and the Tijuana Watershed to the south. The Otay Watershed elevation ranges from sea level at the western extent to approximately 3,740 feet at Lyons Peak (HDR, 2006).

The Otay Watershed is primarily unincorporated area (70%) (SDBW (a), N.D.). The rest of the Otay Watershed is divided between the following jurisdictions: Port of San Diego and the Cities of Chula Vista, Coronado, Imperial Beach, National City, and San Diego. The major population centers in the watershed include the Cities of Chula Vista, Imperial Beach, and San Diego. Most of the land ownership in the Otay Watershed is private with a small percentage of local, state, and federally owned lands. The Jamul Indian Village (approximately 6 acres) lies within the Otay Watershed; tribal lands account for less than 1% of the total area of the Otay Watershed.

Land use within the three HAs comprising the Otay Watershed varies significantly (Copermittees 2012). In the Coronado HA, land use is predominantly military (52%), residential (15%), and transportation (12%). The Dulzura HA land uses are characterized as predominantly open space/parks and recreation (47%) and vacant and undeveloped land (36%). The Otay Valley HA land use is categorized as 26% open space/parks and recreation, 23% vacant and undeveloped land, and 18% residential (Copermittees ,2012).

Water Quality and Water Quality Impairments

Eight water bodies within the Otay Watershed are listed on the 303(d) list (SDBW (c), N.D. and PCW (a), N.D.):

- Lower Otay Reservoir for ammonia, color, iron, manganese, nitrogen, and pH
- Pacific Ocean Shoreline (at Imperial Beach Pier) for fecal coliform, PCBs, and total coliform
- Pacific Ocean Shoreline, Coronado Hydrologic Area (Silver Strand) for *Enterococcus*
- Poggi Canyon Creek for toxicity
- Pacific Ocean Shoreline, Otay hydrologic unit at Carnation Avenue and Surf Jetty for total coliform
- Jamul Creek for toxicity
- San Diego Bay for PCBs
- San Diego Bay Shoreline for copper, total coliform, or *Enterococcus*.

Pollutants of concern and stressors within the watershed include nutrients, pathogens, metals/metalloids, toxicity, and other organics (Copermittees, 2012). Potential sources of these contaminants are largely unknown point and non-point sources, along with urban runoff/storm sewers and natural sources (SDRWQCB, 2010).The major impacts from these pollutants/stressors consist of surface water quality degradation, reduced ground water recharge, sedimentation, and habitat degradation. Several of the sources/activities responsible for the listed water quality issues consist of urban runoff, agricultural runoff, resource extraction, septic systems, marinas and boating activities. Though water quality in the urbanized portion of the watershed is impaired, waters upstream of the Otay Reservoir, which are located in undeveloped or protected areas, are generally of good quality (Aspen, 2006).

The 2006 Otay River Watershed Management Plan, which was prepared by the County of San Diego, the City of Chula Vista, the City of San Diego, the City of Imperial Beach, and the San Diego Unified Port District, is a programmatic document that recommends implementation strategies for meeting various water quality and water

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management goals within the watershed. The recommended programs include water quality monitoring and other efforts that aim at addressing some of the aforementioned water quality issues and impairments in the watershed. Furthermore, a Water Quality Improvement Plan will be developed for the entire Otay Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

The Otay Valley Groundwater Basin's costal region contains high concentrations of sodium chloride and TDS (DWR (b), 2004). The coastal plain of the groundwater basin is rated marginal to inferior for domestic use due to the high TDS content. The groundwater in the eastern portion of the watershed is of sodium-calcium and chloride-bicarbonate character. Groundwater for most of the watershed is rated marginal to inferior for irrigation use due to the high chloride concentrations. The San Diego formation water quality can be highly variable with high TDS concentration of marine origin in the western portion of the watershed and decreasing TDS concentrations in the eastern portion of the basin.

Specific water quality objectives have been established in the Basin Plan for only the Otay and Dulzura HAs (SDRWQCB, 2007). The inland surface water quality objectives established are TDS, nutrients, iron, manganese, turbidity, and color. A summary of the TMDLs that have been adopted or are in progress for this watershed are provided in *Chapter 3, Region Description.*

Stormwater and Flood Management

Major drainages within the watershed include the Otay River and Telegraph Canyon Creek, which encompass drainage areas of approximately 123 and 7 square miles, respectively. The peak discharges during a 100-year event for Otay River and Telegraph Canyon Creek are 22,000 and 2,800 CFS, respectively. Within the watershed, the acreage of land uses within mapped flood hazard zones total nearly 4,400 acres, and includes the following: agriculture, 18 acres; commercial and services, 170 acres; industrial, 1,238 acres; open space and recreation, 2,318 acres; residential, 267acres; and transportation, communications, and utilities, 317 acres (see Appendix 7-B, Integrated Flood Management Planning Study).

Stormwater and flood management within the Otay Watershed falls under the jurisdiction of the County of San Diego Flood Control District Zone IV, the City of Chula Vista, the City of Coronado, the City of Imperial Beach, and the City of San Diego. These agencies and municipalities are responsible for flood control and drainage system facilities as well as maintaining storm drains, channels and debris basins. Stormwater and flood management is limited to developed regions in the County because much of the lands within the Otay Watershed consist of undeveloped, agricultural, and State and Federal lands and parks. There are approximately 80 miles of storm drains and drainage channel on the Otay Watershed, with the majority of this infrastructure located in the lower part of the watershed, below the Otay Reservoirs (Aspen, 2006).

The Otay Reservoirs were designed primarily for municipal water supply and therefore has limited capacity for flood control. Nevertheless, the reservoirs effectively control most flows from small storms in the upstream watershed and for the most part have eliminated flooding on the main stem of the Otay River. The reservoirs impound most upstream runoff effectively leaving the mainstream of the Otay River downstream dry except during extreme rain events.

The primary flood risk in the Otay Watershed is in older urbanized areas in the lower part of the watershed. Flooding issues in this area of the watershed are due to the inherent difficulty in draining low lying coastal areas, as well as from older drainage facilities that are under-sized (Aspen, 2006). Flood risks are less upstream of the Otay Reservoirs due to less development in that part of the watershed. While increased development in these areas could create more impervious areas increasing peak flow and thus flood potential, erosion potential, and modification of the overall hydrologic regime, implementation of best management practices and hydromodification mitigation measures will help to lessen these effects.

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Natural Resources

The Otay Watershed supports 14 aggregated natural communities/land cover types. Within these communities reside native vegetation such as coast live oak woodland, Engelmann oak woodland, southern willow scrub, cotton-wood willow riparian forest, southern sycamore alder riparian woodlands, amongst many others.

The Otay Watershed contains important conservation areas such as the San Diego National Wildlife Refuge, Rancho Jamul Ecological Reserve and vernal pool lands. Approximately 36 square miles of the Otay Watershed is part of the MSCP effort to preserve habitat for a wide range of endangered plant and animal species. The Otay Watershed has 61 sensitive plant species, seven of which are federally endangered. The seven federally endangered plants consist of the San Diego thorn-mint, San Diego ambrosia, salt marsh birds-beak, San Diego button celery, Mexican flannelbush, willowy monardella, California orcutt grass, and Otay Mesa mint. The Otay Watershed has 57 sensitive animals, nine of which are federally endangered. The nine federally endangered animals consist of the San Diego fairy shrimp, quino checkerspot butterfly, Riverside fairy shrimp, arroyo toad, southwestern willow flycatcher, California brown pelican, light-footed clapper rail, California least tern, and Least Bell's vireo (Aspen, 2006).

The Otay Watershed also contains a significant portion of the Otay Mountain Wilderness. Since 1999, BLM has been managing 18,500 acres of the Otay Mountain Wilderness and has been one of the active participants in the MSCP (BLM (a) and Public Lands Information Center (a), 2012). The Otay Watershed also contains several sensitive habitats which have been impacted by urban and rural development, livestock, grazing, and recreational use. Vernal pools are a highly specialized habitat within the Otay Watershed that supports a unique flora and fauna (Aspen, 2006). Oak woodlands are considered a sensitive habitat as they are scarce, with high wildlife value and the ability to provide watershed protection.

Invasive species have been an issue in the Otay Watershed. In an effort to remove invasive non-natives, the *Habitat Restoration Plan and Non-Native Plant Removal Guidelines* were drafted in 2006 by the City of San Diego, County of San Diego, and the City of Chula Vista for the Otay Valley Regional Park (OVRP). The Guidelines provide information on how to manage and minimize the expansion of invasive non-native species within the OVRP. The OVRP is a 11-mile long park of over 8,500 acres that extends from the southeastern end of the salt ponds through the river valley up to the area surrounding both the upper and lower Otay Reservoirs (HDR, 2006). The OVRP represents one of the largest open space areas within the San Diego County linking the South San Diego Bay with the Upper and Lower Otay Lakes (BLM (a)).

The Otay Watershed landscape and vegetation is also heavily impacted by wildfire, most of which is human-caused (BLM (a)). Wildfires take out a lot of the native vegetation providing an opportunity for invasive species such as arundo and tamarisk to overrun the land, and fragmenting native habitat. Weed control projects have been put in place to help ensure native plants continue to grow in recently fire burned lands. Non-native vegetation in the Otay Watershed includes eucalyptus woodland, arundo, giant reed, salt cedar, and castor bean. The giant reed is estimated to use three times the volume of water used by native vegetation and its presence in the watershed deters the growth of native vegetation. The giant reed affects various riparian native species, alters the hydrologic regimes, reduces groundwater availability, alters channel morphology, and increase fire hazards (River Partners (a), 2012).

The San Diego Bay is an ecosystem of concern associated with the Otay Watershed; while the San Diego Bay is not technically within the watershed, there is hydrologic connectivity between the watershed and the bay. The San Diego Bay is characterized with salt marshes, tidal flats, bird nesting, foraging sites, essential fish habitats such as eelgrass beds and home to a diverse wildlife and important species of plants and animals. Several plant and animal species of the San Diego Bay are federally protected under the ESA act, such as the Salt Marsh Bird's Beak, California Least Tern, Western Snowy Plover, and Eastern Pacific Green Sea Turtle (Port (b), N.D., Port (d), 2008, and Port and NAVFAC, 2011). Invasive species in the San Diego Bay's ecosystem poses a series threat to native species. The following invasive species are present in the San Diego Bay: one species of marine algae, one marine protozoan, 47 marine invertebrates, five marine fish, and 28 species of invasive coastal plants. There at least 82 non-native species that can be found along the San Diego Bay (Port (b), N.D.).

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Potential Climate Change Impacts

Climate change has the potential to impact the Otay Watershed via potential decrease in freshwater supplies, sea level rise, changes to the vital San Diego Bay habitats, and increased wildfire frequency (Port (d), 2008 and CCCC, 2009).The Otay Watershed is highly dependent on imported water supplies from the State Water Project and the Colorado River. Climate change is expected to pose challenges to imported water sources to the region as snowmelt is an important contributor to the region's imported supplies; snowmelt is expected to decrease with increasing temperatures. Climate change can have potential effects on the watersheds water demands; increases in temperature can increase industrial and residential water demands, impacting companies' decisions to locate business within the Otay Watershed.

Sea level rise in the Otay Watershed along the San Diego Bay and Pacific Ocean will have a potentially significant impact on shoreline structures and intertidal and subtidal habitats. The Otay Watershed has a widespread beach community and sea level rise has the potential to damage coastal infrastructure, recreation, and negatively impact tourism. Tidal habitats in the San Diego Bay are home to a large diversity of wildlife that is strongly influenced by climate regime shifts (CCCC, 2009). Increases in temperature could shift vital eelgrass beds due to changing water clarity, depth and temperatures. Increased high tides and storm surges may deplete and/or destroy vital tidal habitat for avian species that live and feed in the area. Marginal bay habitats would be at risk as these require special salinity conditions, intermittent inundation, and light penetration. Changes in sea temperature could affect coastal ecosystems dynamics sensitive to temperature changes.

The rapid rate of climate change can pose a problem to many of the watershed's endangered and threatened species, which may be unable to adapt fast enough to habitat shifts and increasing temperatures. With the predicted rapid changes in climate, it is expected the list of species at risk in the Otay Watershed will only increase. Additionally, changes in climate can make conditions much more favorable for invasive species in the watershed reducing available habitat space for native species.

Wildfires in the Otay Watershed are a common occurrence, particularly in the undeveloped regions of the watershed. Climate change has the potential to impact the wildfire season in the watershed. Research suggests Santa Ana conditions, dry hot winds which blow from the mountains to the deserts in the east, may increase earlier in the fire season (September) and decrease later in the season (December). A shift to earlier Santa Ana wind occurrences could mean an increase frequency in Santa Ana related wildfires (CCCC, 2009). A longer wildfire season can create large scale damage to many residential homes particularly with the increased level of ongoing urbanization in the Otay Watershed.

Post-wildfire rain events in the watershed cause erosion, mudslides, and sedimentation which create negative water quality issues. Stormwater runoff from post-wildfire rain events in the watershed have shown to carry high levels of turbidity, nutrients, and TDS. An increased wildfire season can increase erosion and sedimentation process in the watershed, negatively impacting water quality in streams and local reservoirs. The potential effects on the Upper and Lower Otay Reservoirs include increased sedimentation with loss of storage, temporary increases in turbidity, and increased water treatment needs and costs. Rain events after wildfires are also known to create flash floods in the Otay Watershed. Increased frequency of wildfires will increase the frequency of flash floods which current stormwater infrastructure in the Otay Watershed may not have the capacity to withstand.

Climate change also has the potential to create changes in precipitation which can decrease seasonal stream flows in the Otay Watershed. Decreased seasonal stream flows will create stream flows with irrigation/dry weather flows, thus increasing the concentration of constituents and requiring stream flows to receive a greater level of treatment.

Otay Watershed
Management Issues and Conflicts Population in the Otay Watershed is expected to double by 2031. An increase in population increases developments, impervious surfaces, and urban runoff which could impact water quality and add additional strain on the dynamic ecosystem of the watershed (Aspen, 2006). Without effective watershed based management in the Otay Watershed, increased developments, impervious surfaces, and population growth could lead to a degrading of the watersheds natural resources. Under the City of Chula Vista General Plan, the land planned for residential use will increase from 3,089 acres to 5,676 acres (84% increase). Land for open space/vacant and water use is expected to decline from 9,624 acres to 5,141 acres representing a 47% loss (Aspen, 2006). In the eastern territories of the Otay Watershed, approximately 10,800 acres have been proposed for residential land use while the proposed open space use would decrease from 34,796 acres to 20,607 acres (Aspen, 2006). Development in the overall Otay Watershed is expected to increase which is likely to create new or increase watershed management issues that need to be addressed before new development commences. Given water quality concerns in this watershed, it is also a notable issue that there are no adopted TMDLs in this watershed; resource limitations such as funding to implement water quality protection and improvement programs are considered a barrier to implementation of such measures. The Otay River flows are significantly controlled (69%) via dams and reservoirs which has significantly altered the river flow regimes. The altered flow regimes have a negative impact on various native plant and wildlife communities that depend on the Otay River flows as a food source, home, and reproduction. The impoundment of water at the reservoirs have reduced natural flows and changed the chemical and physical characteristics of the Otay River. Reduced stream flows can create poor water quality conditions in the lower portion of the Otay River which affect the aquatic communities. Lastly, the reservoirs also distort the sediment equilibrium in the downstream Otay River as nearly all of the bed sediment of the upper watershed is retained by the reservoirs (Aspen, 2006).

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5.11 Tijuana Watershed

The Tijuana Watershed (Tijuana Hydrologic Unit or Tijuana HU (911)) encompasses 1,750 square miles on either side of the U.S./Mexico border. Twenty-seven percent of the watershed area (467 square miles) is within California; a majority of this area is in the upper reaches of the watershed. Figure 5-12 presents a map showing the boundaries and features of the portion of the Tijuana River Watershed that is within the Region.

The lower Tijuana River flows from Mexico across the International Border to the Tijuana Estuary in California. Morena and Barrett Reservoirs are located in the upstream portion of the watershed. Water impounded in these reservoirs is transferred to the Otay River Watershed via the Dulzura Conduit. Urban centers within the watershed include the cities of Imperial Beach and San Diego in the United States, and the cities of Tijuana and Tecate in Mexico. The total population of the watershed is approximately 2.8 million people; according the 2010 U.S. Census data, approximately 83,000 people live within the watershed within the United States.

Urban stormwater runoff pollution from Tijuana, Mexico has created significant impacts within the 8-square mile Tijuana River Valley and Tijuana River Estuary.

Barrett Dam, shown releasing water, stores surface water in the upper portion of the Tijuana Watershed.

Photo credit: Jeff Pasek, City of San Diego

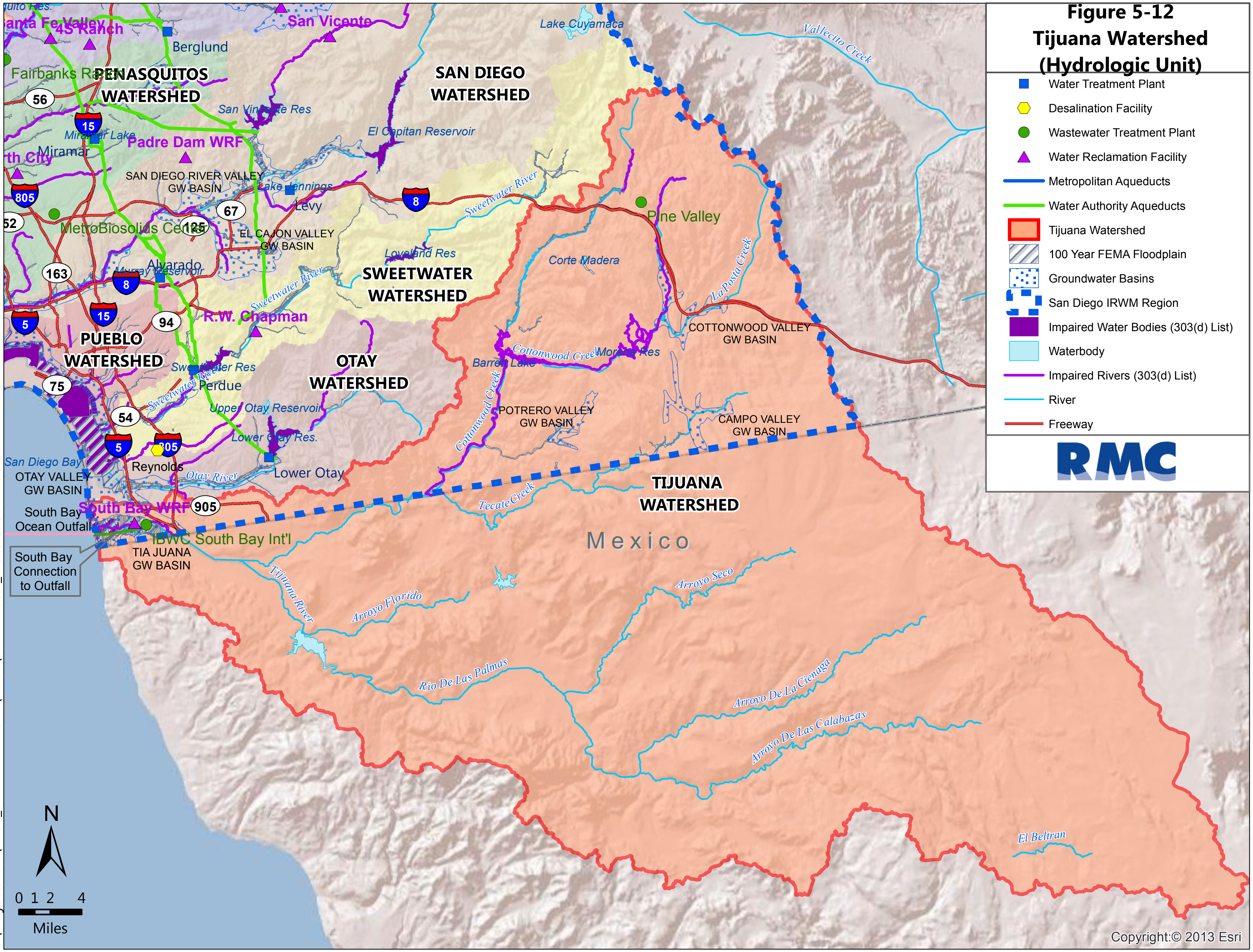

Figure 5-12
Tijuana Watershed (Hydrologic Unit)

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Tijuana Watershed

Hydrology

The Tijuana Watershed is comprised of eight HAs on the U.S. side of the border: Tijuana Valley (911.1), Portrero (911.2), Barrett (911.3), Monument (911.4), Morena (911.5), Cottonwood (911.6), Cameron (911.7), and Campo (911.8) HAs (County of San Diego (a), 2008). HAs are designated by the State of California, which has no jurisdiction outside of California. Therefore, HAs are not defined for the entire Tijuana Watershed. Instead, the Binational Vision for the Tijuana River Watershed (2005) defines twelve subbasins. Two are entirely within the United States: Pine Valley and Upper Cottonwood; three are bi-national: Lower Cottonwood/Río Alamar, Río Tijuana, Campo Creek; and seven are entirely within Mexico: El Florido, Río Seco, Las Palmas, La Ciénega, Las Calabazas, Las Canoas, and El Beltrán.

The major water bodies in the United States include the Tijuana Estuary, Tijuana River, Cottonwood Creek, Pine Valley, Campo Creek, Barrett Reservoir, and Lake Moreno. Major water bodies in Mexico include the Rio Las Palmas system which joins with the Cottonwood-Alamar system (primarily in the U.S.) to form the Tijuana River, the El Carrizo Reservoir, and the Abelardo L. Rodríguez Reservoir,

The Tijuana River is an intermittent river that originates in both the United States and Mexico and then enters the U.S. at San Ysidro about five miles east of the Pacific Ocean. The Tijuana River flows through the Tijuana Slough National Wildlife Reserve, one of the largest in Southern California and into the Pacific Ocean about one mile south of Imperial Beach.

The U.S. Border Fence runs along most of the border with Mexico in the San Diego IRWM Region, which has the potential to affect hydrology in the Tijuana Watershed. Some potential impacts of the border fence include increased risk of flooding due to diverted or obstructed water ways, or otherwise altered natural drainages; reduced infiltration and subsequent reduction in groundwater levels; changes in natural drainages that lead to standing water; deflection of runoff (due to obstruction of waterways) to low-lying, often agricultural, areas; public health problems related to stagnant water such as increase in diseases carried by mosquitos (SEMARNAT et al., 2007). The border fence itself is also considered a significant hydromodification that can impact hydrology and natural hydrologic flows.

Annual precipitation varies from less than 10.5 inches near the coast to more than 22.5 inches in the inland areas (Copermittees, 2012).

Water Systems

Water supply for urban uses in the Tijuana Watershed includes surface runoff, imported water, and groundwater pumping. Imported water in the U.S. portion of the watershed is currently purchased from the San Diego County Water Authority. During wet years no imported water is purchased, however during dry years imported water is purchased and stored in reservoirs in the fall/winter months. The Mexico portion of the watershed imports water from the Colorado River through the Colorado River Aqueduct.

Two water supply reservoirs are located in the Tijuana Watershed on the U.S. side:

- Morena Reservoir, owned by City of San Diego and stores surface water. Morena Reservoir is the highest (3,000 feet above sea level) and the most remote of the City's reservoirs. The reservoir has a water storage capacity of approximately 50,700 AF (CSD (a), 2012).
- Barrett Reservoir, owned by City of San Diego and stores surface water. Barrett Reservoir is located 35 miles east of San Diego and has a water storage capacity of approximately 34,800 AF (CSD (b), 2012).

Two other reservoirs located in Mexico also reside in the Tijuana Watershed (BWAC, 2005):

- Abelardo L. Rodríguez Reservoir (Rodriguez Reservoir) has a storage capacity of 111,067 AF, and is the primary local surface water supply for the city of Tijuana.
- El Carrizo Reservoir has a storage capacity of 32,428 AF, and is supplied by the Colorado River Aqueduct.

Tijuana Watershed

Morena Reservoir is connected to Barrett Reservoir by Cottonwood Creek. Water from both the Morena and Barrett reservoirs is transported to the Otay via the Dulzura Conduit when capacity exists within the Lower Otay Reservoir. Therefore, water levels in both the Morena and Barrett Reservoirs are allowed to fluctuate in order to help maintain minimum water levels in the Lower Otay Reservoir (County of San Diego (a), 2008).

The South Bay International Wastewater Treatment Plant (SBIWTP), located in San Diego County just 2 miles west of the San Ysidro Port of Entry, can treat 25 MGD of sewage (IBWC (a), N.D.). The SBIWTP treats sewage originating in Tijuana, Mexico and discharges it to the Pacific Ocean. The SBIWTP treats wastewater to minimize and prevent the contamination of the Tijuana River from sewage flows originating from Tijuana. Both the U.S. and Mexico share the operation and maintenance expenses of the SBIWTP. The Mexico portion of the watershed has a 25 MGD wastewater treatment plant, San Antonio de los Buenos Wastewater Treatment Plant. Though a 17 MGD expansion was planned for this plant, it was abandoned when the SBIWTP was built (IBWC (b), N.D.).

The South Bay Water Reclamation Plant is a water reclamation plant owned and operated by the City of San Diego, and located in the Tijuana River Valley. This water reclamation plant provides wastewater treatment services to the City's South Bay service area, and also produces recycled water for beneficial reuse purposes. The plant's current capacity is 15 MGD, and in 2010 the plant produced 4.2 MGD of recycled water for beneficial reuse purposes (City of San Diego, 2011).

On the U.S. side of the border, the Tijuana Watershed has four underlying groundwater basins: Tijuana (9-19), Cottonwood Valley (9-27), Campo Valley (9-28), and Portrero Valley (9-29). The Mexican side of the border in the Tijuana Watershed has three geohydrologic zones: the Tijuana Valley, Tecate Valley, and Valle de Las Palmas (BWAC, 2005). The Tijuana Watershed's U.S. groundwater basins are considered low priority basins for Salt and Nutrient Management Plans (SNMPs), and it is not anticipated that SNMPs will be required for these basins in the future. For more information on SNMPs and basin prioritization, see *Chapter 7, Regional Coordination*.

Tijuana groundwater basin underlies the portion of the coastal Tijuana River Valley that lies in California. The Tijuana basin is bordered by the Mexican international border on the south, the Pacific Ocean on the west, and the semi-permeable Pleistocene and Pliocene marine deposits on the east and north. The Tijuana basin consists of two water bearing units, the quaternary age alluvium and San Diego Formation, with the most productive unit in the basin being the quaternary alluvium. Recharge in the Tijuana basin is mainly from the Tijuana River and from controlled releases from the Barrett, Morena, and Rodriguez reservoirs. Some recharge also occurs from irrigation and discharge from septic tanks (DWR (a), 2006).

Cottonwood Valley groundwater basin underlies portions of Cottonwood, Cameron, and La Posta Valley in eastern San Diego County (DWR (b), 2004)). The quaternary alluvium and residuum are the primary water bearing units in Cottonwood Valley basin.

Campo Valley groundwater basin underlies the Campo Valley. The quaternary alluvium is the primary water bearing unit in the Campo Valley basin. Recharge is primarily from direct precipitation and effluent from a small number of septic tanks (DWR (c), 2003).

Portrero Valley groundwater basin underlies a small valley 30 miles inland from San Diego and about 2 miles from the Mexican border (DWR (d), 2004). The quaternary age alluvium and residuum are the principal water bearing units in the Portrero Valley basin. Recharge is primarily from percolation from ephemeral stream flows.

The three groundwater basins in the Mexico portion of the watershed are primarily sandy alluvium, and recharged by creeks and rivers.

Internal Boundaries and Land Uses

The Tijuana Watershed encompasses a region approximately 1,720 square miles and covers approximately 1.12 million acres on both sides of the international border between California and Baja California, Mexico. Only 27% (467 square miles) of the Tijuana Watershed is within California (County of San Diego (a), 2008). The Tijuana Watershed is bounded on the north by the Otay Watershed, the south by the remainder of the

Tijuana Watershed

watershed within Baja California, the west by the Pacific Ocean, and the east by the Anza Borrego Watershed of the Colorado River Basin.

The Tijuana Watershed has several jurisdictions with land use authority which include the cities of Imperial Beach and San Diego, the County of San Diego, and several Mexican municipalities. Within the U.S. portion of the watershed, primary land uses are vacant and undeveloped land (59%) and open space/parks and recreation (25%). Other land uses include residential and spaced rural residential (9%), agriculture (3%), and transportation (2%) (Copermittees, 2012). In the Mexican portion of the WMA, land use is predominately vacant and undeveloped land, which is most commonly used for low-intensity cattle and goat grazing (81.8%) (Copermittees, 2012).

Tribal lands associated with four separate tribal reservations are located within the United States portion of the upper Tijuana Watershed. Those tribal reservations include the Ewiiaapaayp Reservation, Manzanita Reservation, La Posta Reservation, and Campo Reservation. These tribal lands account for approximately 8% of the total area of the Tijuana Watershed that is located within the United States.

The South Bay International Wastewater Treatment Plant is a bi-national water quality improvement project headed by the International Boundary and Water Commission (IBWC). This project is an example of a cooperative solution to a complex watershed-based issue that spans multiple jurisdictions. The shared resource of the Tijuana River, which flows indiscriminately between the United States and Mexico and into the Pacific Ocean through the Tijuana River Estuary, was heavily impacted by sewage discharge largely from the City of Tijuana in Mexico. After decades of failed or inadequate solutions to the issue of wastewater impacts on the Tijuana River and Tijuana River Estuary, the IBWC developed an agreement between the United States and Mexico to pump wastewater from the Mexican side of the border to the United States side of the border to a co-owned and operated wastewater treatment facility that would treat sewage to meet water quality standards established by the United States. Currently, the South Bay International Wastewater Treatment Plant treats 25 MGD of wastewater to secondary standards prior to discharge to the Tijuana River. The treatment plant has the capacity to treat approximately 90% of the sewage produced in the urban areas of the City of Tijuana, Mexico, and has led to increased protection of human and environmental health on both sides of the border.

Water Quality and Water Quality Impairments

The Tijuana Watershed is one of the most severely water quality impacted watersheds in the San Diego County, primarily in the western lower portion of the watershed. The eastern portion of the watershed is known to have higher water quality, but with increasing development water quality issues could arise in the near future. The Tijuana Watershed is classified as a Category I (impaired) watershed by the State Board due to its array of water quality problems (PCW (a), N.D.).

Eight water bodies within the U.S. portion of the Tijuana Watershed are listed on the 303(d) list:

- Tijuana River for indicator bacteria, eutrophication, dissolved oxygen (DO), pesticides, solids, synthetic organics, trace elements, trash, phosphorus, sedimentation/siltation, selenium, surfactants, nitrogen, and toxicity,
- Tijuana River Estuary for indicator bacteria, eutrophication, DO, lead, nickel, pesticides, thallium, trash, and turbidity,
- Pacific Ocean shoreline (0.75 miles north of Tijuana River, Monument Road, Tijuana River Mouth, Seacoast drive, and U.S. Border) for *Enterococcus,* fecal coliform, or total coliform

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- Barrett Reservoir for color, manganese, perchlorate, nitrogen, and pH
- Pine Valley Creek for turbidity
- Tecate Creek for selenium
- Cottonwood Creek for selenium
- Morena Reservoir for ammonia as nitrogen, color, manganese, pH, and phosphorus

Pollutants of concern and stressors within the watershed include eutrophic conditions, nutrients, pathogens, pesticides, metals/metalloids, sedimentation/siltation, salinity, toxicity, trash, and other organics (Copermittees 2012). The sources of the pollutants are varied and include urban runoff/storm sewers, wastewater, agriculture, erosion, streambed modifications and destabilization, natural sources, septic systems, and unknown point and non-point sources (SDRWQCB, 2010).The major impacts from these pollutants/stressors consist of surface water quality degradation, groundwater quality degradation, trash, sedimentation, and eutrophication.

Surface water quality in the Tijuana Watershed, primarily the Tijuana River, has been adversely affected by runoff from across the international border with Mexico. Significant improvements have been made in the City of Tijuana to collect and treat its sewage; however not all households are yet connected to the city's sewer system. Following rain events, sewage and trash from the City of Tijuana flow into the Tijuana River and are transported to the Tijuana River Estuary.

During rain events, surface runoff containing trash and wastewater enter the Tijuana River and flow through the watershed into the Tijuana Estuary and ultimately into the Pacific Ocean. The lower portion of the Tijuana Watershed receives runoff which has been recorded to contain high concentrations of sediment, trace metals, coliform bacteria, polychlorinated biphenyls (PCBs) and other urban, agricultural, and industrial pollutants. Depending on ocean currents, these pollutants impact the beach water quality from Playas de Tijuana to Coronado (Wildcoast (a), 2012).

The Tijuana River Valley Recovery Team (Recovery Team) was created in 2008 in an effort to address water quality issues in the Tijuana River Valley. The Recovery Team completed and released the *Tijuana River Valley Recovery Strategy* in January 2012 (TRVRS, 2012). This document was developed with input from stakeholders on both sides of the border and establishes a strategy for managing sediment and trash in the watershed, as well as, for the protection of natural resources. The upper watershed is primarily open space, with little to no urbanization, while water quality issues are primarily found in the watershed downstream of dams on both sides of the U.S.-Mexico border (TRVRS, 2012).Furthermore, a Water Quality Improvement Plan will be developed for the United States portion of the Tijuana Watershed in accordance with the 2013 MS4 Permit, which will address some of the sources of pollutant loading into the water bodies and determine actions that can be taken to improve water quality. Efforts associated with the 2013 MS4 Permit will present opportunities for coordinated IRWM projects to ensure that the efforts are integrated to achieve maximum benefits.

The Tijuana groundwater basin is sodium chloride in character (DWR 2006). The basin contains chloride and sulfate concentrations that exceed the maximum contaminant level (MCL) at some wells, as well as for aluminum, barium, lead, selenium, and silver concentrations. The Cottonwood Valley groundwater basin and the Campo Valley groundwater basin are calcium bicarbonate in character (DWR 2003 and 2004a). The Campo Valley groundwater basin has been rated suitable for domestic and irrigation uses (DWR 2003). The Portrero Valley groundwater basin's water character is variable with calcium and sodium as the dominant anions and bicarbonate and chloride as the dominate anions (DWR 2004b).

Specific water quality objectives have been established in the Basin Plan for the eight individual HAs. The inland surface water quality objectives established are for TDS, nutrients, iron, manganese, and color. A summary of TMDLs that have been adopted or are in progress are provided in *Chapter 3, Region Description.*

Tijuana Watershed

Stormwater and Flood Management

A major drainage within the watershed is the Tijuana River, which encompasses a drainage area of 1,700 square miles. The peak discharge during a 100-year event at the mouth of the river is 75,000 CFS. Within the watershed, the acreage of land uses within mapped flood hazard zones total over 7,700 acres, and includes the following: agriculture, 800 acres; commercial and services, 188 acres; industrial, 23 acres, open space and recreation, 4,758 acres; residential, 852 acres; and transportation, communications, and utilities, 319 acres (see Appendix 7-B, Integrated Flood Management Planning).

Stormwater management is limited to the County of San Diego for most of the upper watershed due to its undeveloped, park, and agricultural uses on unincorporated lands. The City of Imperial Beach and the County of San Diego are responsible for municipal stormwater runoff in the lower portion of the watershed. Polluted urban runoff during rain events enters the Tijuana River which affects the water quality of the Tijuana River Estuary downstream, potentially impacting sensitive habitat and ecosystems. Erosion and sedimentation issues, even after light rain events, are a serious issue within the Tijuana Estuary. Sediment in the Tijuana River carried by stormwater originating in Mexico has been responsible for the destruction of at least 20 acres of salt marsh (Wildcoast). The municipality of Tijuana is responsible for stormwater management in its urban center, and Mexico has channelized a portion of the Tijuana River to combat flood risks. A binational flood warning system was installed in 2003 (BWAC, 2005).

The Tijuana Watershed is part of the City of San Diego's planned efforts to further protect the streams and ocean from stormwater pollution. A Watershed Urban Runoff Management Plan (WURMP) was written for the Tijuana Watershed in which it details the projects and activities that are planned for the watershed to protect from storm water pollution (CSD (c), 2012).

Natural Resources

The Tijuana River Estuary occupies over 2,000 acres of land and is one of the few intact wetlands in Southern California. The Tijuana River Estuary is among one of the most biologically productive systems on earth and contains sand dunes to coastal sage scrub, including riparian habitat, mudflat/tidal channels, salt marsh, salt panne, brackish-freshwater marsh, transition habitat, and upland habitat. The Tijuana River Estuary is home to more than 370 species of birds, six of which are threatened or endangered, and several endangered plant species (California's Critical Coastal Areas, 2006). One of the most sensitive habitats in the Tijuana River Watershed is the vernal pools which are highly specialized habitats that support unique flora and fauna (California's Critical Coastal Areas, 2006). The Tijuana River Estuary receives flows from the Tijuana River which carry nonpoint source pollution flows from Tijuana, Mexico. Managing the Tijuana River Estuary's cross-border water quality issues adds an extra layer of complexity to how the estuaries resources are managed (NOAA, 2004).

Tijuana River National Estuarine Research Reserve (TRNERR) encompasses approximately 2,293 acres and is designated by the Ramsar Convention as a *Wetland of International Importance*, (Wetlands Recovery Project (a)). The reserve is owned and operated by the California Department of Parks and Recreation (CDPR), U.S. Fish and Wildlife Service, the City of San Diego, the County of San Diego, and the U.S. Navy. It encompasses beach, dune, mudflat, saltmarsh, riparian, and coastal sage and upland habitats.

Marron Valley occupies approximately 2,300 acres of the southeastern portion of the City of San Diego's MSCP. The valley primarily consists of sage scrub and chaparral vegetation with large drainages that support significant stands of riparian habitat functioning as wildlife corridors (County of San Diego *et. al*., 1997). Marron Valley provides wildlife habitat and protect lands surrounding the San Ysidro Mountains.

The Tijuana River valley floodplain consists of a mixture of agricultural fields, rural housing, and riparian woodland. The mesas and canyon areas in the Tijuana Watershed contain coastal sage, maritime succulent scrub communities, riparian and chaparral habitat. Several species found in the floodplain region of the Tijuana Watershed consist of Shaw's agave, Orcutt's birds-beak, wart-stemmed ceanothus, San Diego barrel cactus, least Bell's vireo, lightfooted clapper rail, Belding's savannah sparrow, California least tern, Western snowy plover, northern harrier, Cooper's hawk, and the California gnatcatcher (County of San Diego (b), 1997).

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Invasive species within the Tijuana Watershed pose series threats to the native species. The following invasive species are present in the Tijuana Watershed: sea fig, tamarisk, giant cane, castor bean, salt cedar, and *arundo donax* (County of San Diego (b), 1997; SMSLRWMA, 2004). Tribal nations in the Region have indicated concern that jurisdictional habitat conservation efforts such as those described above may not consider current or future tribal developments, and tend to categorize tribal lands as open space for habitat and conservation planning purposes.
Potential Climate Change Impacts Climate change vulnerabilities that have been identified for the San Diego IRWM Region and are relevant to the Tijuana Watershed include but are not limited to: • Decrease in imported water supply • Decrease in groundwater supply • Decrease in surface water availability • Water quality concerns related to lower surface water flows • Sea level rise • Decrease in availability of necessary habitat • Exacerbation of wildfires • Due to the importance of imported water supply used within the Tijuana Watershed, decreases in imported water supply are anticipated to be a critical climate change impact. Due to the extensive amount of habitat and open space located within the Tijuana River Estuary, reduced surface water availability and potential water quality concerns could impact or decrease available habitat that is necessary for species survival. The Tijuana River Estuary is a very resilient ecosystem that has remained fairly stable despite its many issues (i.e. pollution and sedimentation) (Tijuana River National Estuarine Research Reserve (a), 2012). However, it is also home to a diverse wildlife that can negatively be potentially affected by significant climate regime shifts. The rapid rate of climate change can pose a problem to many of the sensitive species, such as endangered and threatened species, that will be unable to adapt fast enough to habitat shifts and increasing temperatures. With the predicted rapid changes in climate, it is expected the list of species at risk in the Tijuana Watershed will only increase. Additionally, changes in climate can make conditions much more favorable for invasive species in the watershed reducing available habitat space for native species. Sea level rise in the Tijuana Watershed could have a potentially significant impact on shoreline structures and the Tijuana River Estuary. Sea level rise has the potential to damage coastal infrastructure, recreation, and negatively impact tourism. Wildfires in the Tijuana Watershed are a common occurrence, particularly in the undeveloped regions of the watershed. Climate change has the potential to impact the wildfire season in the watershed. Post-fire rain events in the watershed cause erosion, mudslides, and sedimentation which create negative water quality issues. Stormwater runoff from post-fire rain events in the watershed have shown to carry high levels of turbidity, nutrients, and TDS. An increased wildfire season can increase erosion and sedimentation process in the watershed, negatively impacting water quality in streams, local reservoirs and the Tijuana River Estuary. The potential effects on the Morena and Barrett reservoirs include increased sedimentation with loss of storage, temporary increase in turbidity, and increased water treatment needs and costs. Rain events after wildfires are also known to create flash floods in the Tijuana Watershed.

Tijuana Watershed
Management Issues and Conflicts The Tijuana Watershed has various bi-national environmental problems that require developing and implementing a watershed management plan that addresses the many water resource related issues impacting both sides of the international border. Pollution is a multidimensional problem in the Tijuana Watershed that has impacts to the public health, the environment, and the economy of San Diego-Tijuana border communities (Wildcoast (a), 2012). Various watershed projects have already been undertaken to tackle several of the pollution and flood control issues on both sides of the international border, such as the Tijuana River Recovery Team, the Border 2012 program, BEACH act monitoring program, the Southwest Center for Environmental Research and Policy, the Tijuana Watershed Advisory Committee, and the Baja California/California Water Task Force (EPA). Though progress has been made, more bi-national work and coordination needs to be done to see a significant marked decrease in pollution and flood control related issues (NOAA, 2004). Unplanned development, industry, and population growth in Tijuana, Mexico has led to an increase in water quality issues. Many new developments in Mexico near the Tijuana River have no sewer infrastructure (Campana *et al*., 2006). No programs equivalent to the US EPA's National Discharge Elimination System (NPDES) currently exists in Mexico to minimize the threat of chemical pollutants entering and contaminating the Tijuana River and the Tijuana River Estuary. Wastewater flows originating from Tijuana and inadequate infrastructure to collect, treat, and dispose of those flows have also been long standing issues within the watershed (Wetlands Recovery Project (a), 2001). These are transboundary and cross-cultural water quality management challenges that need to be addressed (Wetlands Recovery Project (a), 2001). The Tijuana River has a diversion structure that sends flows to be treated at the SBIWTP. During periods of low flow the Tijuana River is diverted to the SBIWTP, whereas the Tijuana River flows freely once the water level rises over the diversion structure. Therefore flows downstream in the Tijuana River are nonexistent during low flow periods (summer) (Weston Solutions *et. al*., 2005). Surface water quality pollution has impacted the underlying aquifer in the Tijuana Watershed. The city of Tijuana, Mexico currently uses only 5% of the available groundwater supplies as the quality is poor from surface pollution and salt-water intrusion. The lack of sewer connections on the Mexico side of the Tijuana Watershed will only continue to degrade surface and groundwater quality. At the moment, the Tijuana Watershed relies heavily on surface water however as the population increases, groundwater will become a much needed water supply source that might not be available to either country due to contamination (Campana *et al*., 2006). Another concern in the Tijuana Watershed are the environmental regulation exemptions that have been allowed for Border Infrastructure System projects. The Department of Homeland Security has allowed for construction projects under this program to be exempt from environmental regulations which could degrade habitat and water quality in the Tijuana Watershed.

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