Appendix L

WCVC Climate Change Vulnerability Assessment
2019

APPENDIX L
WCVC IRWM Plan – 2019 Amendment
Climate Change Vulnerability Assessment

This assessment addresses the questions in Section 4 (Box 4-1) of the 2011 Climate Change Handbook for Regional Water Planning, as recommended by the Department of Water Resources in the 2016 IRWM Guidelines (Plan Standards, Volume 2).

I. WATER DEMAND

A. Are there major industries that require (potable) cooling/process water in your planning region? *YES*

Summary: While some local industries use cooling water for their processes, this is not a major use of potable water. Seawater (power plants) and recycled wastewater (oil production) likely represents a larger proportion of water used for cooling.

Approximately 189,984 acre-feet of water is used annually in Ventura County for municipal and industrial purposes, which is approximately 42.7 percent of the County's total water use (Ventura County, 2015). Of this water use, it is estimated that approximately 4,732 acre-feet are delivered to 721 industrial water connections (SWRCB, 2018). There are no available statistics on how much water is used for cooling and/or processing; the amount of water is insignificant. Overall, industrial water use accounts for approximately 2.5 percent of the County's municipal and industrial water use, and approximately one percent of the County's total water use.

A major industrial water user in Ventura County is the Proctor & Gamble (P&G) plant located in the City of Oxnard. This plant, previous owned by the International Paper Company, produces paper products. According to a company source, P&G adopted a water stewardship plan in 2017 and reported that it has successfully exceeded its goal of reducing water demand by more than 30%.

Oil production is a major industry in Ventura County. No information was available regarding the amount of water used in the production and processing of oil in the County, though at least one company – Aera Energy, reportedly uses recycled wastewater in their processes which require water.

The two power plants operated by Southern California Edison, located adjacent to the ocean, are in the process of being de-commissioned. When they were operating, seawater was used as the source of their cooling water.

B. Does water use vary by more than 50% seasonally in parts of your region? *YES*

Summary: Data show that County-wide summer urban water deliveries can be almost four times (400 percent) greater than winter water deliveries due largely to an increase

in irrigation demand (landscape and agriculture) resulting from higher temperatures and lack of rainfall in the summer.

Water districts in Ventura County provide water for a variety of urban land uses, including single- and multi-family residences; commercial and institutional uses; industrial uses; and landscape irrigation. Based on water use data reported to the State Water Resources Control Board in 2017 by the County's water districts (SWRCB, 2018), County-wide total water use for urban-related uses does vary by more than 50 percent seasonally. For example, the lowest total reported monthly water deliveries for urban uses in 2017 occurred in February, when water districts delivered 3,989 acre feet. The highest reported water deliveries for urban uses in 2017 occurred in September when districts delivered a total of 15,337 acre feet. The data show that County-wide summer urban water deliveries can be almost four times (400 percent) greater than winter water deliveries due largely to an increase in irrigation demand resulting from higher temperatures and lack of rainfall in the summer.

Seven of the County's 17 larger urban water districts also supply water for agricultural uses. The lowest total reported monthly water deliveries in 2017 for agricultural uses occurred in January when water districts delivered 250 acre feet. The highest reported water deliveries in 2017 for agricultural uses occurred in October when water districts delivered a total of 2,261 acre feet. The data show that district-supplied summer agricultural water deliveries can be almost ten times (1,000 percent) greater that winter water deliveries.

C. Are crops grown in our region climate-sensitive? Would shifts in daily heat patterns, such as how long heat lingers before night-time cooling, be prohibitive for some crops? *YES*

Summary: Particular crops grown in Ventura County, such as avocados, are sensitive to temperature extremes, such as hard frost or high heat. More research is needed to better understand long-term changes in the minimum temperatures for all crops. A growing number of crops are grown in hoop houses which helps shield plants from temperature extremes.

Ventura County supports a prosperous agricultural industry and is ranked eleventh among all crop producing counties in the United States. The estimated gross value of Ventura County's agricultural production for calendar year 2017 was almost 2.1 billion dollars (Ventura County, 2018). Water is crucial to agricultural production and agricultural water demand in the County accounts for approximately 255,300 acre-feet, or 57.3 percent, of the total water use in the County (Ventura County, 2015).

The high demand for agricultural water is in part attributed to crop types grown in the County that are considered water intensive to sustain production. Future changes in existing weather patterns and resulting fluctuations in water availability may result in agricultural land being taken out of production due to a lack of water. With increases in day and nighttime temperatures, plant evapotranspiration rates will increase and soil moisture levels will likely decline, which will result in an increased demand for agricultural water.

Temperatures have increased steadily in the South Coast climate region over the last few decades, with the most notable increases in minimum temperatures (overnight lows; WRCC 2018). For the period 1895-2018, five of the top-10 warmest average temperatures for the South Coast Region have occurred since 2014 (WRCC 2018). The South Coast region has experienced the greatest warming among all regions in California with an average temperature increase of approximately 2.7° F per century (CalEPA 2018). An increase of extreme heat days (top 2% of maximum temperatures April-October) has also been observed in the South Coast region, at a rate of approximately 1.2-1.6 days per year over the 1987-2016 period. The rate of increase of extreme heat nights (top 2% of maximum minimum temperatures April-October) is nearly double for the South Coast region, at 3-4 days per year (CalEPA 2018).
Warming is expected to continue for Ventura County. Following the RCP 8.5 emissions pathway (also known as the business as usual scenario), average annual temperatures are expected to rise by 6° F by the mid-century (2040 to 2069) and more than 8 °F by late-century (2070-2099). This is based on the mean outcome across multiple models (Hall et al. 2018). The intensity and frequency of extreme heat events are also projected to increase. By the late 20th Century, the average hottest day of the year is projected to increase by 7-10 °F under the RCP 8.5 pathway.

As described above, Ventura County supports a prosperous agricultural industry. Increased temperatures associated with climate change pose potential challenges and opportunities to the County's production of crops. Recently, the County's most lucrative crop has been berries. Berries are a perennial crop, and are considered temperature-sensitive. Statistical modeling projections based on historic crop yield and temperature data suggest a 2°F warming will have a differential impact on yield across crops. As temperature-sensitive crops, berry production could be adversely affected from projected increases in temperature.

Avocados are another example of a crop grown in Ventura County that is impacted by heat extremes. The fruit is grown as both a cash crop and by hobbyists throughout Ventura County. Avocados experience stomatal closure with temperatures exceeding 88°F and flowering problems with temperatures ≥95 °F (Liu et al. 2002). Preliminary analysis by the Desert Research Institute (unpublished) suggests an annual increase of

30-70 days exceeding 88 °F by the late 20th century as compared to the historic (1950-2005) average in areas of Ventura County excluding the coastal plain and highest terrain. An increase of approximately 25-50 days per year over ≥95 °F is projected by the end of the century; the changes are generally confined to inland valleys.

D. Do groundwater supplies in your region lack resiliency after drought events? *VARIES*

Summary: Some groundwater basins with primarily shallow wells that have ample overlying recharge areas, recover quickly after drought events. Wells in deeper zones do not recover as quickly, taking many years to recover. Due to extensive pumping over many years, some wells in areas with little to no recharge, such as the Lower Aquifer system on the Oxnard Plain, are essentially being mined and may never return to historic levels.

There are four water supply sources in Ventura County: groundwater, imported water, surface water, and recycled water. The relative amount of each source fluctuates each year due to climatic conditions and the availability of imported water. In 2013, groundwater accounted for 63.2 percent of the County's water supply. Groundwater is pumped by municipalities, private domestic users, public users, utilities, small mutual companies, water districts and agricultural users.

The Ventura County Watershed Protection District, as well as local water districts and cities, collects groundwater elevation data to determine the general groundwater elevations and to determine if water storage is increasing or decreasing. The Watershed Protection District regularly publishes reports on groundwater conditions. According to the 2015 Groundwater Conditions report (the most recent report published), approximately 200 wells in the County were gauged (Ventura County, 2016). "Key" monitoring wells for seventeen of the largest groundwater basins in the County have been established and are monitored because they are considered representative of conditions within the basin. The results of the well gauging conducted in 2015 for the major groundwater basins in the County are summarized below. In general, groundwater levels in Ventura County show a downward trend due to prolonged drought conditions beginning in the summer of 2011 and associated increased reliance on groundwater resources.

- Groundwater levels in the Forebay area of the Oxnard Plain *respond quickly to seasonal and annual changes in precipitation and recharge*. In 2015, one key monitoring well was dry, and another was down 12.7 feet from the previous spring. The water level elevation in an Oxnard Plain Fox Canyon aquifer well was up 7.3 feet from the previous spring. Other portions of the Oxnard Plain groundwater basin are collectively listed as being in "critical overdraft" in conjunction with groundwater management requirements of the Sustainable Groundwater Management Act.

- The water elevation of a key well in the Grimes Canyon Aquifer was down 8.8 feet from the previous spring. The *Pleasant Valley groundwater basin is also listed as being in a state of "critical overdraft*" for purposes of groundwater management and the implementation of the Sustainable Groundwater Management Act.

- In the Las Posas Valley, the East Las Posas Basin key well was up 10.2 feet from the previous year. *The water levels in this well had been generally declining over the previous ten years*. The water level elevation in the South Las Posas key well continued its slight upward trend of the past several years rising 3.0 feet in 2015. The depth to water in this well has risen from 136 feet to as high as 27 feet below ground surface since 1975. This trend is attributed to groundwater recharge from treated effluent from upstream waste water treatment plant discharges and groundwater discharge from the Simi Valley Basin.

- In the Santa Rosa Valley, the water level in the key monitoring well was up 3.8 feet from 2014.

- The water level elevation in a Simi Valley Basin key well was up 1.2 feet from 2014. This well has seen only slight changes in depth to water over the past ten years (less than plus or minus 10 feet).

- The Ojai Valley key well was down 5.1 feet from the 2014 measurement after having been down 50.2 feet from the 2013 measurement. The Ojai Valley basin responds quickly to rainfall or the lack of rainfall, and it is not uncommon to see large drops in water level during dry periods and recovery to at or above normal levels during wet periods.

- In the northern end of the Upper Ventura River Basin, the key well water level elevation was up 13.1 feet from the measurement in 2014.

- *The basins that underlie the Santa Clara River Valley also respond quickly to fluctuations in annual rainfall*. The water level elevation in the Piru basin key well was down 14.1 feet in 2015 compared to 2014. The water level elevation in the Fillmore Basin key well was down 3.7 feet after being down 1.9 feet the previous spring. The water level elevation in the key well in the Santa Paula Basin was down 2.7 feet from the 2014 measurement.

- The key well water level in the Mound Basin was down 6.7 feet from the 2014 spring measurement.

- The water level elevation in the Cuyama Valley Basin key well was down 7.0 feet from the 2014 measurement. *The Cuyama Valley Groundwater Basin is listed as being in a state of "critical overdraft"* for purposes of groundwater management and the implementation of the Sustainable Groundwater Management Act.

E. Are some instream flow requirements in your region either currently insufficient to support aquatic life, or occasionally unmet. *YES*

Summary: There are creeks and rivers in the County that may have inadequate flows to sustain healthy aquatic ecosystems either long-term or at times of extended low flows such as during drought periods. The Ventura River currently experiences relatively high levels of pumping and diversion which has led to lower instream flows over time. This watershed is subject to several Total Maximum Daily Load requirements - such as for algae and flow - which can impact the health of water-dependent ecosystems.

Drought conditions that result in decreased surface water flows can adversely affect water availability, sediment transport, water quality and temperature, and other related conditions that may impact aquatic species and the habitats they rely on. In addition, as water agencies plan to rehabilitate infrastructure or develop more supply, those programs may have the potential to adversely affect aquatic resources and may be required to comply with regulations such as the State and Federal Endangered Species Acts. A wide variety of sensitive aquatic species are located in Ventura County, including southern pond turtle, arroyo chub, and tidewater goby. A species of particular concern is the southern California steelhead. Adequate stream flow is necessary for steelhead returning from the ocean and for young fish that are migrating to the sea.

In the **Ventura River Watershed**, the Robles Diversion diverts Ventura River water to Lake Casitas. A Biological Opinion (BO) written by the National Marine Fisheries Service includes requirements to provide flow for the migration and passage of the southern California steelhead up and down the main stem of the Ventura River and past the diversion during the steelhead migration season (January 1 to June 30). Implementation of the flow release requirements of the BO started in 2005. The Robles Fish Passage Facility became operational in 2006. There is concern by Casitas Municipal Water District that future changes to the BO could require additional infrastructure and impact diversions to Lake Casitas, which is the water supply source for approximately 70,000 people.

In September 2014 Santa Barbara Channelkeeper, a nonprofit organization that works to protect and restore the Santa Barbara Channel and its watersheds, filed a lawsuit against the State Water Resources Control Board to protect the Ventura River and the people, animals and plants that depend on it. SB Channelkeeper alleges that "even though the State of California has designated the river as impaired because of excessive

pumping and diversions, the City of Ventura has for decades pumped and diverted hundreds of millions of gallons of water from the river each year with little regard for the consequences. This consistent over-pumping and diversion has put the health of the river—and the life it sustains—in serious jeopardy". The outcome of this lawsuit could have significant impacts on future water extractions and flow in the Ventura River and connected groundwater basins. In 2018 the City of Ventura took initial legal steps toward potential future adjudication of water rights within the watershed of the Ventura River. The parties in the lawsuit are attempting to reach a settlement through mediation.

Meanwhile, the State Water Resources Control Board has been working on an instream flow study on the Ventura River. As directed under the California Water Plan, the State Water Resources Control Board (SWRCB) and CA Dept of Fish and Wildlife (CDFW) are working on science and policy to enhance instream flows in the Ventura River Watershed for endangered steelhead trout populations. CDFW is studying steelhead migration and habitat flow needs on the Ventura River and San Antonio Creek. The SWRCB expects CDFW to deliver a flow recommendation to the SWRCB in one to two years. The SWRCB expects the flow recommendation to consider water year type and species life stage seasonal flow needs. The SWRCB is developing a surface water-groundwater model of the Ventura River Watershed. The model is a tool to evaluate CDFW's flow recommendation amongst potential state and local water management actions and projected future climate change and population growth conditions. The SWRCB is committed to developing the model and future policy through a scientifically-sound, transparent, and expedient process. The SWRCB expects to complete model development in 2021 (Source: SWRCB, 2019).

The SWRCB is considering a variety of policy adoption and implementation options and encourages local solutions. These different options are potential avenues for achieving results, specifically sustainable fish populations. The SWRCB encourages local water management solutions that produce results and lessen the need for the SWRCB to adopt or implement a policy. The SWRCB encourages local water management actions that increase local water security, restore habitat through non-flow actions (ex: *Arundo donax* removal, Matilija Dam removal), and enhance instream flows.

The SWRCB will use the model to evaluate scenarios, including potential policies. The scenarios will consider CDFW's flow recommendation, potential state and local water management actions, and projected climate change and population growth. To inform the climate change and population growth scenario, the SWRCB modeling team is coordinating with climate change modelers at the NOAA Desert Research Institute which were funded by the Resources Legacy Fund to provide updated, localized climate data and projections for the Watersheds Coalition of Ventura County IRWM Region.

In the **Santa Clara River Watershed**, the United Water Conservation District (UWCD) diverts Santa Clara River water at the Freeman Diversion to recharge groundwater basins and for direct delivery to agricultural users. UWCD provides bypass flows at the Freeman Diversion for the upstream and downstream migration of southern California steelhead. In July 2008, the National Marine Fisheries Service (NMFS) issued a final Biological Opinion that concluded that operations at the Freeman Diversion were likely to jeopardize the continued existence of southern California Steelhead in the Santa Clara River. UWCD is currently developing a multi-species habitat conservation plan and is in consultation with NMFS. The resulting bypass flows are unknown, but the decline in diversions is anticipated to average around 22,000 AFY, though this is highly variable from year to year.

The Santa Clara River Estuary is an important ecological resource in the County. The City of Ventura owns and operates a water reclamation facility that discharges into the Santa Clara River Estuary (SCRE). As the result of a consent decree, a Scientific Review Panel (SRP) was convened in 2017 to determine how much, if any, discharge from the Ventura Water Reclamation Facility (VWRF) is needed to protect and sustain the native and endangered species known to use the SCRE, and/or how much discharge could be eliminated to protect these species and sustain additional priority beneficial uses. The results of their findings can be found at:
https://www.cityofventura.ca.gov/1109/Estuary-Studies

Other creeks and estuaries in the County support threatened and endangered species, but do not currently have set flow requirements.

II. WATER SUPPLY

A. Does a portion of the water supply in your region come from snowmelt? *YES*

Summary: Approximately 25% of the water used in the County is imported from the State Water Project and a portion of that water is derived from snowmelt. A small percentage of snowmelt from higher elevations in the County drains into local creeks, but is not considered to be a significant portion of local water supply to the populated areas of the southern half of the County.

The State Water Project (SWP) is the source of the County's imported water, and a portion of the water delivered by the SWP is derived from snowmelt. The Calleguas Municipal Water District (CMWD) purchases treated State Water and distributes it on a wholesale basis to cities, local water agencies and private and mutual water companies throughout southern Ventura County. Roughly 25 percent of the water used in Ventura County is imported from the SWP, and approximately three-quarters of Ventura County's residents receive imported water from CMWD. Projections by the Metropolitan Water District allow up to 147,013 acre feet of State Water to be allocated to CMWD per year. Ventura County holds an annual allocation of 20,000 acre feet of State Water, on behalf of the City of Ventura (10,000 acre-feet), Casitas Municipal Water District, (5,000 acre-feet) and United Water Conservation District – UWCD (5,000 acre feet). There is currently no infrastructure to deliver that allocation, though United commonly takes their allocation through middle Piru Creek via upstream releases from Pyramid Reservoir.

Local surface water supplies provide approximately eight percent of Ventura County's water supply and are diverted from streams, rivers, and springs. Local surface water sources are not derived from snowmelt. The majority of local surface water diversions occur in the Ventura and Santa Clara River watersheds. Lake Casitas can hold up to 254,000 acre feet of water and is fed by flows diverted from the Ventura River and flows coming into the reservoir directly from Coyote and Santa Ana Creeks. In the Santa Clara River Watershed, the United Water Conservation District uses releases from the Santa Felicia Dam that impounds water in Lake Piru Reservoir that recharges the Piru, Fillmore, Santa Paula, and Coastal groundwater basins. The Freeman Diversion is the largest surface water diversion in the County and is the source of a majority of the recharge to coastal groundwater basins.

Rising snow levels have been documented in the Sierra Nevada in recent years, meaning more precipitation is falling as rain rather than snow over a greater part of Sierra Nevada watersheds (Hatchett et al. 2017). A recent study led by Dr. Alex Hall Director of the UCLA Center for Climate Science suggests a 64% decline in springtime Sierra

snowpack volume by the late 21st century following the RCP (Representative Concentration Pathway) 8.5 (business as usual) scenario (Reich et al. 2018). This loss of water stored as snow could mean reduced reliability of SWP deliveries for water resources in Ventura County.

B. Does part of your region rely on water diverted from the Delta, imported from the Colorado River, or imported from other climate-sensitive systems outside your region? ***YES***

Summary: A significant percentage (25%) of the County's water is derived from water imported from the State Water Project which flows from the Delta.

As described in response A above, roughly 25 percent of the water used in Ventura County is imported from the SWP, which comes through the Sacramento-Bay Delta. In the past, during extreme drought conditions impacting the SWP supplies, Metropolitan Water District has delivered water from the Colorado River to some of its member agencies, such as Calleguas MWD.

C. Does part of your region rely on coastal aquifers? Has salt water intrusion been a problem in the past? ***YES***

Summary: Seawater intrusion into coastal aquifers on the Oxnard Plain has been a significant challenge for nearly 70 years due to overdraft (pumping rates exceeding natural recharge). Local infrastructure projects, such as the Freeman Diversion, a series of groundwater recharge basins and alternative water delivery systems (Pumping Trough Pipeline and Pleasant Valley Pipeline), as well as establishment of the Fox Canyon Groundwater Management Agency and related pumping restrictions, were implemented to help combat seawater intrusion. As a result of passage of the Sustainable Groundwater Management Act, Groundwater Sustainability Agencies are building on past efforts to bring these overdrafted basins into balance. This will be accomplished by reducing pumping and seeking alternative supplies to meet demand and/or recharge the basins, which will help minimize intrusion of seawater, particularly during wet periods.

Groundwater elevations on the Oxnard Plain dropped below sea level as early as the 1930s, and annual overdraft in the southern and eastern portion of the Plain are estimated to be 20,000 to 25,000 acre-feet per year (AFY). This continued overdraft allows seawater intrusion and puts the area at risk of land subsidence. The USGS and UWCD have documented the inland movement of seawater adjacent to the large, near-shore Hueneme and Mugu submarine canyons.

The Oxnard Plain Pressure Basin is the largest and most complex of the groundwater basins in Ventura County. The Oxnard Plain Pressure Basin consists of two major aquifer systems. The Upper Aquifer System (UAS) consists of a single shallow aquifer, known as the Perched and/or Semi Perched, as well as the Oxnard, and Mugu aquifers. The Lower Aquifer System (LAS) consists of, from shallowest to deepest, the Hueneme, Fox Canyon and Grimes Canyon aquifers. The extent of seawater intrusion is greater in the confined aquifers of the UAS than aquifers in the LAS because they are more transmissive and historically were the primary production aquifers on the Oxnard Plain. Policies in the Fox Canyon Groundwater Management Agency have promoted more production from the LAS, which is now severely overdrafted, but these aquifers are less transmissive and more structurally complex, slowing the advance of seawater intrusion in these deeper aquifers. Both the UAS and LAS suffer water quality problems from poorly constructed and improperly abandoned wells.

The Fox Canyon aquifer is the second most developed production zone in the Oxnard Plain Pressure Basin based on the number of wells and depth of perforations. Depth to the main water bearing material averages approximately 580 feet. The Fox Canyon aquifer generally has excellent water quality and high yields, but is subject to seawater intrusion near the Point Mugu and the Hueneme submarine canyons and other forms of saline intrusion such as upwelling brines. Extractions from the Fox Canyon Basin are monitored and allocated by the Fox Canyon Groundwater Management Agency to reduce aquifer overdraft. Efforts to recharge groundwater center on using the Freeman Diversion located on the Santa Clara River, in an effort to recharge more water than is being pumped from the aquifers in order to mitigate the inland intrusion of seawater. Despite these efforts, continued groundwater pumping and drought have contributed to the continued expansion of intruding seawater plumes. In addition to seawater intrusion management efforts, there has been an expansion of pumping and treatment of other wells high in chlorides to remove salts not related to seawater intrusion. The treatment facilities are connected to a Regional Salinity Management Pipeline developed by the CMWD This system removes chloride from groundwater and discharges brine effluents into an ocean outfall off Port Hueneme. Although SGMA requires that the Oxnard Plain be sustainably operated within 20 years, it is uncertain if this project, groundwater recharge efforts, pumping restrictions or other initiatives will be sufficient to reverse historical seawater intrusion impacts. In addition, climate change-related increases in sea level may make coastal agricultural wells more vulnerable to seawater intrusion, potentially increasing the demand for surface and imported water.

D. Would your region have difficulty in storing carryover supply surpluses from year to year? NO

Summary: While there is currently ample capacity in the Region, in local storage reservoirs and groundwater basins, to store surplus water in wet years, this capacity is diminished in a prolonged wet period.

Existing surface storage reservoirs include the Matilija Reservoir, Lake Casitas, Lake Piru and Lake Bard.

- The Matilija Dam was built in the late 1940s for the purpose of providing irrigation water to the western Ojai Valley and originally had a storage capacity of 7,018 acre feet. However, the storage capacity of the reservoir has been substantially reduced by sedimentation and its current capacity is only 500 acre-feet. The majority of the sediment was deposited during a few years with big storm events. The are plans to remove the dam to improve surrounding and downstream ecosystems and over time allow sediments to move down to the ocean.

- Lake Casitas is the largest reservoir in Ventura County with a capacity of 254,000 acre feet. The approximate safe yield is 20,000 AFY. Source water for Lake Casitas is direct rainfall on the lake surface, local watershed runoff from Coyote and Santa Ana Creeks, and diversions of the Ventura River made through the Robles Diversion Facility. The primary purpose of Lake Casitas is to supplement local groundwater supplies. As a result of a persistent six-year drought, reservoir storage in Lake Casitas was drawn down to approximately 30% of capacity as of Fall of 2018.

- The construction of Santa Felicia Dam on Piru Creek in 1955 created Lake Piru Reservoir for the specific purpose of recharging groundwater. The reservoir can now store approximately 82,000 acre approximately 18% lower than the original storage capacity of 100,000 AF. The reservoir receives winter runoff from local drainages and can receive imported SWP water.

- Lake Bard is an approximately 10,500-acre foot surface water reservoir constructed to store treated water from the Metropolitan Water District of Southern California. This water is used to meet emergency demands.

There are limited opportunities in Ventura County to create new surface storage facilities.

Depending upon timing and quantity, additional subsurface storage (groundwater recharge) of surplus water may be feasible. The major groundwater recharge facilities in Ventura County are briefly described below.

- Water from Lake Piru Reservoir is released into Piru Creek and flows to the Santa Clara River where it is joined by runoff from Sespe and Santa Paula Creeks. The releases are used to replenish aquifers, and recharged water is available to municipalities, industry, and agriculture. Generally, a release of water from the reservoir is scheduled in the fall to recharge the Piru, Fillmore, and Santa Paula groundwater basins. The remaining portion of the flows are diverted at the Freeman Diversion for recharge in the Oxnard Forebay and distribution to agricultural users on the Oxnard coastal plain. Releases since 1999 averaged 28,369 AFY with an annual minimum of zero and a maximum of 47,400 AF, dependent on rainfall that year and environmental bypass flow requirements.

- In addition to recharging the Piru, Fillmore, and Santa Paula groundwater basins, water released from Lake Piru provides flows to the Freeman Diversion, which diverts Santa Clara River water to recharge groundwater basins and for direct delivery to agricultural users. In recent years, between 2,500 AF (in 2015) and 94,000 AF (in 2011) has been diverted at the Freeman Diversion. The diverted water is the primary source of recharge to the Oxnard coastal plain.

- To increase groundwater storage and recharge in the Ojai Valley Groundwater Basin, the San Antonio Spreading Grounds Rehabilitation Project was completed in 2014. It was originally projected that the project could increase recharge to the basin by an average of 126 AFY. It has yet to reach that capacity.

E. Has your region faced a drought in the past during which it failed to meet local water demands? *NO*

Summary: In the most recent multi-year climatic drought, which some believe ended in Ventura County with winter rains in 2019, local water demands were met with local surface water, groundwater and imported State Water; there were no serious shortages or need for rationing. Local urban users significantly reduced demand as a result of voluntary conservation, restrictions imposed by water providers, and the state's mandatory reduction targets many of which remain in effect along with tiered rate structures. Agricultural users had adequate water supplies to meet their needs, though local groundwater basins continued to decline due to a combination of lack of recharge and ongoing agricultural irrigation. Agricultural irrigation has become more efficient due to state and local incentives, requirements, and restrictions. It should be noted that the impacts of the drought on local water supplies have continued and in that respect the drought continues. Basins of the coastal plain are still severely depleted, some local declarations remain in place, the County's well moratorium is still in place and Lake Casitas gained only 25,000 AF in storage in the winter of 2018-19.

Adequate water supply is a current and ongoing concern in Ventura County due to climate change and drought. Declines in river flows and reservoir levels, historic overdraft of several local groundwater basins, curtailment of groundwater supplies in the southern portion of the County, new groundwater well prohibitions, and reduced deliveries of imported water, have all resulted in drought-related reductions in available water supplies. More than 850,000 residents and 156 square miles of irrigated farmland in the County have experienced direct impacts from the drought that began in 2012. To reduce the risk of water supply shortages, major water suppliers in Ventura County implement water demand management measures during normal water supply conditions, and implement additional measures during periods of drought.

Through the implementation of water demand management programs, local water supply districts have been able to meet local water demands. However, on-going drought conditions have affected some portions of the County more than others. For example, the Piru and Fillmore groundwater basins saw significant recovery, while the Oxnard and Pleasant Valley basins did not. A significant factor impacting recovery in the Oxnard Plain and Pleasant Valley basins was new environmental restrictions on diversion from the Freeman Diversion. In another example, due to lack of distribution infrastructure and required agreements, imported water cannot be delivered to western Ventura County where groundwater is very limited. Recharge to groundwater is primarily from Ventura River flow and smaller amounts from direct precipitation, percolation from small creeks and channels. The groundwater in the area is relatively shallow and responds quickly to rainfall or lack thereof. Wells operated by the Meiners Oaks Water District have gone dry due to low water levels in the Ventura River and the District is now entirely dependent on purchases of Lake Casitas water. In 2015, the Ventura River Water District had only one of its four wells still in operation and the District's customer needs were being served primarily through purchases of Lake Casitas water supplies. Since 2011, purchases of Lake Casitas water have increased by 1,000 percent. The lake is an important, but dwindling, water resource that has both water quality and water supply concerns. The water level in Lake Casitas dropped below 40 percent of its "full" volume since the onset of the six-year drought in 2012.

F. Does your region have invasive species management issues at your facilities, along conveyance structures, or in habitat areas? *YES*

Summary: Invasive species of flora and fauna are found in all three of the Region's major watersheds. These invasive species pose a significant challenge which local, state and federal entities are working to address. It is expected that climate change stressors will exacerbate these issues.

Riparian resources along major waterways in Ventura County, primarily the Ventura and Santa Clara Rivers, have become infested with an invasive grass species known as giant reed (*Arrundo donax*). This grass readily invades riparian channels, especially in disturbed areas, is very competitive, difficult to control, and generally does not provide food or nesting habitat for native animals. The removal of established stands of this plant can be very difficult, however, its removal provides numerous native species habitat, wildfire protection, water quantity, and water quality benefits.

Quagga mussels *(Dreissena rostriformis)* are a highly invasive mollusk that can range in size from microscopic to about two inches in length. The destructive mussels can reproduce rapidly, resulting in clogged water intake structures, distribution works, pumps and pipes. Quagga mussels were first found in Lake Piru in 2013. In August 2017, the mussels were discovered in the Santa Clara River under bridges in Santa Paula and Piru. In September 2017, additional mussels were found at the Santa Paula site, and in October 2017 the mussels were discovered under creek cobbles near Piru, just upstream from the Santa Clara River.

Within the Santa Monica Mountains, there are a number of invasive species that are of concern to land managers. The invasive Polyphagous shot hole borer is becoming a prevalent issue. The wood-boring beetle attacks dozens of tree species in Southern California, including commercial avocado groves, common landscape trees, and native species in urban and wildland environments. Measures for handling downed trees and mulch via appropriate chipping/solarizing/disposal and movement of wood materials (firewood, compost, mulch) helps controls its spread. Extensive tree die-off increases fire and flooding risks.

Fountain Grass (*Pennisetum setaceum*) has invaded the coastal bluffs and dune habitats of the County's South Coast. Native to north Africa, fountain grass is a billowy garden plant topped with plumes resembling little foxtails. In California, its seed blows out of gardens and hightails into wildlands. It is seen as similar to the invasion of "Pampas Grass" along the Big Sur Coast; disrupting natural vegetative communities, producing low quality pollen for insects, producing seeds that animals do not eat, creating fire prone areas.

The New Zealand mudsnail (*Potamopyrgus antipodarum*) is an aquatic invasive species that was first found in the United States in Idaho in the 1987 and has since spread to every Western state except New Mexico. They appeared in California in the late 1990s in the Owens River, and were found in southern California in Malibu Creek in 2005 and in Piru Creek in the Santa Clara River watershed in 2006. Since their discovery in Malibu Creek, they have spread to several streams in the Santa Monica Mountains, where a single female and her offspring are capable of yielding 40 million individuals in a year.

Argentine ants (*Linepithema humile*) are widespread through the County, also occurring on Santa Cruz Island. The ants have significant impacts on the functioning of an ecosystem, because of their strong competitive ability and broad diet. Argentine ants impact the native invertebrate community through direct predation, competition, interference, and egg predation. Native ants are particularly vulnerable and are largely eliminated in the presence of Argentine ants. "Argentines in particular increase the abundance of aphids," as the ants protect the aphids as they suck sap from plants, which they then process into a sugary substance the ants subsequently ingest.

III. WATER QUALITY

A. Are increased wildfires a threat in your region? If so, does your region include reservoirs with fire-susceptible vegetation nearby which could pose a water quality concern from increased erosion. *YES*

Summary: Increased frequency and intensity of wildfires in the Region are an anticipated effect if climate change; one which is already occurring. The watersheds and drainages surrounding the area's major water reservoirs (Casitas and Piru) have burned in recent fires, leading to increased erosion during the rainy season. This resulted in increased sedimentation and water quality concerns. Future increases in wildfire activity would be an added threat to water quality.

The chaparral ecosystem of coastal southern California remains ignition limited. This means for a period in most summer and autumn seasons, the area is susceptible to wildfire and only lacks an ignition, which is typically human-caused (Keeley et al. 2017). Large fires in California shrublands are driven – or made larger - primarily by weather, such as Santa Ana winds, sundowner winds, and multi-year droughts. Both fire frequency and length of the fire season are anticipated to increase in southern California. One of the primary drivers of these changes is a type conversion from shrublands to grasslands. Grasses can dry quickly and are susceptible to wildfire throughout the year. These vegetation shifts are associated with various human activities on the landscape (Syphard et al. 2018).

Increased fire hazards associated with vegetation type conversion are compounded by climate factors and population growth. An increasing number of dry days (Polade et al. 2014) and a shift towards drier autumn and spring seasons in southern California (Swain et al. 2018) coupled with temperature increases (described in section I.C.) also contribute to an extension of the wildfire season. Projected population growth in Ventura County and at the wildland urban interface (Radeloff et al. 2018) creates conditions favorable for more frequent wildfires and shifting in timing of wildfire

impacts (Keeley et al. 2016). The 2017 Thomas Fire ignited in early December and the 2018 Woolsey and Hill fires beginning on November 8 are likely associated with a combination of the aforementioned changes. While fires this late in the year are not unprecedented, these dates are outside of the region's peak fire season.

Wildfire burn severity is a critical factor in assessment of post-fire debris flow hazards (USGS 2018) and enhanced erosion following a wildfire (which can lead to reservoir sedimentation). While most of the western US is anticipated to experience little change or a decrease in burn severity in the future, some areas of Ventura County have a potential for slightly increased burn severity (Parks et al. 2016). Fire risk is increased by a lengthening fire season, allowing more opportunities for wildfire and potential increases in fire intensity.

Short duration, high intensity rainfall is another key factor in initiating post-wildfire debris flows (USGS 2018). Results from Prein et al. (2017) and preliminary unpublished analyses by the Desert Research Institute indicate an increase in short-duration, high-intensity rainfall events in the area under a warmer climate. Increased fire frequency and/or intensity coupled with more frequent intense precipitation events is likely to increase sediment loads in water infrastructure and impact water quality.

In December 2017 the Thomas Fire burned a total of 281,893 acres in Ventura and Santa Barbara Counties, including slopes adjacent to the western and southern shores of Lake Casitas. The areas adjacent to the lake that burned are designated as a Very High Fire Hazard Severity Zone (VHFHSZ) by Cal Fire (2010). Lake Piru in eastern Ventura County is the other major water storage reservoir in the County, and areas surrounding the Lake also have a VHFHSZ designation. A small wildfire in June 2018 burned approximately 100 acres located north of and adjacent to the lake. A major impact of these fires has been increased turbidity at the Robles Diversion, resulting in very low diversion capacity. This is a significant water quality issue impact of the fires.

B. Does part of your region rely on surface water bodies with current or recurrent water quality issues related to eutrophication, such as low dissolved oxygen or algal blooms? Are there other water quality constituents potentially exacerbated by climate change? ***YES***

Summary: Lake Casitas, the source of water for more than 70,000 people in the Region, has experienced periods of algal blooms and low levels of dissolved oxygen during extended droughts. Water quality, primarily turbidity, in the reservoir is also at risk in the years following a wildfire that burns much of the watershed, as occurred with the Thomas Fire in 2017. Climate change stressors will likely exacerbate water quality issues.

Casitas Reservoir (Lake Casitas), the source of water supply for more than 70,000 people in western Ventura County, was at risk of water quality issues related to eutrophication due to the drought that began in 2012. Imported water cannot currently be delivered to western Ventura County due to the lack of required infrastructure, and groundwater is very limited in some portions of the Casitas service area. Water agencies that typically get all or part of their water from wells have had to start purchasing Lake Casitas water because their wells have run dry. During the drought, purchases of Lake Casitas water have increased by 1,000 percent. The lake is an important resource threatened by both water quality and water supply concerns.

In 2018, the first time since 1968, storage in Lake Casitas dropped below 35 percent of capacity. Historically, low water levels in 1968 resulted in significant thermal stratification and anoxic (low dissolved oxygen content) conditions. The low oxygen levels created an environment where manganese and hydrogen sulfide that is normally trapped in sediments became soluble, causing the lake water to have a brown color and a bitter metallic taste. There were also large blue-green algae blooms. Normally creek inflows provide supply and facilitate lake mixing, which helps maintain good water quality. Inflows had significantly decreased since 2012, causing the lake to stratify and stagnate. The Casitas Municipal Water District added aeration facilities in 2017 to combat the water quality effects from the drought.

Two major climate change stressors that are likely to lead to exacerbated water quality concerns are more frequent/intense droughts and wildfires and an increase in intensity of precipitation. In general, water quality degradation can be expected to occur during extended droughts in areas that rely on fresh water inflows. Water quality degradation can be expected to occur as a result of erosion from runoff in areas experiencing significant rain events following a wildfire. An increase in temperatures will likely result in more frequent eutrophication, algal blooms and low dissolved oxygen in surface waters.

C. Are seasonal low flows decreasing for some water bodies in your region? *YES*
If so, are the reduced low flows limiting the waterbodies' assimilative capacity? *NO*

Summary: Water levels at Lake Casitas, the County's largest water supply reservoir, declined to historic low levels due to lack of inflow from tributaries and precipitation related to the drought. Due to the large size of the reservoir these low flows have not limited the reservoir's assimilative capacity.

The largest reservoir in the County is Lake Casitas, with a capacity when full of 238,000 acre-feet. As described in response III.B above, reduced surface water flows into Lake Casitas due to the recent drought resulted in impacts to the quality of water stored in

the lake, and lake conditions required the implementation of measures to minimize the potential for water quality impacts.

The assimilative capacity of Lake Casitas has not yet been limited by seasonal low flows.

D. Are there beneficial uses designated for some water bodies in your region that cannot always be met due to water quality issues? *YES*

Summary: There are water quality impairments impacting beneficial uses in all three of the major watersheds in the Region. A number of Total Maximum Daily Limit (TMDL) standards are being implemented in each watershed.

The Los Angeles RWQCB has identified beneficial uses for waterbodies in the Ventura River, Santa Clara River, and Calleguas Creek Watersheds.

Ventura River Watershed. Designated beneficial uses of waterbodies in the Ventura River Watershed include various urban and agricultural uses, and a wide range of habitat- and wildlife-related uses. Total Maximum Daily Limit (TMDL) standards have been established for algae, eutrophic conditions and nutrients, which impair the Ventura River, its tributaries, and its estuary. A TMDL for trash has also been established for the Ventura River estuary. In addition to the existing TMDLs, several Ventura River Watershed areas are included in California's 303(d) list of impaired waters. Identified impairments in the Ventura River and its tributaries include total dissolved solids, aluminum, and mercury. Rincon Beach and the Ventura Harbor are listed for impairments due to bacteria. The Ventura Marina jetties are listed as impaired with DDT and PCBs (persistent organic pollutants).

Santa Clara River Watershed. Designated beneficial uses of waterbodies in the Santa Clara River Watershed include various urban and agricultural uses, and a wide range of habitat- and wildlife-related uses. TMDLs have been established for bacteria in the Santa Clara River Estuary and the river reaches between Fillmore and Saticoy, and between the Los Angeles County line and 4,500 feet into Ventura County. A TMDL for chloride has been established for the river reach between Fillmore and Saticoy, and for a small portion of the Upper Santa Clara River that is located in Ventura County. In addition to the existing TMDLs, several Santa Clara River Watershed areas are included in California's 303(d) List. Impairments in the Santa Clara River and its tributaries include chloride, trash, pH, sulfates, selenium, total dissolved solids, and toxicity. The Santa Clara River Estuary is considered impaired by Toxaphene (a pesticide), ammonia, and multiple pesticide chemicals generally referred to as "Chem A". The McGrath Beach area is considered to be impaired by coliform bacteria and toxic sediments.

Calleguas Creek Watershed. Designated beneficial uses of waterbodies in the Calleguas Creek Watershed include various urban and agricultural uses, as well as habitat- and wildlife-related uses. TMDLs for the following have been established for Calleguas Creek: metals, selenium, salts, toxicity, organochlorine pesticides and PCBs, and nitrogen compounds and related effects. Other waterbodies in the Calleguas Creek Watershed that have adopted TMDLs include: Mugu Lagoon and tributaries to Calleguas Creek for metals and selenium; the Revolon Slough and Beardsley Wash for trash; and Oxnard Drain 3 for pesticides, PCBs and sediment toxicity. In addition to the existing TMDLs, other impairments in the Calleguas Creek Watershed include ammonia, boron, copper, bacteria, nitrogen, nitrate, selenium, sulfate, insecticides, and pesticides such as DDT, Dieldrin, and Toxaphene. The Channel Islands Harbor area is limited by lead and zinc in sediments, and several Oxnard area beaches are limited by bacteria.

Chumash Creek, formerly named J Street Drain, is impaired by trash. Coyote Creek on the Oxnard Plain is impaired for pesticides and metals. Hueneme Drain is impaired by trash and bacteria. Parts of Ventura Harbor are impaired by arsenic, pesticides, PCBs, and bacteria. Ormond Beach Wetlands is impaired by bacteria, trash, and pH.

E. Does part of your region currently observe water quality shifts during rain events that impact treatment facility operation? *YES*

Summary: Major nitrogen (nutrient) contributors to the Ventura River include wet-weather runoff from urban areas and flow into the Ojai Valley Sanitary District Wastewater Treatment Plant.

As described in response III.D above, the Ventura River is impaired by elevated nutrient levels. Major nitrogen (nutrient) contributors to the Ventura River were identified by the Los Angeles RWQCB and include wet-weather runoff from urban areas and inflow to and discharges from from the Ojai Valley Sanitary District Wastewater Treatment Plant. The algae TMDL for the Ventura River sets limits on the amount of nutrients that can be discharged from various sources and requires upgrades to the sewage treatment plant and widespread implementation of BMPs to limit sources of nitrogen from the river.

IV. SEA LEVEL RISE

A. Has coastal erosion already been observed in your region? *YES*

Summary: The Region has long experienced coastal erosion which has required coastal armoring, rock revetments and seawalls to protect public and private property including housing, water/wastewater infrastructure and roadways.

The Ventura County coast has a long history of erosion and shoreline changes. To protect important transportation, recreation, wastewater infrastructure, and private residences, over 18 miles of coastal armoring, rock revetments and seawalls have been constructed. Three examples of on-going coastal erosion issues are described below.

Highway 101 and Rincon Parkway. Highway 101 is the major transportation corridor in the County. In the northern portion of the County, the highway fronts the coast where it is heavily armored with revetments. Almost the entire length of the Rincon Parkway, which is the coastal highway that existed before the current Highway 101 was constructed, is also armored. This armoring limits beach access and the beach is almost non-existent at high tide. In addition, erosion has occurred along unarmored areas such as Rincon Point, where there is a very narrow strip of "beach" remaining between the homes and ocean.

Surfer's Point. Ongoing erosion at Surfer's point in the City of Ventura has resulted in substantial damage to recreation facilities, an important regional bicycle path, and the County Fairground parking lot. After substantial damage to these facilities in the 1990s, rather than installing a seawall or other coastal armor, a plan was approved to move the parking lot, a pedestrian path and bicycle pathway from the ocean. Phase 1 of the project was completed in 2011 and has become an excellent example of managed shoreline retreat. Storms during the 2015-16 El Niño (extreme high sea levels are most often observed during El Niño conditions) did not cause any damage to the relocated facilities. Immediately adjacent downcoast facilities continue to be damaged by on-going erosion. Phase II of the Surfers Point Managed Retreat Project is supposed to address this section. The preliminary design for Phase II was approved by the landowner and City of Ventura in 2019.

Ventura Harbor and Channel Islands Harbor. Historic erosion has occurred downcoast of the Ventura and Channel Islands Harbors when disruptions in harbor dredging to remove accumulated sand have occurred. During the 1982-83 El Niño, substantial damage at Oxnard Shores, Hueneme Beach and at the Hueneme Harbor occurred due to a reduction in beach sand. In addition, the southern end of Silverstrand Beach has a higher erosion rate than Hollywood Beach, which requires filling in lower areas when maintaining the beach. Erosion along the coast of the Naval Base Ventura County continues to threaten military structures.

Point Mugu and Pacific Coast Highway. Caltrans has applied for emergency permits and is planning improvements to address erosion at beaches and revetments that have resulted in damages and closures of Pacific Coast Highway along areas of Thornhill-Broome Beach and Sycamore Cove in Point Mugu State Park as recently as 2018. Secant

walls are being planned to augment and reinforce existing revetments, and the 81-year old bridge over Sycamore Creek needs to be replaced.

B. Are there coastal structures, such as levees or breakwaters, in your region? *YES*

Summary: There are many coastal structures in Ventura County, including groins, breakwaters and levees constructed to protect public and private coastal property and facilities.

As described by response IV.A, over 18 miles of coastal armoring, rock revetments, and seawalls have been constructed along the Ventura County coast to protect transportation, recreation, wastewater infrastructure and private residences. Other coastal structures, including beach groins, breakwaters, and levees have also been constructed. Beach groins along the Pierpont Bay neighborhood were constructed in the 1940s due to beach erosion caused by the construction of the Santa Barbara Harbor and a resulting decrease in downcoast sand transport. Breakwaters have been constructed at the entrances of the Ventura, Channel Islands, and Hueneme Harbors.

There are 5.17 square miles in Ventura County that are protected from 100-year floods by levees. Levees have been constructed along the Santa Clara River, Ventura River, and Calleguas Creek to protect coastal resources. In 1969, a break in the Santa Clara River levee threatened the City of Oxnard. In 1980, Calleguas Creek breached its levee on the Oxnard Plain, which resulted in extensive flooding and sediment damage at the Point Mugu Naval Base. http://www.vclevees.com/

C. Is there significant coastal infrastructure, such as residences, recreation, water and wastewater treatment, tourism, and transportation, at less than six feet above mean sea level in your region. *YES*

Summary: Numerous structures and other infrastructure are threatened by rising sea levels in the Region.

An assessment of impacts to coastal infrastructure that would result from varying amounts of seal level rise is described by a report titled *Ventura County Resilient Coastal Adaptation Project Vulnerability Assessment* (Revell Coastal, LLC, 2018). The report determined that a 16- to 58-inch rise in sea level, combined with a one percent annual chance storm, would result in extensive erosion and coastal flooding to infrastructure in the unincorporated areas. Examples of potential structures and infrastructure resulting from a sea level rise of up to 58 inches are summarized below.

- 2,187 structures are at risk of coastal flooding, 1,513 structures are at risk of coastal erosion, and 930 structures are at risk of tidal inundation.

- 59 wastewater manholes are at risk of tidal inundation, erosion or flooding, and an active waste discharge site at Sycamore Cove Beach is at risk of tidal inundation.

- Two water supply pump stations in Hollywood Beach are at risk of tidal inundation, and 23 ground water supply wells are at risk of coastal flooding.

- 16.5 miles of road are at risk of coastal flooding, and 8.25 miles of road are at risk of tidal inundation. 2.6 miles of rail alignment are at risk of coastal flooding along the County's North Coast.

- All vertical beach access points are at risk of erosion and flooding, and 17.6 miles of trails are at risk of flooding, including segments of the Coastal Trail that are on beaches.

- Naval Base Ventura County (Point Mugu and Port Hueneme) is vulnerable to tidal inundation and storm flooding form the Calleguas Creek and Revlon Slough

In addition to the identified structure and infrastructure, impacts, coastal and beach access is an important recreation and economic factor in Ventura County. It is estimated that the County has over three million beach day visits per year, resulting in a total economic value of over $156 million per year. Climate change-related reductions in beach access would adversely affect recreation opportunities and revenues in Ventura County.

The *Ventura County Resilient Coastal Adaptation Project Vulnerability Assessment* also evaluated potential impacts to critical facilities, including medical, fire, sheriff, and other facilities. The assessment determined that only North Coast Fire Station No. 25 could be exposed to coastal flooding with about five feet of sea level rise. Evacuation routes along the North Coast Highway 101, and South Coast Pacific Coast Highway 1, and for Silverstrand would be exposed to coastal flooding and erosion. With approximately five feet of sea level rise, 4.7 miles of evacuation routes across the County will be exposed to coastal flooding; 0.4 miles will be subject to coastal erosion; and 2.2 miles will be exposed to routine tidal inundation.

The City of Oxnard is in the process of updating their Local Coastal Plan and have conducted a vulnerability assessment for sea level rise and the related economic impacts. According to a summary report published by the City – "the Sea Level Rise

Vulnerability Assessment and Fiscal Impact Report was prepared to address sea level rise, associated hazards, and their economic impact in the City of Oxnard to inform the LCP update process as well as future planning and regulatory processes. The vulnerability assessment relies on Coastal Resilience modeling funded by The Nature Conservancy, the County of Ventura, and the State of California. The vulnerability assessment evaluates hazards to each planning area based on high SLR scenarios at three planning horizons: 2030 (8 inches), 2060 (25 inches) and 2100 (58 inches)."

D. Are there climate-sensitive low-lying coastal habitats in your region? *YES*

Coastal areas of Ventura County support a variety of sensitive habitats, including beaches, dunes, estuaries, bluffs, native woodlands, and freshwater habitats. If Ventura continues to experience drier seasons with more frequent fires, the more area consumed by fire annually may result in grasslands advancing into the simulated historical range of woodlands and shrublands of the County. The effect of fire will likely interact with climatic change, where the survivorship of woody plants will be dependent upon their life history strategies. Research suggests that the biological thresholds of dominant species will play a crucial role in the vulnerability of California terrestrial ecosystems[1]. In addition, numerous sensitive animal species like the Western Monarch Butterfly, Southwestern Pond Turtle, Steelhead, and others are likely to be negatively impacted by climate change, and those that succeed will be dependent upon which life history strategies the most beneficial, and which management actions can be implemented. For species of concern, including those that only occur in California, protecting both current populations and locations where they can live in the future may be critical to long-term survival. Large, well-connected areas of natural and working landscapes will have a strong influence on local climate diversity and resilience. The County's rugged terrain creates variable conditions, including colder air in valley bottoms, hot dry south-facing slopes, and mesic north-facing slopes that can enhance the resilience of sensitive habitats in the face of climate change. Enhanced connectivity between protected areas could provide important migration pathways for plants and animals adapting to climate change.

The *Ventura County Resilient Coastal Adaptation Project Vulnerability Assessment* predicts that with a 58-inch rise in sea level, approximately 28 percent of the unincorporated County's freshwater habitats (755 acres out of a total of 2,701 acres) are vulnerable to tidal inundation during a 100-year storm. Of the 755 acres of freshwater habitat projected to be at risk for inundation by a 58-inch rise in sea level, roughly half of that area (404 acres) is now currently at risk of inundation during an

[1] Cornwell, W.K.; S.A.Stuart, A. Ramirez, C.R.Dolanc, J.H.Thorne, D.D.Ackerly. 2012. Climate change impacts on California vegetation: physiology, life history, and ecosystem change. A white paper from the California Energy Commission's California Climate Change Center – CEC-500-2012-023.

extreme monthly high tide condition. It is also projected that with a 58-inch rise in sea level, approximately 35 percent (51 acres of a total of 146 acres) of the unincorporated beach areas would be at risk of inundation. Sandy beach habitats are likely to be replaced by rocky intertidal zones or remaining beaches will be narrower and steeper. These changes are expected to negatively affect critical breeding habitats for a species like the California grunion or shorebirds such as the Western Snowy Plover or California Least Tern.

Approximately 54 percent (61 acres out of a total of 113 acres) of the unincorporated estuarine habitat would be at risk for inundation. The major impacts to estuarine habitat are projected to occur at small creek estuaries (Rincon Creek, Sycamore Cove), while due to the location of the County's jurisdictional boundaries, which are set back from the coast, the larger estuaries of the Santa Clara or Ventura Rivers have smaller percentages of habitat subject to tidal inundation.

Dune habitats are the least likely to be affected by tidal inundation, with only six percent (11 acres out of a total of 173 acres) subject to potential inundation impacts. Most of the dune acreage in the unincorporated area are back dunes that are located inland from the beach. Although, the majority of the County's foredune habitats are located on Hollywood Beach. These foredunes are projected to erode by 8-inches of sea level rise and be significantly tidally inundated by 58-inches of SLR. The Assessment also found the following USFWS designated critical habitats will likely be impacted by SLR hazards (erosion, tidal inundation, coastal flooding): Western Snowy Plover, Ventura Marsh Milk Vetch, Southwestern Willow Flycatcher, and Tidewater goby; with the critical habitat on Hollywood Beach projected to be currently subject to all sea level rise hazards.

E. Are there areas in your region that currently flood during extreme high tides or storm surges? *YES*

Ventura County has 43 miles of coastline that is subject to tidal flooding, storm surge, and wave action. Low-lying coastal areas of Ventura County, such as Ventura Harbor, Rincon Beach and Faria Beach along Highway 1, and the Oxnard Shores area are vulnerable to flooding associated with El Niño-related storm surges, which can be 0.5 to 1 foot above normal conditions. According to the Federal Emergency Management Agency, a winter storm during the strong El Niño of 1997-1998 caused storm damage totaling approximately $50,000,000.

As described above, the County of Ventura recently completed a sea level rise vulnerability assessment. According to the report, "the 2018 VC Resilient Coastal Adaptation Vulnerability Assessment provides Ventura County (County) with a science-

based vulnerability assessment that evaluates a variety of resources and infrastructure in the unincorporated coastal areas of the county and the risk of future damage associated with coastal hazards (high tides, erosion, and storm flooding) and sea level rise. This Report will be used to support community discussions on existing and future hazards, identify potential adaptation strategies that can reduce the risk of future damage, and guide land use goals, policies and programs.

Rising sea levels alone will not be the primary cause of damage to County resources and infrastructure. These impacts will be caused by coastal process hazards, particularly coastal erosion and coastal flooding, that occur during large wave events. Over time with sea level rise, the episodic storm event impacts will become more routine and predictable as high tides inundate county lands with more depth and frequency. This Report examines the impact of coastal erosion, coastal flooding and high tides on County resources and infrastructure and how these will change over time with sea level rise. Because of the different shoreline orientations in the County, it is highly unlikely that a single storm wave event would affect all shorelines simultaneously during a high tide".

F. Is there land subsidence in the coastal areas of our region? *YES.*

The Oxnard Plain portion of Ventura County is experiencing subsidence. The causes of the subsidence are likely groundwater extraction rates and deeper oil/water/brine extraction by the petroleum industry, though no specific studies have been done to measure these impacts. Groundwater levels have dropped to as much as 55 feet below sea level. The U.S. Coast and Geodetic Survey has monitored this situation since the 1930s. Up to 1965, one large area of the Oxnard Plain was subject to subsidence of between 0.04 and 0.05 feet per year. A single point located at Hueneme Road and Highway 1 has dropped 1.5 feet in just 21 years. Records to 1968 show a dozen benchmarks that indicate the ground may have settled a foot in a fifteen to twenty-year period (County of Ventura, 2013).

G. Do tidal gauges along the coastal ports of your region show an increase over the past decades? *YES*

Ventura County is located between the Santa Barbara and the Santa Monica tide gauges. The Santa Barbara gauge has shown that the local seal level rise rate is approximately 1.01 (+/-1.17) millimeters per year. This tide gauge, however, has been subject to intermittent damage from storms. The Santa Monica gauge shows a higher rate of sea level rise, 1.51 (+/- 0.34) millimeters per year, with a longer more consistent record that averages about a half an inch of sea level rise per decade.

V. FLOODING

A. Does critical infrastructure in your region lie within the 200-year floodplain? *YES*

Climate Change and Flood Risk

Climate models disagree on the magnitude and sign of precipitation changes in California, though generally express small mean precipitation changes (Hall et al. 2018). Models do, however, generally agree on an increasing number of zero-precipitation days in southern California (Polade et al. 2014). To maintain precipitation totals similar to the historic period, this means that a greater amount of precipitation must fall in a shorter amount of time (in fewer days), suggesting an intensification of storms. Espinoza et al. (2018) found that atmospheric rivers will likely be fewer over southern California, but have greater moisture transport and longer durations than in the historic period. Preliminary analyses by the Desert Research Institute indicate an approximately 5-15% increase in contribution of the wettest 5% of days to total precipitation over Ventura County by the late 21st century. Hourly precipitation extremes are also projected to increase over the region (Prein et al. 2017). An increase in extreme precipitation events may make Ventura County more susceptible to flooding. Changes in the frequency and magnitude of precipitation events may also overwhelm infrastructure designed to historic precipitation observations.

Critical Infrastructure in Floodplains

The Department of Water Resources has not mapped 200-year floodplains in Ventura County, however, the Federal Emergency Management Agency has delineated 100- and 500-year floodplains. The *Ventura County Multi-Hazard Mitigation Plan* (Ventura County, 2015) includes a flood exposure analysis for the entire County for both 100- and 500-year flood conditions.

Critical infrastructure in Ventura County located within a 100-year floodplain includes: three emergency response facilities, including Fire Station No. 22 and 25; 82 public utility facilities, including pump stations, electric substations, potable and waste water facilities, wells, dams, and reservoirs; and 107 transportation facilities, including bridges, the Ventura County Airport, and transit stations. The number of critical infrastructure facilities located within a 500-year floodplain increases substantially compared to 100-year flood conditions. For example, facilities located within the 500-year floodplain include: 27 additional emergency response facilities; 49 additional public utility facilities; and 23 additional transportation facilities.

B. Does part of your region lie within the Sacramento-San Joaquin Drainage District? *NO.*

Ventura County is located south of the Sacramento-San Joaquin Drainage District.

C. Does *aging* critical flood protection infrastructure exist in your region? *YES*

Levees have been developed in Ventura County to provide flood protection for agricultural and urban areas. Urban levee systems that are shown to provide protection from a 100-year storm must be documented to demonstrate compliance with the Federal Levee Certification requirements. The *Ventura County Multi-Hazard Mitigation Plan* (2015) includes an evaluation of potential impacts from levee failure, and describes recent levee evaluation actions taken by the County. This information is summarized below.

In November 2009, the Ventura County Watershed Protection District (VCWPD) completed federally mandated engineering evaluations of nine provisionally accredited levees (PALs) within the Calleguas Creek, Santa Clara River, and Ventura River watersheds. The VCWPD also submitted Levee Certification Report compliance documentation packages to FEMA for three of the nine PAL-designated levees. At the same time, PAL-Response Reports were submitted to FEMA for the remaining six PAL-designated levees. The PAL-Response Reports indicated that in their current condition, those six levees could not be certified by the VCWPD before FEMA's 2009 compliance submittal deadline. Subsequently, two additional levee systems were added to the list of six levees requiring rehabilitation work to be fully compliant with federal levee certification regulations. http://www.vclevees.com/. The VCWPD has received state Levee Assistance grant funding to repair these levees.

D. Have flood control facilities (such as impoundment structures) been insufficient in the past? *YES*

Structural works are the traditional means of alleviating flood hazards, however, such facilities are extremely costly and are rarely able to keep up with development. Other preventive measures for alleviating flooding hazards include public acquisition of floodplain lands, public information programs, and development policies and regulations. The most effective means of preventing flood damage appears to be natural floodplain management and the regulation of the types of activities, such as urban development, permitted in flood hazard areas. Natural floodplain management addresses the problems encountered in the utilization of floodplains and considers the total spectrum of possible solutions to problems involving possible future land uses. Natural floodplain management cannot, however, protect all existing development. Therefore, to provide for the maximum alleviation of the flood hazard, a combination of corrective and preventive measures is necessary.

The largest and most damaging recorded floods in the Santa Clara and Ventura watersheds occurred in 1969. The combined effects of the 1969 flood were disastrous:

thirteen people lost their lives, a break in a Santa Clara River levee threatened the City of Oxnard, and property damage was estimated to be $60 million in 1969 dollars. Adjusted for inflation, this equates to approximately $411 million in 2018 dollars. In 1980, Calleguas Creek breached its levee on the Oxnard Plain, which resulted in extensive flooding and sediment damage at the Point Mugu Naval Base. In 2005 destructive flooding occurred along both the Ventura and Santa Clara Rivers causing substantial property damage along the Ventura River and damaging a runway at the Santa Paula Municipal Airport which is adjacent to the Santa Clara River.

E. Are wildfires a concern in parts of your region? *YES*

Wildfires are a common occurrence in Ventura County. Between 1965 and 2015, 23 wildfires that each burned more than 10,000 acres occurred in the County. Most recently, in December 2017 and January 2018, the Thomas Fire burned a total of 281,893 acres in both Ventura and Santa Barbara Counties. Cal FIRE has mapped Fire Hazard Severity Zones (FHSZ) in Ventura County. Within the County, approximately 82 square miles have been designated as a High FHSZ, and 504 square miles are in the Very High FHSZ. Decisions associated with leaving areas of natural communities for wildlife and ecosystem services are increasingly becoming debated as the climate changes (e.g., riparian areas located in the wildland-urban interface). Conversations associated with the wildland-urban interface and vegetation management within these areas will be a major issue as the climate changes. A major strategy to allow natural systems to adapt to a changing climate is to ensure connectivity between protected areas to provide important migration pathways for plants and animals adapting to climate change. In Ventura County, most of these areas fall within the wildland-urban interface.

See section III.A.

VI. ECOSYSTEM AND HABITAT VULNERABILITY

A. Does your region include inland or coastal aquatic habitats vulnerable to erosion and sedimentation issues? *YES*

The response of Southern California's coastal systems to ongoing climate change is highly uncertain. Predicting wetland response is challenging given the complex processes at work in coastal areas. In general, wetland response is determined by the ability of that system to keep pace with sea level rise, where systems that have high sediment inputs or higher elevation areas to migrate to are less vulnerable than those that cannot gain elevation. There are a number of site-specific drivers that maintain elevation in a coastal aquatic habitat. They include: vertical land motion from plate tectonics, compaction/subsidence, fluvial sediment discharge, and biological marsh

accretion. These site-specific drivers are also influenced by processes such as sea level rise, interdecadal climate oscillations and estuary mouth dynamics. These factors must also be considered when predicting coastal aquatic habitat vulnerability (Doughty, C. et al. 2017).

In general, the County has six types of coastal aquatic habitats. Small creek systems (Rincon Creek, Sycamore Cove), small lagoon without an associated creek (McGrath Lake), Open Harbors (Ventura and Channel Islands Harbor), Intermittently opened estuaries (Ventura River), Large river valley estuary (Santa Clara River), and Large perennially open lagoon (Mugu Lagoon). Most of these coastal aquatic systems will require additional sea level rise/climate change planning across multiple jurisdictions to understand what the ecosystem's vulnerabilities are and how they are likely to respond to climate change effects.

High flow storm events, particularly storms that effect recent wildfire burn areas, can cause substantial erosion and increased sediment loads that have the potential to result in adverse changes to the bottom profile and substrate composition of aquatic habitats. These conditions can cause an increase in the elevation of estuary or freshwater habitat, and a decrease in overall water depth and quality.

Following wildfires, endangered aquatic species can be threatened in local creeks and rivers due to sediment and toxic ash. In 2016 The federal Fish and Wildlife Service collected unarmored threespine stickleback fish in Soledad Canyon in the Upper Santa Clara River Watershed after the Sand fire. The fish were then temporarily stored at the Fillmore Fish Hatchery until suitable habitat could be found to relocate them. More conditions and scenarios like this may occur with increased fire and flooding.

B. Does your region include estuarine habitats which rely on seasonal freshwater flow patterns? *YES*

The County's floodplains drain into five major coastal wetlands and smaller two creek estuaries:

McGrath Lake Wetlands. These wetlands are located on the City of Oxnard's western city limits with a portion falling within Ventura County and extend south from the Santa Clara River. A small lake within the wetlands attracts more than two hundred species of birds.

Mugu Lagoon. The Mugu Lagoon is located within Point Mugu Naval Base, eight miles southeast of the City of Oxnard. The lagoon consists of 1,474 acres of wetlands that are

fed by Calleguas Creek. There is also a tidal connection through an inlet in the barrier beach. Numerous special-status species rely on habitat provided by the lagoon.

Ormond Beach Wetlands. These wetlands are divided by the City of Oxnard and Ventura County between the Port of Hueneme and the Point Mugu Naval Base. A former metal smelting operation in this area resulted in extensive toxic pollution, to the extent that the site is now a U.S. EPA Superfund site. Despite the contamination, the wetlands support many rare plants and hundreds of species of migratory birds.

Santa Clara River Estuary. This 49-acre estuary falls within or adjacent to the City of Ventura, the County of Ventura, and the City of Oxnard (with a portion owned by California State Parks). The estuary is at the mouth of the Santa Clara River, which drains a watershed of approximately 1,600 acres. This is a very important estuary for wildlife. The City of Ventura's wastewater treatment plant discharges into the estuary. Adjacent to the treatment plant are wildlife treatment ponds that are home to dozens of aquatic bird species. Studies are underway to determine the minimum discharge requirements which will impact the amount of wastewater effluent the City will be able to divert for potable and non-potable recycling.

Ventura River Estuary. This 110-acre estuary is west of the City Ventura and forms a border of the northern portion of the Red Mountain range in the County. The estuary is at the mouth of the Ventura River, which drains a watershed of approximately 226 square miles. The estuary supports numerous special status wildlife species.

Rincon and Sycamore Canyon Creek Estuaries. These two creek estuaries lie along the border with Santa Barbara County and Los Angeles County respectively, and are home to the Federally endangered tidewater goby.

C. Do climate-sensitive fauna or flora populations live in your region? *YES*

The United States Fish and Wildlife Service (USFWS) has designated critical habitat in Ventura County for the following four species:

Western snowy plover. 639 acres of designated habitat includes sandy beach and dune habitats along the Oxnard Plain.

Ventura marsh milk vetch. 220 acres of designated habitat is located near McGrath Lake in wetland swales located in back dune habitat.

Tidewater goby. 442 acres of designated habitat is located in the Santa Clara and Ventura River mouths, Ormond Lagoon, and at the mouth of Sycamore Canyon Creek.

Southwestern willow flycatcher. 2,337 acres of habitat have been designated along the Santa Clara and Ventura Rivers.

The *Ventura County Resilient Coastal Adaptation Project Vulnerability Assessment* (2018) includes an evaluation of potential impacts to USFWS designated critical habitats located in unincorporated County areas resulting from coastal flooding during a 100-year flood. That analysis concluded that with a 58-inch rise in sea level, coastal flooding could result in impacts to the following habitat areas:

- 49 percent of the 155 acres of designated habitat for western snowy plover located in unincorporated areas may be impacted.
- 93 percent of the 43 acres of designated habitat for Ventura marsh milk vetch located in unincorporated areas may be impacted.
- 39 percent of the 117 acres of designated habitat for tidewater goby located in unincorporated areas may be impacted.
- Less than one percent of the 2,000 acres of designated habitat for southwestern willow flycatcher located in unincorporated areas may be impacted.

In addition to the critical habitat designated by the USFWS, 49 other special status species that inhabit beach, dune, estuarine, and freshwater habitats are identified by the California Department of Fish and Wildlife's California Natural Diversity Data Base as having the potential to be vulnerable to sea level rise exposure and also to other impacts of climate change such as increasing temperatures and variations in precipitation.

D. Do endangered or threatened species exist in your region? Are changes in species distribution already being observed in parts of your region? *YES*

As described in response VI.C, special status species in Ventura County are vulnerable to habitat modifications caused by sea level rise and other climate change-related effects such as increased temperatures.

E. Does the region rely on aquatic or water dependent habitats for recreation or other economic activities. *YES*

Lake Casitas and Lake Piru are both recreation reservoirs offering boating, fishing and camping. Lake Piru also allows swimming and water skiing. Lake Casitas, as a drinking

water source, does not allow body contact. Local rivers and creeks, such as Sespe Creek and Calleguas Creek, the Ventura River and the Santa Clara River, also provide recreational opportunities, including hiking, fishing, and camping. The Santa Clara and Ventura River Estuaries and Mugu Lagoon adjacent to the Naval Base also provide access and recreational opportunities. These aquatic resources attract not only local residents but tourists from outside the County, and the recreational activities generate revenue and support the local economy.

Water quality in the Ventura River Watershed is generally not an impairment to using water for domestic water supply. However, other beneficial uses, including recreation, are negatively affected by water quality in the river. The majority of water quality problems involve eutrophication (excessive nutrients, nitrogen, and the resulting algae blooms) and affect the portion of the river from Foster Park to the Estuary.

The Los Angeles RWQCB has identified the Santa Clara River, downstream of Piru Creek, as having water quality impairments related to bacteria. The Los Angeles RWQCB has identified runoff from residential, industrial, and commercial areas as the source of the bacteria. Elevated bacteria levels are an indicator that a potential health risk exists for individuals exposed to this water, which limits the recreational uses of the Santa Clara River.

F. Are there rivers in your region with quantified environmental flow requirements or known water quality/quantity stressors to aquatic life. ***YES***

Several local diversions are subject to flow restrictions developed to provide flow for the migration and passage of Southern California steelhead; the Robles Diversion on the Ventura River and the Freeman Diversion on the Santa Clara River. In the Ventura River watershed, the Robles Diversion diverts Ventura River water to Lake Casitas. A Biological Opinion (BO) written by the National Marine Fisheries Service includes requirements to provide flow for the migration and passage of the Southern California steelhead up and down the main stem of the Ventura River and past the diversion during the steelhead migration season (January 1 to June 30). Implementation of the flow release requirements of the BO started in 2005. In the Santa Clara River Watershed, the Freeman Diversion, which diverts water from the Santa Clara River for groundwater recharge, has similar flow restrictions as a result of a BO written in 2008.

TMDLs have been established for algae, eutrophic conditions, and nutrients, which impair the Ventura River, its estuary and its tributaries. A TMDL for trash has also been established for the Ventura River estuary. In addition to the existing TMDLs, several Ventura River Watershed areas are included in California's 303(d) list of impaired

waters. Identified impairments in the Ventura River and its tributaries include total dissolved solids, aluminum, and mercury.

Several Santa Clara River Watershed areas are included in California's 303(d) List. Impairments in the Santa Clara River and its tributaries include chloride, pH, boron, sulfates, total dissolved solids, toxicity, as well as multiple chemicals generally referred to as "Chem A."

TMDLs for the following have been established for Calleguas Creek: metals, selenium, salts, toxicity, organochlorine pesticides and PCBs, and nitrogen compounds and related effects.

G. Do estuaries, coastal dunes, wetlands, marshes, or exposed beaches exist in your region? If so, are coastal storms possible frequent in your region? *YES*

The rainy season in Ventura County is from mid-autumn to mid-spring. Winter storms during this period have the potential to result in heavy rain and flooding impacts.

The *Ventura County Resilient Coastal Adaptation Project Vulnerability Assessment* (2018) includes an evaluation of potential coastal storm flooding impacts to sensitive habitats located in unincorporated portions of the County. Under existing conditions, virtually all 146 acres of unincorporated beach areas would be subject to flooding during a 100-year storm. Flooding related effects during a 100-year storm may also impact 18 percent (30 acres) of the County's 173 acres of dune habitat; 52 percent (59 acres) of the County's 113 acres of estuary habitat; and 21 percent (557 acres) of the County's 2,701 acres of freshwater habitat.

H. Does your region include one or more of the habitats described in the Endangered Species Coalition's Top 10 habitats vulnerable to climate change? *NO*

The 10 vulnerable habitats identified by the Endangered Species Coalition include three habitat types located in California, including: southwestern deserts (e.g., the Mojavedesert), the Bay-Delta, and the Sierra Nevada Mountains. None of the California habitat types included on the top 10 list are located in Ventura County.

I. Are there areas of fragmented estuarine, aquatic, or wetland wildlife habitat within your region? YES. Are there movement corridors for species to naturally migrate? YES and NO. Are there infrastructure projects planned that might preclude species movement? YES

South Coast Missing Linkages: A Wildland Network for the South Coast Ecoregion

Habitat loss and fragmentation threaten biodiversity in southern California. Countering these threats requires protecting connections between existing open space areas to form a regional wildland network. Such an interconnected set of reserves would allow natural ecological processes—such as migration and range shifts with climate change--to continue operating as they have for millennia. The South Coast Missing Linkages project as described in the 2008 document *South Coast Missing Linkages: A Wildland Network for the South Coast Ecoregion* has developed a comprehensive plan for such a regional network that would maintain and restore critical habitat linkages between existing reserves. These linkages form the backbone of a conservation strategy for southern California where the whole would be greater than the sum of the parts. This strategy represents the best hope for maintaining what remains of southern California's wildlife legacy, while ensuring quality of life for local citizens via clean air, clean water, and recreational opportunities. South Coast Missing Linkages is a highly collaborative inter-agency effort to identify and conserve the highest priority linkages in the South Coast Ecoregion.

Habitat Connectivity and Wildlife Corridor Project

The County of Ventura has been considering a potential land use ordinance to protect and enhance local wildlife corridors as part of the VC Habitat Connectivity and Wildlife Corridor Project. This project will apply in areas mapped by the South Coast Missing Linkages Project mentioned above. The 2008 report shows these "linkages" in the context of other core areas and linkages throughout southern California.

Excerpt from County website regarding this project*: County Wildlife corridors connect fragmented patches of habitat. The main goal of a corridor (also referred to as a linkage) is to facilitate movement of plants and animals through dispersal and migration. The fragmentation of natural areas within Ventura County due to development patterns limits the ability of plant and animal populations to disperse and move to areas they need for survival. Within natural resource management and conservation communities, this issue is considered among the most urgent of biological resource concerns. Wildlife biology specialists consider the maintenance (or enhancement) of existing habitat connectivity linkages, or connections between large, natural areas of protected habitat, as well as the native vegetation linkages within such corridors, as essential to ensure the future health of the County's natural resources.*

The removal of native habitat or the construction of buildings, roads, and fences can either degrade or eliminate the functionality of a wildlife movement corridor. Currently, the County's regulatory structure does not incorporate review standards and General Plan policies that would fully protect the viability of these corridors. For example, the General Plan provides only one broad biological resource protection goal that mentions protections for wildlife corridors. The General Plan provides no supporting policies that specifically address development in these

areas. In addition, the Non-Coastal Zoning Ordinance (NCZO) contains no standards that address proposed development in the wildlife corridors. Therefore, no guidance, or regulatory framework, is provided in the County's existing planning documents to protect these resources.

A major focus of the proposed ordinance is to address ministerial and exempt development and their setbacks from water features such as ephemeral drainages. Currently, there are no County regulations preventing vegetation removal or development that is currently exempt or ministerial within riparian zones. There are WPD encroachment permits needed for development within channels, and all ministerial and discretionary projects must comply with stormwater BMPs, but there are no development setbacks unless development is discretionary per General Plan policies. Many of the County's ephemeral drainages are fairly degraded and somewhat fragmented as are some other wetland features such as vernal pools and seeps. Some of these features have been degraded over time by grazing or other agricultural development.
Often wildlife have multiple resource needs, occur at low densities, and have low reproductive rates, and as a result have large home ranges. Many species of wildlife in Ventura County do not migrate seasonally, but instead have large home ranges that cause them to move through developed areas among patches of habitat. The bigger the home range is, the more widespread the movement. Some examples of this are mountain lion, coyote, bobcat, American badger, bear, and mule deer.

VII. HYDROPOWER

A Is hydropower a major source of electricity in your region? *NO*

There are no major hydropower facilities located in Ventura County. There are several small facilities which do not produce a significant amount of power. Electrical power in Ventura County is provided by Southern California Edison (SCE). Large hydroelectric generated power accounts for three percent of SCE's total retail sales.

B. Are energy needs in your region expected to increase in the future? *YES* If so, are there future plans for hydropower generation facilities or conditions for hydropower generation in your region? *Minimal*

There is minimal potential for future energy demands in Ventura County to be met by developing local hydropower facilities.

REFERENCES

California Environmental Protection Agency (CalEPA), 2018, *Indicators of Climate Change in California*. Available online at https://oehha.ca.gov/climate-change/report/2018-report-indicators-climate-change-california

City of Oxnard, Local Coastal Program Update*; Sea Level Rise Vulnerability Assessment and Fiscal Impact Report Summary*, 2017

County of Ventura, December 2018, *Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment*. Co-Authored by Revell Coastal, LLC.

County of Ventura, January 2018, *General Plan Update, Chapter 10 – Water Resources Revised Public Review Draft.*

County of Ventura, March 2017, *General Plan Update, Chapter 9 – Agriculture Revised Public Review Draft.*

County of Ventura, 2018, *2017 Crop & Livestock Report*.

County of Ventura, 2016, *2015 Annual Report of Groundwater Conditions*.

County of Ventura, 2015, *Ventura County Multi-Hazard Mitigation Plan*.

County of Ventura, 2015, *County of Ventura 2013 Water Supply and Demand.* Prepared by Hydrometrics

County of Ventura, 2013, *Ventura County General Plan, Hazards Appendix*.

Doughty, C., K. Cavanaugh, R. Ambrose, E. Stein. 2017. Sea Level Rise Impacts to Coastal Habitats in Southern California Estuaries. University of Southern California Sea Grant Traineeship Program Report. May.

Endangered Species Coalition, Undated, *It's Getting Hot Out There: Top 10 Places to Save for Endangered Species in a Warming World.*

Espinoza, V., Waliser, D. E., Guan, B., Lavers, D. A., & Ralph, F. M. (2018). Global Analysis of Climate Change Projection Effects on Atmospheric Rivers. *Geophysical Research Letters*, *45*(9), 4299-4308. https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2017GL076968

Hall, Alex, Neil Berg, Katharine Reich. (University of California, Los Angeles), 2018, *Los Angeles Summary Report. California's Fourth Climate Change Assessment.* Publication number: SUM-CCCA4-2018-007. Available online at: http://www.climateassessment.ca.gov/regions/docs/20180928-LosAngeles.pdf

Hatchett, B., Daudert, B., Garner, C., Oakley, N., Putnam, A., & White, A. (2017). Winter snow level rise in the northern Sierra Nevada from 2008 to 2017. *Water*, *9*(11), 899.

Keeley, J., and Syphard, A. "Climate change and future fire regimes: examples from California." *Geosciences* 6, no. 3 (2016): 37.

Keeley, J. E., & Syphard, A. D. (2017). Different historical fire–climate patterns in California. *International Journal of Wildland Fire*, *26*(4), 253-268 https://www.researchgate.net/profile/Alexandra_Syphard/publication/315875417_Different_historical_fire-climate_patterns_in_California/links/5a6206500f7e9b6b8fd420fb/Different-historical-fire-climate-patterns-in-California.pdf

Liu, X., Mickelbart, M. V., Robinson, P. W., Hofshi, R., and Arpaia, M. L. (2002). Photosynthetic Characteristics of Avocado Leaves. Proc. IS on Trop. & Subtrop. Fruits, R. Drew (Ed.), Acta Hort. 575, ISHS 2002, 865-875.

Parks, S. A., Miller, C., Abatzoglou, J. T., Holsinger, L. M., Parisien, M. A., & Dobrowski, S. Z. (2016). How will climate change affect wildland fire severity in the western US?. *Environmental Research Letters*, *11*(3), 035002.

Polade, S. D., Pierce, D. W., Cayan, D. R., Gershunov, A., & Dettinger, M. D. (2014). The key role of dry days in changing regional climate and precipitation regimes. *Scientific reports*, *4*, 4364. https://www.nature.com/articles/srep04364

Prein, A. F., Rasmussen, R. M., Ikeda, K., Liu, C., Clark, M. P., & Holland, G. J. (2017). The future intensification of hourly precipitation extremes. *Nature Climate Change*, *7*(1), 48.

Radeloff, V. C., Helmers, D. P., Kramer, H. A., Mockrin, M. H., Alexandre, P. M., Bar-Massada, A., ... & Stewart, S. I. (2018). Rapid growth of the US wildland-urban interface raises wildfire risk. *Proceedings of the National Academy of Sciences*, *115*(13), 3314-3319. http://www.pnas.org/content/pnas/115/13/3314.full.pdf

Reich, KD, N Berg, DB Walton, M Schwartz, F Sun, X Huang, and A Hall, 2018: "Climate Change in the Sierra Nevada: California's Water Future." UCLA Center for Climate Science

Syphard, A. D., Brennan, T. J., & Keeley, J. E. (2018). Chaparral Landscape Conversion in Southern California. In *Valuing Chaparral* (pp. 323-346). Springer, Cham.

South Coast Wildlands, 2008, *South Coast Missing Linkages: A Wildland Network for the South Coast Ecoregion.*

State Water Resources Control Board, 2018, *2017 Electronic Annual Report – Water Production and Water Deliveries.*

US Geological Survey, 2018, *Emergency assessments of post-wildfire debris flow hazards.* Available online at: https://landslides.usgs.gov/hazards/postfire_debrisflow/

Western Regional Climate Center, 2018, *California Climate Tracker*. Available online at: https://wrcc.dri.edu/Climate/Tracker/CA/