State Water Resources Control Board

FINAL DRAFT

Proposed Updates to the Cannabis Cultivation Policy

Staff Report

February 5, 2019

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Acronyms and Abbreviations

ACL	Administrative Civil Liability
Antidegradation Policy	State Water Board Resolution 68-16, the Statement of Policy with Respect to Maintaining High Quality of Waters in California
Army Corps	United States Army Corps of Engineers
AUMA	Adult Use of Marijuana Act of 2016
Basin Plan	Water Quality Control Plan
BOF	Board of Forestry
BPTC	Best Practicable Treatment or Control
BPC	California Business and Professions Code
CAL FIRE	California Department of Forestry and Fire Protection
CAO	Cleanup and Abatement Orders
CDFA	California Department of Food and Agriculture
CIWQS	California Integrated Water Quality System
CUA	Compassionate Use Act of 1996
CEQA	California Environmental Quality Act
CDEC	California Data Exchange Center
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CDO	Cease and Desist Order
cfs	Cubic feet per second
CHRIS	California Historical Resources Information System
CWA	Clean Water Act
Deputy Director	Deputy Director for the Division of Water Rights
DPR	Department of Pesticide Regulation
DPS	Distinct Population Segments
DTE	Distinct Taxonomic Entities
DWR	California Department of Water Resources
e.g.	Latin exempli gratia (for example)
ESA	Federal Endangered Species Act
ESU	Evolutionary Significant Unit
Executive Officer	Executive Officer of the Regional Water Quality Control Board
FER	Flashy, Ephemeral Rain hydrologic regime
FPR	Forest Practice Rules
Cannabis Cultivation General Order	*General Waste Discharge Requirements for Discharges of Waste associated with Cannabis Cultivation Activity*
GW	Groundwater hydrologic regime
HELP	High Elevation and Low Precipitation hydrologic regime
HSR	High-Volume Snowmelt and Rain hydrologic regime
HUC	Hydrologic Unit Code
HSC	Health and Safety Code
ILRP	Irrigated Lands Regulatory Program
LSA Agreement	Lake and Streambed Alteration Agreement
LSR	Low-Volume Snowmelt and Rain hydrologic regime
LTO	Licensed Timber Operator
MCRSA	Medical Cannabis Regulation and Safety Act
MMRSA	Medical Marijuana Regulation and Safety Act
NCRO	Department of Water Resources, North Central Region Office

NHD	National Hydrography Database
NHDPlusV2	National Hydrography Database Plus Version 2
NMP	Nitrogen Management Plan
NOA	Notice of Applicability
NONA	Notice of Non-Applicability
NOT	Notice of Termination
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source Pollution Control Program
NRO	Department of Water Resources, North Region Office
NTU	Nephelometric Turbidity Units
NWIS	National Water Information System
O/E	Observed over expected
OWTS	Onsite Wastewater Treatment System
PGR	Perennial Groundwater and Rain hydrologic regime
Policy	Cannabis Cultivation Policy, Principles and Guidelines for Cannabis Cultivation
RO	Reverse Osmosis
RSG	Rain and Seasonal Groundwater hydrologic regime
Regional Water Board	Regional Water Quality Control Board
Road Handbook	Handbook for Forest, Ranch, and Rural Roads
RPF	California Registered Professional Forester
RWD	Report of Waste Discharge
State Water Board	State Water Resources Control Board
SB	Senate Bill
SCCWRP	Southern California Coastal Water Research Project
SCR	Site Closure Report
SIC	Standard Industrial Code
SDR	Small Domestic Registrations
SEPs	Supplemental Environmental Projects
SIUR	Small Irrigation Use Registrations
SM	Snowmelt hydrologic regime
SW-CGP	Storm Water Construction General Permit
SW-IGP	Storm Water Industrial General Permit
SWPPP	Storm Water Pollution Prevention Plan
THP	Timber Harvest Plan
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
UC Davis	University of California, Davis
US	United States
USBR	United States Bureau of Reclamation
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
Water Boards	State Water Board and Regional Water Boards
WDRs	Waste Discharge Requirements
WLPZ	Watercourse and Lake Protection Zone

INTRODUCTION

The purpose of this Cannabis Cultivation Policy Staff Report (Staff Report) is to provide background, rationale and justification for the principles and guidelines contained in the *Cannabis Cultivation Policy: Principles and Guidelines for Cannabis Cultivation* (Policy). The Policy establishes principles and guidelines (herein "Requirements") for cannabis cultivation activities to protect water quality and instream flows. The purpose of the Policy is to ensure that the diversion of water and discharge of waste associated with cannabis cultivation does not have a negative impact on water quality, aquatic habitat, riparian habitat, wetlands, and springs. The Policy applies to the following cannabis cultivation activities throughout California:

- Commercial Recreational
- Commercial Medical
- Personal Use Medical

The Policy does not apply to recreational cannabis cultivation for personal use, which is limited to six plants under the Adult Use of Marijuana Act (Proposition 64, approved by voters in November 2016)[1].

Legislative / Regulatory Background

Proposition 215, the Compassionate Use Act (CUA) of 1996 (Health and Safety Code Section 11362.5 et seq.) established the medical cannabis industry. While Proposition 215 laid the groundwork for medical cannabis use, it did not provide a regulatory system for oversight of the cultivation, distribution, or sale of cannabis, nor did it establish any type of control of the environmental impacts from cannabis cultivation within the state. In 2003, Senate Bill (SB) 420 was enacted by the Legislature to clarify the scope of the CUA and provided California cities and counties authority to adopt and enforce cannabis related rules and regulations consistent with SB 420 and the CUA. Without appreciable regulatory oversight however, large-scale cannabis cultivation proliferated in remote areas throughout California.

In an effort to provide a regulatory framework for the cannabis industry, Governor Brown signed the Medical Marijuana Regulation and Safety Act (MMRSA)[2], which became effective on January 1, 2016. MMRSA created a state licensing system for cultivation, manufacture, sale, distribution, and testing of medical cannabis.

On June 27, 2016, the Governor signed SB 837, which included a number of changes to the MMRSA including replacing the term marijuana with cannabis, changing the name of the MMRSA to the Medical Cannabis Regulation and Safety Act (MCRSA), and adding environmental protection statutes that place certain mandates on the State Water Resources Control Board (State Water Board).

In November 2016, voters approved Proposition 64, the Adult Use of Marijuana Act (AUMA), which legalized recreational cannabis cultivation, and the possession and use of limited amounts of cannabis by adults over 21 years of age. AUMA requires the same environmental protections as MCRSA. Among other provisions, the MCRSA and the AUMA require the

[1] Recreational cannabis cultivation for personal use as defined in Health and Safety Code section 11362.1(a)(3) and section 11362.2.
[2] The Medical Marijuana Regulation and Safety Act consisted of Assembly Bills 243 and 266, and Senate Bill 643.

California Department of Food and Agriculture (CDFA) to issue licenses to commercial cannabis cultivators and establish a track and trace program that tracks commercial cannabis from seed or clone through cultivation, harvest, transport, manufacture, distribution, and sale to the end user.

On June 27, 2017, the Governor signed SB 94 which combines the requirements of MCRSA and AUMA into a unified code.

Cannabis cultivation related legislation established:

- Water Code section 13149, which authorizes the State Water Board, in consultation with the California Department of Fish and Wildlife (CDFW), to adopt interim and long-term principles and guidelines (requirements) for the diversion and use of water for cannabis cultivation. The requirements:
  - shall include measures to protect springs, wetlands, and aquatic habitats from negative impacts of cannabis cultivation; and
  - may include requirements that apply to groundwater diversions where the State Water Board determines those requirements are reasonably necessary.
- Water Code section 13276, which directs the Regional Water Quality Control Boards (Regional Water Boards) or the State Water Board to address discharges of waste resulting from medical and commercial cannabis cultivation, including adopting a general permit establishing waste discharge requirements, or taking action pursuant to Water Code section 13269.
- Business and Professions Code section 26060.1(b) requires that any cannabis cultivation licenses issued by CDFA include conditions requested by the Department of Fish and Wildlife and the State Water Resources Control Board to ensure that individual and cumulative effects of water diversion and discharge associated with cannabis cultivation do not affect the instream flows needed for fish spawning, migration, and rearing, and the flows needed to maintain natural flow variability. The conditions shall include, but not be limited to, the principles, guidelines, and requirements established pursuant to Section 13149 of the Water Code.

OVERVIEW OF POLICY REGIONS

California is a large and geographically diverse state, covering 163,696 square miles, and spanning over 800 miles of coastline. California's multiple mountain ranges and valleys result in highly variable climate, precipitation and drainage patterns.

Fourteen regions are identified in the Policy to account for the state's size and geographic diversity: Klamath, Upper Sacramento, North Eastern Desert, North Coast, Middle Sacramento, Southern Sacramento, North Central Coast, Tahoe, South Central Coast, San Joaquin, Mono, Kern, South Coast, and South Eastern Desert (Figure 1). As mentioned above, the Policy establishes Requirements to protect water quality and instream flows statewide. These Requirements include minimum instream flows that must be met or exceeded at a specific compliance flow gage when water is being diverted for cannabis cultivation. The Policy identifies 14 regions, and identifies nine regions as priority regions that support anadromous salmonids. The priority regions are: Klamath, Upper Sacramento, North Coast, Middle Sacramento, Southern Sacramento, North Central Coast, South Central Coast, San Joaquin, and South Coast.

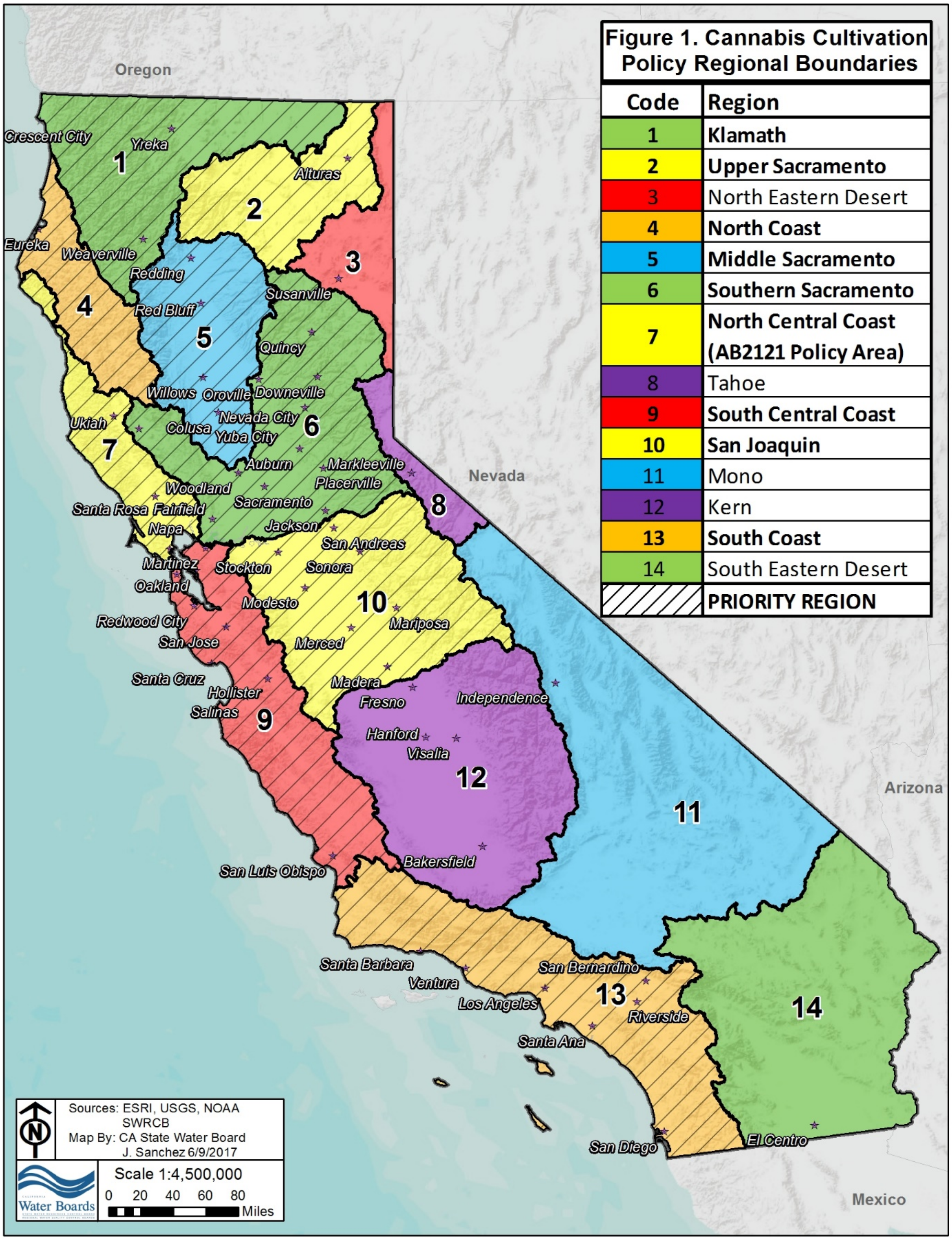
Figure 1. Cannabis Cultivation Policy Regional Boundaries
Code Region
1 Klamath
2 Upper Sacramento
3 North Eastern Desert
4 North Coast
5 Middle Sacramento
6 Southern Sacramento
7 North Central Coast (AB2121 Policy Area)
8 Tahoe
9 South Central Coast
10 San Joaquin
11 Mono
12 Kern
13 South Coast
14 South Eastern Desert
PRIORITY REGION
Oregon
Nevada
Arizona
Mexico
Crescent City
Yreka
Alturas
Eureka
Weaverville
Redding
Susanville
Red Bluff
Quincy
Willows
Oroville
Downeville
Ukiah
Colusa
Nevada City
Yuba City
Auburn
Markleeville
Placerville
Woodland
Sacramento
Santa Rosa
Fairfield
Napa
Jackson
San Andreas
Martinez
Stockton
Sonora
Oakland
Modesto
Mariposa
Redwood City
San Jose
Merced
Santa Cruz
Madera
Hollister
Fresno
Independence
Salinas
Hanford
Visalia
San Luis Obispo
Bakersfield
Santa Barbara
Ventura
Los Angeles
San Bernardino
Riverside
Santa Ana
San Diego
El Centro
Sources: ESRI, USGS, NOAA SWRCB
Map By: CA State Water Board J. Sanchez 6/9/2017
Water Boards
Scale 1:4,500,000
0 20 40 60 80 Miles

This section provides a general overview of the climate, precipitation, hydrology, geology and anadromous salmonid populations throughout the state. More detailed descriptions for each priority region (including discussion of regional elevations, climate, precipitation, hydrologic classifications, monthly average temperatures, and anadromous fish distribution) are located in Appendix 1.

Climate

California's diverse topography has a profound impact on regional climates. CDFW modified the Köppen Climate Classification System, a classification system that is used to describe the world's climates, to describe California climatic conditions on a more localized scale (CDFG[3], 2002). CDFW's modified Köppen Climate Classification System includes 11 climate classifications, which fall within five general categories: Steppe, Desert, Mediterranean, Cool Interior, and Highland. A general overview of the climatic and temperature patterns for each climate category is described below. Figure 2 shows a climatic map of California based on CDFW's adaptation of the Köppen Climate Classification System.

California's Steppe climates include the following classifications: Semi-arid, steppe (hot); Semi-arid, steppe; and Semi-arid, steppe with summer fog. California's southern San Joaquin Valley, portions of the Basin and Range and Mojave Desert are characterized by Steppe climates. Similar to the desert climates, Steppe climates are characterized by heat, but these regions tend to receive enough moisture to support vegetation, such as grasslands, that are not typically found in deserts. In these areas, average maximum temperatures are approximately 80 degrees Fahrenheit (°F) and average annual minimum temperatures are approximately 45-50°F. Temperatures are less extreme in the southern San Joaquin valley compared to many locations in the Colorado and Mojave Deserts because there is a slightly more marine influence in the San Joaquin Valley.

California's Desert climates include the following classifications: Arid low latitude desert (hot); and Arid mid latitude desert. Much of the Colorado and Mojave Deserts are characterized by Desert climates. California's Desert climatic regions are characterized by low annual precipitation, low humidity, high daily temperature fluctuations, and annual temperature extremes. Dry climates (including both Desert and Steppe) are characterized by the actual precipitation generally being below the potential evapotranspiration. In Desert climatic regions, temperature extremes and the range of temperature fluctuation tend to be much greater than those in Mediterranean climates, which is a result of the lower humidity and very little marine influence in Desert areas. In portions of the Mojave and Colorado Deserts, average annual maximum temperatures reach 90°F, and average annual minimum temperatures fall to 45°F.

[3] The California Department of Fish and Wildlife was previously named the California Department of Fish and Game (CDFG).

California's Mediterranean climates include the following classifications: Mediterranean/hot summer; Mediterranean/cool summer, and Mediterranean/summer fog. California's coastal regions, northern Central Valley, and Sierra Nevada foothills are generally characterized by Mediterranean climates. California's Mediterranean climatic regions are characterized by warm to hot summers, and cool, wet winters. Weather systems and marine influences in these regions tend to reduce the range of temperature fluctuations and moderate temperature extremes. Areas with stronger marine influences tend to exhibit lower average annual maximum temperatures.

Average annual maximum temperatures reach 65-70°F along the California coast, 75°F in the Sierra Nevada foothills and northern Central Valley, and up to 80°F in much of the Central Valley and in portions of the southern California coast. Average annual minimum temperatures in these areas rarely fall below 40°F.

California's Cool Interior climates include the following classifications: Cool continental/dry summer; and Cold winter/dry summer. The Modoc Plateau and upper elevation Sierra Nevada mountains are characterized by Cool Interior climates. California's Cool Interior climatic regions are characterized by dry summers, cool to cold winters, and significant winter snowfall. In these regions, average annual maximum temperatures tend to remain below 65°F and many areas exhibit average annual maximum temperatures below 55°F. Average annual minimum temperatures in these areas are generally below 40°F, with below freezing temperatures common.

California's Highland climate includes the Highland/Timberline classification: The highest elevation areas of the southern Sierra Nevada Mountains are characterized by Highland/Timberline climates. California's Highland/Timberline climatic regions are climatically similar to Cool Interior regions. These areas are often drier than the Cool Interior regions in the northern Sierra Nevada Mountains and Cascade Range, but Highland/Timberline climatic areas more commonly receive summer rainfall. Average annual maximum temperatures in many high elevation areas stay below 45°F, with average minimum temperatures remaining below freezing.

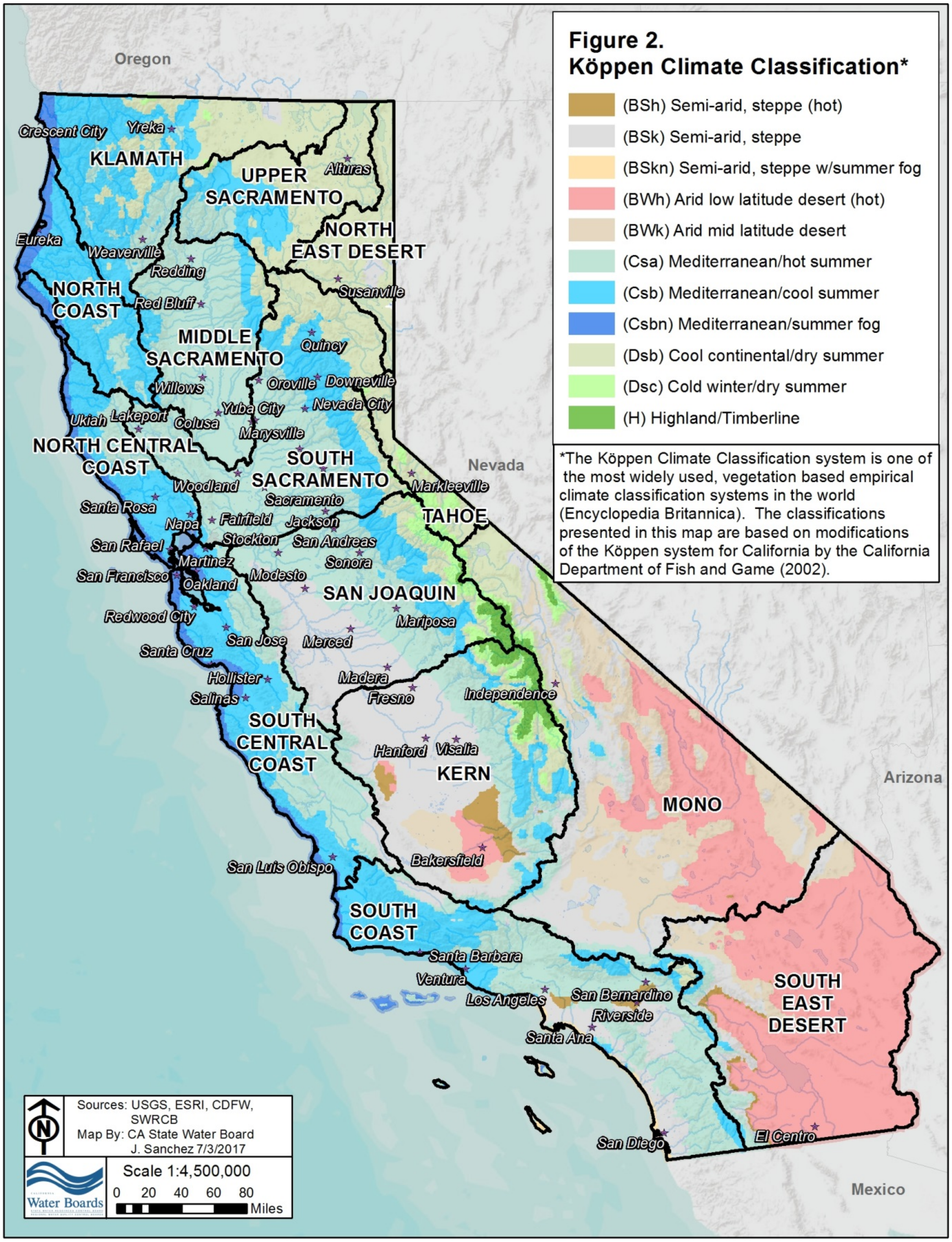

Figure 2. Köppen Climate Classification*

Precipitation

Overall, California precipitation patterns are characterized by cool, wet winters and very dry summers. The vast majority of California's precipitation typically falls between October and May, and half of the annual precipitation tends to fall between December and February. California receives very little precipitation during the summer months; most locations receive less than 10 percent of annual precipitation between June and September. Summer thundershowers occur in the Sierra Nevada Mountains, Klamath Mountains, and Cascade Range, but these weather events contribute little to overall precipitation volumes.

Precipitation in California falls as rain and snow. Figure 3. Average Annual Precipitation, shows the statewide average annual precipitation amounts based on observations and extrapolated data (PRISM, 2016). As illustrated in Figure 3, precipitation volumes are typically much higher in northern California compared to southern California, and a north-to-south precipitation gradient is readily apparent. Snowfall typically occurs at elevations above 3,000 feet, and significant snowpack can persist at elevations above 5,000 feet. Spring snowmelt pulse flows that typically continue into summer are characteristic of streams in high elevation watersheds.

Precipitation patterns in California are influenced by regional topography. Orographic uplift and rain shadow effects impact precipitation and streamflows on the western and eastern side of California's mountain ranges. California's precipitation patterns also tend to vary substantially from year to year as the result of ocean circulation patterns, atmospheric moisture, and other factors. Large scale ocean circulation patterns, such as the El Niño/La Niña ocean circulation cycle, exert great influence over California's precipitation volumes and patterns. During El Niño, California tends to receive higher amounts of precipitation during winter, especially in southern California. During La Niña, high amounts of winter precipitation may occur in northern California, while southern California often remains cool and dry. Weather phenomena, such as atmospheric rivers, can also greatly affect California's precipitation patterns. Atmospheric rivers are highly concentrated corridors of atmospheric moisture that bring warm rains in extreme volumes to California. Since these features are very narrow, one region may be heavily impacted by an atmospheric river while another area sees only minimal precipitation.

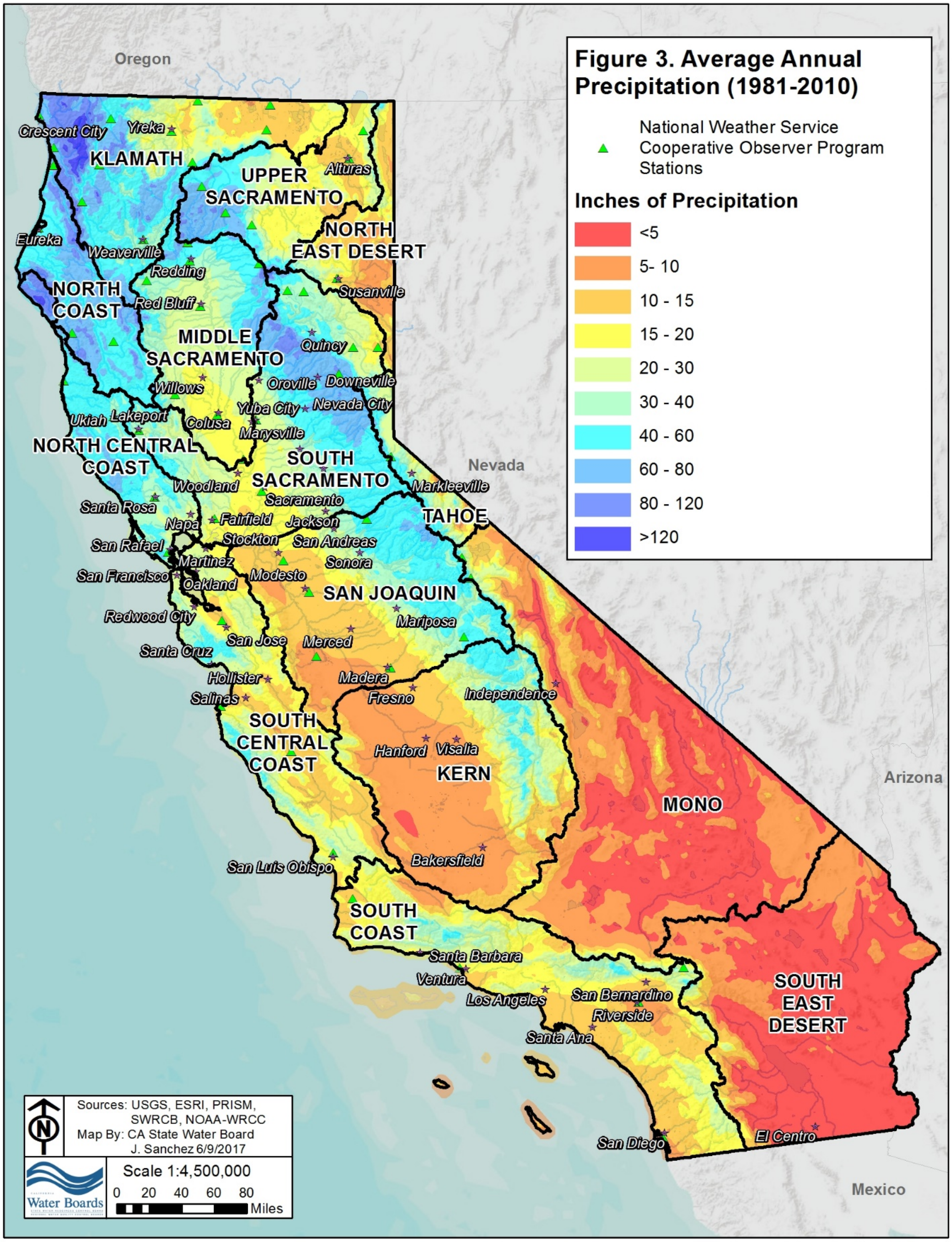

Figure 3. Average Annual Precipitation (1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
<5
5- 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
80 - 120
>120
Oregon
Nevada
Arizona
Mexico
KLAMATH
UPPER SACRAMENTO
NORTH EAST DESERT
NORTH COAST
MIDDLE SACRAMENTO
NORTH CENTRAL COAST
SOUTH SACRAMENTO
TAHOE
SAN JOAQUIN
SOUTH CENTRAL COAST
KERN
MONO
SOUTH COAST
SOUTH EAST DESERT
Crescent City
Yreka
Alturas
Eureka
Weaverville
Redding
Susanville
Red Bluff
Quincy
Willows
Oroville
Downeville
Yuba City
Nevada City
Ukiah
Lakeport
Colusa
Marysville
Markleeville
Woodland
Sacramento
Santa Rosa
Napa
Fairfield
Jackson
San Rafael
Stockton
San Andreas
Martinez
Sonora
San Francisco
Oakland
Modesto
Redwood City
Mariposa
San Jose
Merced
Santa Cruz
Hollister
Madera
Salinas
Fresno
Independence
Hanford
Visalia
Bakersfield
San Luis Obispo
Santa Barbara
Ventura
Los Angeles
San Bernardino
Riverside
Santa Ana
San Diego
El Centro
Sources: USGS, ESRI, PRISM, SWRCB, NOAA-WRCC
Map By: CA State Water Board J. Sanchez 6/9/2017
Water Boards
Scale 1:4,500,000
0 20 40 60 80
Miles

Hydrology

In California, stream hydrology is influenced by regional geologic, climatic, and precipitation patterns. To characterize California's diverse streamflow patterns, a team from the University of California-Davis (UC Davis) in collaboration with the Southern California Coastal Water Research Project (SCCWRP) developed a hydrologic classification system for California. The resultant stream classification was applied to all stream reaches in California attributed to the United States Geological Survey (USGS) National Hydrography Database (NHD) Plus Version 2 (NHDPlusV2), as shown in Figure 4. The hydrologic classification system excludes first-order (headwater) streams and all streams in the Lake Tahoe Basin from its hydrologic analysis. The UC Davis-SCCWRP hydrologic classification system defines nine hydrologic classifications, described as follows: Snowmelt; High-Volume Snowmelt and Rain; Low-Volume Snowmelt and Rain; Rain and Seasonal Groundwater; Winter Storms; Groundwater; Perennial Groundwater and Rain; Flashy, Ephemeral Rain; and High Elevation and Low Precipitation.


Figure 4.
Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
High Elevation and Low Precipitation
Hydrologic Classification did not occur for streams draining out of California.
Oregon
Nevada
Arizona
Mexico
KLAMATH
UPPER SACRAMENTO
NORTH EAST DESERT
NORTH COAST
MIDDLE SACRAMENTO
NORTH CENTRAL COAST
SOUTH SACRAMENTO
TAHOE
SAN JOAQUIN
SOUTH CENTRAL COAST
KERN
MONO
SOUTH COAST
SOUTH EAST DESERT
Sources: USGS, ESRI, SWRCB, U.C. Davis
Map By: CA State Water Board J. Sanchez 6/21/2017
Scale 1:4,500,000
0 20 40 60 80 Miles
Water Boards

Snowmelt (SM): Stream reaches classified under the Snowmelt (SM) hydrologic regime are characterized by high flows in late spring, a predictable snowmelt recession curve (Yarnell et al., 2010), and very low flows throughout the remainder of the year. In general, SM hydrographs exhibit a period of high flows beginning in late May, which are driven by spring snowmelt. In most snowmelt-dominated watersheds, the spring snowmelt peak flow is the highest streamflow event on an annual basis (Yarnell et al., 2010). The SM hydrologic regime is characterized by very low streamflows throughout the remainder of the year, when snowmelt does not significantly contribute toward streamflows. Some smaller winter peak flows may occur as a result of winter storm events. SM stream reaches tend to be located in watersheds that receive precipitation primarily as winter snow, with minimal winter rain contributions (Lane et al., 2016). SM stream reaches are primarily located in the Sierra Nevada geomorphic region, particularly in the San Joaquin Valley and Kern Regions.

High-Volume Snowmelt and Rain (HSR): Stream reaches classified under the High-Volume Snowmelt and Rain (HSR) hydrologic regime are characterized by a bimodal snowmelt- and rainfall-dominated hydrograph, driven by a strong spring snowmelt pulse flow. In general, the HSR hydrograph is characterized by winter peak flow events driven by winter rainfall events, spring snowmelt peak flows driven by spring snowmelt, a predictable early summer snowmelt recession period, and a summer and fall baseflow period. The HSR hydrologic regime is similar to the SM and LSR hydrologic regimes; however, the HSR hydrograph tends to receive larger streamflow contributions from winter rainfall events compared to the LSR hydrograph (Lane et al., 2016). HSR stream reaches tend to be located at low- to mid-elevations, and tend to have large contributing areas. HSR stream reaches are located in the Klamath, Middle Sacramento, South Sacramento, San Joaquin, and Kern Regions, and are often located downstream of LSR stream reaches. HSR stream reaches in these regions tend to be associated with major rivers, including portions of the mainstem Sacramento River and San Joaquin River.

Low-Volume Snowmelt and Rain (LSR): Stream reaches classified under the Low-Volume Snowmelt and Rain (LSR) hydrologic regime are characterized by high streamflow events that occur as a result of winter rain and spring snowmelt. In general, LSR hydrographs are characterized by winter peak flows driven by winter rainfall events, by high streamflows in the late spring driven by spring snowmelt, by a predictable spring snowmelt recession curve during early summer, and by summer and fall baseflows. The LSR hydrograph is characterized by an earlier spring snowmelt peak flow compared to the SM hydrograph (Lane et al., 2016). LSR stream reaches exhibit the highest flows mainly in spring, and the lowest in summer. The LSR hydrologic regime is characterized by highly seasonal streamflow patterns, similar to those observed in SM and HSR stream reaches, but with larger streamflow contributions from winter storms. LSR stream reaches also tend to maintain higher baseflow contributions throughout the summer season compared to SM and HSR stream segments. LSR stream reaches are located in several geographic areas in California, including the: Klamath Region; the western side of the Sierra Nevada in the Upper Sacramento, Middle Sacramento, South Sacramento, San Joaquin, and Kern Regions; and small portions of the North Coast, South Coast, Mono and South East Desert Regions. LSR stream reaches in the Sierra Nevada mountains are often located downstream of SM stream reaches.

Rain and Seasonal Groundwater (RSG): Stream reaches classified under the Rain and Seasonal Groundwater (RSG) hydrologic regime are characterized by a bimodal hydrograph, driven by winter pulse flows and baseflows supplied by percolating winter precipitation. RSG stream reaches are located at low elevations, receive limited winter precipitation, and have low slopes.
RSG stream reaches are located in watersheds underlain by igneous and metamorphic rock and include small coastal aquifers with short residence times and many Central Valley streams. RSG stream reaches are located in the North Central Coast, South Central Coast, South Coast, Middle Sacramento, South Sacramento, San Joaquin, and Kern Regions. A small number of RSG stream reaches are also located in the South East Desert Region.

Winter Storms (WS): Stream reaches classified under the Winter Storms (WS) hydrologic regime are characterized by substantial rainfall events during fall and winter and low magnitude steady baseflow periods during the summer. In general, the WS hydrograph is characterized by multiple fall and winter peak flows and elevated baseflows, which are driven by winter rainstorms. WS hydrographs also exhibit receding streamflow during the early spring, and low baseflows during the dry season. WS hydrographs tend not to be influenced by snowmelt. WS stream reaches are considered flashy, with rapid flow increases and decreases corresponding to the start and end of individual precipitation events and with the overall streamflow remaining elevated throughout the fall and winter precipitation season. WS stream reaches also exhibit high inter-annual flow variance because winter storm patterns are highly variable on an inter-annual basis. Compared to the other stream classes, WS stream reaches tend to exhibit the earliest wet season peak flows and the largest average annual flow variance. WS stream reaches are primarily found at low elevations along the coast of California north of San Francisco Bay, and in the Sacramento Valley.

Groundwater (GW): Stream reaches classified under the Groundwater (GW) hydrologic regime are characterized by strong surface water-groundwater interactions and significant groundwater contributions, high streamflow predictability, and streamflows that tend to vary less substantially on a seasonal basis compared to other stream classes. Stream reaches classified by the GW hydrologic regime maintain higher average annual stream flows and higher minimum flows compared to comparably-sized streams classified by the other stream classes. GW stream reaches tend to have large drainage areas and low stream densities and are often underlain by volcanic rock or metamorphic rock aquifers. GW stream reaches tend to exhibit low winter precipitation inputs, which further emphasize the dominance of groundwater in the streamflow regime. GW stream reaches are located in several California Regions, including portions of the Klamath River, Sacramento River, and San Joaquin River Regions, some stream reaches in the Mono Region, and small numbers of stream reaches in other regions.

Perennial Groundwater and Rain (PGR): Stream reaches classified under the Perennial Groundwater and Rain (PGR) hydrologic regime are characterized by high streamflows from winter storms, and generally stable streamflows for much of the year. The PGR hydrograph is characterized by winter peak flows driven by winter rainfall events, and by stable, predictable baseflows during the spring, summer, and fall. The PGR hydrologic regime generally combines the WS regime, which is driven primarily by winter rainfall, and the GW regime, which is driven primarily by predictable baseflows (Lane et al., 2016). PGR stream reaches dominate California's South Central Coast Region, with high hydrologic connectivity between the underlying unconsolidated California Coastal Basin aquifers (USGS, 2014). PGR stream reaches are also found in other Policy regions, including the North Central Coast Region, South Coast Region, and other regions.

Flashy, Ephemeral Rain (FER): Stream reaches classified under the Flashy, Ephemeral Rain (FER) hydrologic regime are characterized by high streamflow variabilities, including extended periods of very low flows, as well as large flood events. FER streams tend to be located in watersheds in which runoff responds quickly to precipitation events.
These streams are characterized by highly variable streamflows and can exhibit large flood events that occur within a 10-year return period. Among the nine hydrologic classifications, FER stream segments contain the lowest mean annual flows, but high inter-annual streamflow variability. FER stream reaches are generally located at low elevations, contain high slopes, and drain small watersheds. FER stream reaches are mainly located along California's southern coast and on the eastern side of the Coast Range. Many FER stream reaches are also located in the Mono and South East Desert Regions.

High Elevation and Low Precipitation (HELP): Stream reaches classified under the High Elevation and Low Precipitation (HELP) hydrologic regime are characterized by rain-driven hydrographs. The HELP hydrograph is characterized by winter peak flows and low magnitude baseflows during the rest of the year. Overall, HELP stream reaches receive very low precipitation on an annual basis. HELP stream reaches are considered relatively flashy, but are influenced by perennial baseflows. HELP stream reaches are primarily located within the Modoc Plateau region of northeastern California, and in the Klamath, Upper Sacramento, and North East Desert Regions of the Policy. These stream reaches tend to be located in high elevation areas underlain by volcanic geology.

The characteristics of these nine hydrologic classes are summarized in Table 1.

Table 1. Summary of Nine Hydrologic Classes

Class	Low Flow Characteristics	High Flow Characteristics	Seasonality	Predictability
SM	Many zero-flow days; Extended extreme low flow duration	Largest peak flows; Short flood duration	Very High	Very High
HSR	Long flood-free season; Very short extreme low flow duration; No zero flow days	Longest flood duration	High	High
LSR	Extended extreme low flow duration	Late spring peak flows	Very High	Very High
RGW	High minimum flows	Early summer peak flows	Low	Mid
WS	Extended extreme low flow duration	Winter peak flows; Frequent wet season high flows	High	High
GW	Extremely high minimum flow; No zero-flow days	No floods	Very low	High
PGR	High minimum flow	Winter peak flows	Low	Mid
FER	Most zero-flow days; Longest extreme low flow duration	Short large flood duration; Winter peak flows	Mid	Very low
HLP	High base flow; No zero-flow days	Late spring peak flows; Frequent winter high flows; Limited large floods	Mid	Very High

Lane, B., Sandoval, S., and Stein, E. (2017) "Characterizing diverse river landscapes using hydrologic classification and dimensionless hydrographs." In Prep.

Geology

California is located on the margin of active tectonic plates. California spans the boundary of the North American Plate and the Pacific Plate. The North American Plate is located in the eastern portion of California and the rest of North America. The Pacific Plate is located in the western portion of California and under the Pacific Ocean. The boundary between these two tectonic plates is visible today as the San Andreas Fault, an active transform tectonic plate boundary. California's highly complex geology has been simplified into geomorphic provinces, which characterize California's terrain and geology on a regional basis. The California Geologic Survey identifies the following 11 geomorphic provinces: Basin and Range, Cascade Range, Coast Ranges, Colorado Desert, Great Valley, Klamath Mountains, Modoc Plateau, Mojave Desert, Peninsular Ranges, Transverse Ranges, and Sierra Nevada (Figure 5) (CGS, 2002).

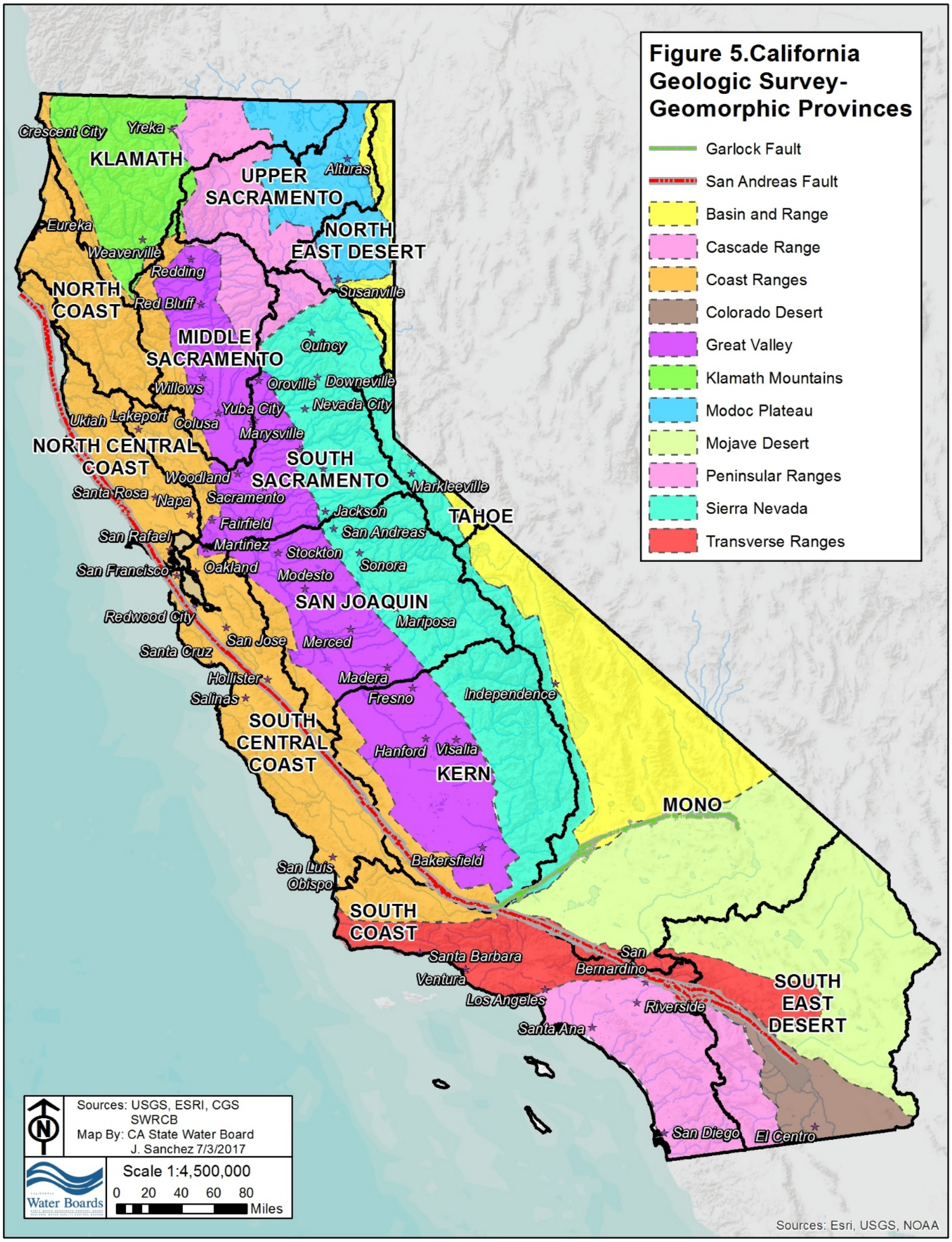

Figure 5.California Geologic Survey-Geomorphic Provinces
Garlock Fault
San Andreas Fault
Basin and Range
Cascade Range
Coast Ranges
Colorado Desert
Great Valley
Klamath Mountains
Modoc Plateau
Mojave Desert
Peninsular Ranges
Sierra Nevada
Transverse Ranges
KLAMATH
UPPER SACRAMENTO
NORTH EAST DESERT
NORTH COAST
MIDDLE SACRAMENTO
NORTH CENTRAL COAST
SOUTH SACRAMENTO
TAHOE
SAN JOAQUIN
SOUTH CENTRAL COAST
KERN
MONO
SOUTH COAST
SOUTH EAST DESERT
Crescent City
Yreka
Alturas
Eureka
Weaverville
Redding
Susanville
Red Bluff
Quincy
Oroville
Downieville
Willows
Nevada City
Yuba City
Ukiah
Lakeport
Colusa
Marysville
Woodland
Markleeville
Santa Rosa
Napa
Sacramento
Jackson
Fairfield
San Andreas
San Rafael
Martinez
Stockton
Sonora
San Francisco
Oakland
Modesto
Redwood City
Mariposa
San Jose
Merced
Santa Cruz
Hollister
Madera
Independence
Salinas
Fresno
Hanford
Visalia
San Luis Obispo
Bakersfield
Santa Barbara
San Bernardino
Ventura
Los Angeles
Riverside
Santa Ana
San Diego
El Centro
Sources: USGS, ESRI, CGS SWRCB
Map By: CA State Water Board J. Sanchez 7/3/2017
Scale 1:4,500,000
0 20 40 60 80
Miles
Water Boards
Sources: Esri, USGS, NOAA

Salmonid Species

Anadromous members of the taxonomic family Salmonidae, collectively known as anadromous salmonids, adapted over many thousands of years to the natural environment and climate variability of California. The three most historically abundant anadromous salmonid species native to California are Chinook salmon, coho salmon, and steelhead. Each of these anadromous salmonid species have multiple distinct populations, called evolutionarily significant units (ESUs), distinct population segments (DPSs), or distinct taxonomic entities[4] (DTEs). These species' characteristic anadromous lifestyle allows them to benefit from the relative safety of inland streams and estuaries during spawning, incubation, and rearing as well as the greater productivity of the ocean environment during maturation.

Human modification of the environment in California, particularly over the last 200 years, has significantly impacted the viability of anadromous salmonid populations in the state. Currently, three ESUs and DPSs of anadromous salmonids are listed as endangered and seven as threatened under the Federal Endangered Species Act (ESA) and/or the California Endangered Species Act (CESA). Six additional ESUs, DPSs, or DTEs are listed as species of concern or species of special concern by the National Marine Fisheries Service (NMFS) and/or CDFW, respectively. The presence of these listed and special-status[5] populations in the Policy regions is listed in Table 2. Information regarding the distributions, life histories, and threats to the viability of these special-status anadromous salmonids, as well as other salmonids of interest, is provided in Appendix 2.

[4] DTEs are populations given distinct consideration by CDFW, but they may be grouped as a larger ESU by federal entities.

[5] For the purposes of the Policy, the term "listed and special-status" refers to species or distinct populations that are federally listed as threatened or endangered, listed as threatened or endangered by the state of California, listed as a species of concern by NMFS, or listed as species of special concern by CDFW. No California salmonids were federally proposed for listing as threatened or endangered or designated as a State Candidate for threatened or endangered listing by the state of California at the time of the preparation of this report (CDFW 2017b).

Table 2: Listed and Special-Status Anadromous Salmonids by Policy Region

Special-Status Anadromous Salmonid Population (ESU/DPS/DTE)	Policy Region: Klamath	North Coast	North Central Coast	Tahoe	South Central Coast	Upper Sacram-ento**	Middle Sacram-ento	South Sacram-ento	San Joaquin	Mono	Kern	South Coast	North Eastern Desert	South Eastern Desert
South Oregon/Northern California Coastal Chinook Salmon ESU	S													
Upper Klamath-Trinity River Chinook Salmon														
*Fall-Run DTE**	S													
*Spring-Run DTE**	S													
Klamath Mountains Province Steelhead DPS	S													
South Oregon/Northern California Coastal Coho Salmon ESU	f/c - T	f/c - T	f/c - T											
California Coastal Chinook Salmon ESU		f - T	f - T											
Northern California Steelhead DPS		f - T	f - T											
Central California Coast Coho Salmon ESU			f/c - E		f/c - E									
Central California Coast Steelhead DPS			f - T		f - T			f - T						

Key: f = Federal Endangered Species Act c = California Endangered Species Act
T = Threatened E = Endangered S = California Special Concern ^ = Federal Special Concern
ESU = Evolutionary Significant Unit DPS = Distinct Population Segment DTE = Distinct Taxonomic Entities*

** DTEs are populations given distinct consideration by CDFW, but they may be grouped as a larger ESU by Federal entities.*
*** Historically the Upper Sacramento Region contained populations listed in this table, but upstream migration is blocked by Keswick Dam.*

Table 2: Listed and Special-Status Anadromous Salmonids by Policy Region (continued)

Special-Status Anadromous Salmonid Population (ESU/DPS/DTE)	**Policy Region**													
	Klamath	North Coast	North Central Coast	Tahoe	South Central Coast	Upper Sacram-ento**	Middle Sacram-ento	South Sacram-ento	San Joaquin	Mono	Kern	South Coast	North Eastern Desert	South Eastern Desert
Sacramento River Winter-Run Chinook Salmon ESU							f/c - E	f/c - E						
Central Valley Chinook Salmon														
Spring-Run ESU							f/c - T	f/c - T						
*Fall-Run DTE**							S^	S^	S^		S^			
*Late Fall-Run DTE**							S^	S^	S^		S^			
California Central Valley Steelhead DPS							f - T	f - T	f - T					
South Central California Coast Steelhead DPS					f - T									
Southern California Coast Steelhead DPS												f- E		

Key: f = Federal Endangered Species Act c = California Endangered Species Act
T = Threatened E = Endangered S = California Special Concern ^ = Federal Special Concern
ESU = Evolutionary Significant Unit DPS = Distinct Population Segment DTE = Distinct Taxonomic Entities*

* *DTEs are populations given distinct consideration by the CDFW, but they may be grouped as a larger ESU by Federal entities.*
*** Historically the Upper Sacramento Region contained populations listed in this table, but upstream migration is blocked by Keswick Dam.*

Water Quality Impairment – Clean Water Act Section 303(d) List

The Federal Clean Water Act gives states the primary responsibility for protecting and restoring surface water quality. Under the Clean Water Act, states that administer the Clean Water Act must review, make necessary changes, and submit the Clean Water Act section 303(d) lists to the United States Environmental Protection Agency (U.S. EPA). Clean Water Act section 305(b) requires each state to report biennially to U.S. EPA on the condition of its surface water quality. The U.S. EPA has issued guidance to states which requires the two reports to be integrated. For California, this combined report is called the California 303(d)/305(b) Integrated Report.

The State Water Board and the nine Regional Water Quality Control Boards (collectively Water Boards) assess water quality monitoring data for California's surface waters every two years to determine if they contain pollutants at levels that exceed protective water quality standards. Waterbodies and pollutants that exceed protective water quality standards are placed on the State Water Board's 303(d) List. This determination in California is governed by the Water Quality Control Policy for developing California's Clean Water Act Section 303(d) List. U.S. EPA must approve the 303(d) List before it is considered final. Placement of a waterbody and pollutant that exceeds protective water quality standards on the 303(d) List, initiates the development of a Total Maximum Daily Load (TMDL). In some cases, other regulatory programs will address the impairment instead of a TMDL.

For the Clean Water Act Section 305(b) Report, the Water Boards place the waterbody segments that were assessed into one of five Integrated Report beneficial use report categories. For this assessment, all readily available data are used to evaluate beneficial use attainment including aquatic life, drinking water supply, fish consumption, non-contact recreational, and swimming.

The 2012 Integrated Report for the Clean Water Act Section 303(d) List was reviewed for water quality impairments on streams to provide a generalized overview of 303(d) impairments in each of the Policy's nine priority regions. It is anticipated that this review and a generalized overview of 303(d) impairments in each of the Policy's five remaining regions will be developed and added to the final Staff Report.

State Water Board staff reviewed State Water Board Geographic Information System (GIS) data layers for 303(d) water quality impaired streams in the state. The 303(d) impaired streams were overlaid with the USGS NHD 12-digit Hydrologic Unit Code (HUC 12) watersheds. For the purposes of this analysis, if a HUC 12 watershed has a 303(d) impairment within its boundary the whole watershed is included in the area analysis even though only a portion of the watershed may have the impairment. The areas of the impaired HUC 12 watersheds were then compared to the total watershed area of the region. The impairments are discussed for each Policy priority region in Table 3, as a percentage of total area impaired by a water quality contaminant category or contaminant name. Specific pollutants and their affected stream reaches are discussed in more detail in the 2012 303(d) List, and in the Water Boards' Basin Plan(s) for each of the Policy priority regions.

Table 3: Water Quality Contaminants and Percent Impairment in the Nine Policy Priority Regions

		Percent of Area Impaired								
Region	**Area (Sq. Mi.)***	**Sediment**	**Temp****	**Nutrient**	**DO*****	**Salinity**	**Trash**	**Pesticides**	**Toxicity**	**Pathogens**
Klamath	10,897	55%	53%	45%	14%	-	-	-	-	-
North Coast	4,947	83%	81%	7%	6%	-	-	-	-	-
North Central Coast	4,784	72%	62%	26%	7%	4%	3%	13%	-	11%
Upper Sacramento	6,956	< 1%	8%	13%	-	4%	-	-	-	-
Middle Sacramento	8,561	-	-	16%	9%	< 1%	-	23%	24%	-
South Sacramento	14,195	< 1%	4%	4%	2%	-	-	10%	17%	-
San Joaquin	13,609	< 1%	6%	8%	2%	9%	-	19%	21%	2%
South Central Coast	10,050	20%	11%	17%	-	15%	6%	28%	14%	2%
South Coast	14,431	7%	3%	27%	-	24%	5%	14%	19%	4%
Kern	16,859	-	-	-	-	2%	-	4%	7%	-
North Eastern Desert	3,951	5%	-	5%	-	9%	-	-	9%	-
Tahoe	2,169	15%	-	30%	<1%	25%	-	-	-	-
Mono	26,673	-	-	<1%	<1%	1%	-	-	-	-
South Eastern Desert	19,859	6%	-	3%	-	5%	-	8%	8%	-

A "-" indicates that the contaminant is not listed within the given region on the State Water Board Geographic Information System (GIS) data layers for 303(d) water quality impaired streams in the state.
* Sq. Mi. = Square Miles
** Temp = Temperature
*** DO = Dissolved Oxygen

Overview of Cannabis Cultivation Impacts

Predominantly unregulated for years, thousands of cannabis cultivators have developed cultivation sites in remote areas of the state near streams. In many cases the routine cannabis cultivation practices result in damage to streams and wildlife. These practices (e.g., clearing trees, grading, and road construction) are often conducted in a manner that causes large amounts of sediment to flow into streams during rains. The sediment smothers gravel spawning beds needed by native fish. The cannabis cultivators also discharge pesticides, fertilizers, fuels, trash, and human waste around the sites, that then discharges into waters of the state. In the North Coast Region, the state has invested millions of dollars to restore streams damaged by decades of timber harvesting. Cannabis cultivation is now reversing the progress of these restoration efforts.

In addition to these water quality discharge related impacts, cannabis cultivators also impair water quality and aquatic habitat by diverting water from streams in the dry season, when flows are low. Diversion of flow during the dry season often completely dries up streams, stranding or killing native fish. The impacts of these diversions have been exacerbated in recent years by periods of drought. CDFW has received dewatering reports for at least 19 streams in northern California, all of which contain anadromous fish listed as threatened or endangered by the state and/or federal government. Diversions for cannabis cultivation also are known to occur in hundreds of streams with Coho salmon in the North Coast region and in countless other streams throughout the state, demonstrating that water quality and habitat-related impacts from cannabis cultivation are widespread.

Cannabis cultivation has been increasing in recent years, and the expansion is accelerating with the passage of MCRSA and AUMA legislation. A recent CDFW study (Bauer et al., 2015), using aerial surveys of four small watersheds in Humboldt and Mendocino counties found that the number of acres in cannabis cultivation doubled from 2009 to 2012, with an estimated 500 individual operations and approximately 30,000 plants in each of these small watersheds. The study concluded that water demand for cannabis cultivation has the potential to divert substantial portions of streamflow in the studied watersheds, with an estimated flow reduction of up to 23 percent of the annual seven-day low flow in the least impacted of the studied watersheds. Estimates from the other study watersheds indicate that water demand for cannabis cultivation exceeds the streamflow during the low-flow period. In the most impacted watersheds, diminished streamflow is likely to: have lethal or sub-lethal effects on state- and federally-listed salmon and steelhead trout; and cause further decline of sensitive amphibian species. The CDFW study concluded that cannabis cultivation on private land has grown so much in the North Coast region that Coho salmon, a federal and state listed endangered species, may go extinct in the near future if the impacts of cannabis cultivation are not addressed immediately. Rare (listed) and sensitive species affected by water diversion for cannabis cultivation in the North Coast region include: Coho salmon; Chinook salmon; steelhead trout; coastal cutthroat trout; southern torrent salamander; red legged frog; northern spotted owl; and Pacific fisher. Other species throughout the state such as deer, bear, and various birds are also being harmed by cannabis cultivation-related impacts to streams.
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Prior to the MRCSA legislation, the Legislature approved the Governor's proposed budget, which provided positions for a pilot project to reduce environmental damage caused by cannabis cultivation activities with direction "to improve the prevention of illegal stream diversions, discharges of pollutants into waterways, and other water quality impacts associated with marijuana production."

The pilot project included the collaboration of CDFW, the Central Valley Regional Water Board, North Coast Regional Water Board, and the State Water Board. The pilot project worked to address the damage to natural resources from cannabis cultivation where high levels of such cultivation are known to occur. The agencies formed a multi-agency task force (Task Force) that coordinates efforts to provide public outreach and education, perform site inspections, handle public complaints, and pursue enforcement actions related to cannabis cultivation activities. The North Coast Regional Water Board (Region 1) and Central Valley Regional Water Board (Region 5) adopted regional board specific water quality orders to address discharges related to cannabis cultivation under Orders R1-2015-0023 and R5-2015-0113, respectively. MCRSA and AUMA have subsequently directed CDFW and the State Water Board to expand the pilot project and Task Force statewide to address the environmental impacts of cannabis cultivation.[6] Reports from Task Force inspections conducted during the pilot program document extensive adverse environmental impacts to aquatic resources from cannabis cultivation activities, including increased erosion (e.g., road construction and site development on slopes greater than 30 percent), stream habitat degradation (e.g., water storage, site development, and road construction in and near waters of the state), and unlawful water diversion that severely limits the supply available for the public and wildlife/fish.

[6] Fish and Game Code section 12029(c) and Water Code section 13276(b).

BACKGROUND AND RATIONALE FOR POLICY REQUIREMENTS FOR WATER DIVERSION AND WASTE DISCHARGES ASSOCIATED WITH CANNABIS CULTIVATION

The State Water Board developed the Policy in accordance with Water Code section 13149 to establish Requirements to address impacts associated with the diversion of water and waste discharges related to cannabis cultivation.

Furthermore, pursuant to Water Code section 13276, the Water Boards may establish or adopt individual or general waste discharge requirements to address discharges of waste resulting from cannabis cultivation under Division 10 of the Business and Professions Code and associated activities. In addressing these discharges, the Water Boards must include conditions to address items that include, but are not limited to, the following:

- Site development and maintenance, erosion control, and drainage features
- Stream crossing installation and maintenance
- Riparian and wetland protection and management
- Soil disposal
- Water storage and use
- Irrigation runoff
- Fertilizers and soil
- Pesticides and herbicides
- Petroleum products and other chemicals
- Cannabis cultivation waste
- Refuse and human waste
- Cleanup, restoration, and mitigation

These 12 categories of discharge to waters of the state can generally be grouped according to the following types of discharge:

a. Discharges of sediment from land disturbance activities (e.g. road construction, grading), improper construction or maintenance of road stream crossings and drainage culverts; or improper stabilization and maintenance of disturbed areas, unstable slopes, and construction material (e.g., spoil piles, excavated material);
b. Discharges from land disturbance and development within and adjacent to wetlands and riparian zones;
c. Discharges of fertilizers and pesticides[7];

[7] The term "pesticide" is defined by California Code of Regulations Title 3. Division 6. Section 6000 as: (a) Any substance or mixture of substances that is a pesticide as defined in the Food and Agricultural Code and includes mixtures and dilutions of pesticides; (b) As the term is used in Section 12995 of the California Food and Agricultural Code, includes any substance or product that the user intends to be used for the pesticidal poison purposes specified in Food and Agricultural Code sections 12753 and 12758. Per California Food and Agricultural Code section 12753(b), the term "pesticide" includes any of the following: Any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest, as defined in

d. Spills or leaks of fuels, lubricants, hydraulic oil, or other chemicals associated with water diversion pumps, construction equipment, or other equipment; and
e. Discharges of trash, household refuse, or domestic wastewater.

Implementation of the Policy Requirements will reduce water quality degradation and water diversion impacts associated with cannabis cultivation.

Additional background and rationale regarding potential cannabis cultivation impacts to water quality from diversions and waste discharges related to cannabis cultivation are discussed below. As impacts associated with water diversions affect only a subset of cannabis cultivation sites (i.e., those with diversions) the background and rationale for Water Diversion, Storage, and Use follows the discussion of the background and rationale for more generally applicable impacts associated with cannabis cultivation that do not involve a water diversion.

Cleanup, Restoration, and Mitigation

Outdoor cannabis cultivation in California typically occurs on undeveloped parcels (as opposed to traditional agricultural lands). In addition to the cannabis cultivation area, there is also typically an indoor nursery and other support facilities (e.g., water supply and distribution, storage bays for soil amendments, generator(s) for power supply, storage sheds, access roads, etc.). Site grading is often a necessary first step to construct these facilities and the resultant disturbed area is vulnerable to increased erosion and sedimentation. Minimizing the extent of disturbance when developing a new site and performing associated clean up, restoring vegetation to pre-cannabis cultivation conditions, and mitigating any impacts to native vegetation through replanting or mulching, will reduce the threat to water quality. Within riparian zones, revegetation of disturbed areas is critical to prevent sediment, nitrogen, phosphorus, pesticides, and other pollutants from reaching a watercourse. Riparian buffers also provide valuable habitat for fish and wildlife (e.g., providing food, shelter, cover, and a travel corridor for wildlife).

Requirements contained in Policy Attachment A, *Section 2: "Cleanup, Restoration, and Mitigation"* specifically address these impacts.

Constituents of Concern

The Policy prohibits direct discharge of waste to surface waters and requires implementation of Requirements to prevent storm water mobilization of constituents of concern to waters of the state, which includes groundwater and surface waterbodies.

Water quality related constituents of concern associated with cannabis cultivation discharges include nitrogen, pathogens (represented by coliform bacteria), phosphorus, salinity, and turbidity. Water quality can be affected by excessive use of fertilizer, soil amendments, or other sources. The constituents have the potential to discharge to groundwater by infiltration and to other waters of the state by either surface runoff or by groundwater seepage. Each of the constituents of concern is discussed briefly below:

- ***Nitrogen.*** Nitrogen compounds may exist in a number of chemical compounds (ammonia, nitrite, nitrate, and organic nitrogen). Nitrogen may exist in any of the

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Section 12754.5, which may infest or be detrimental to vegetation, man, animals, or households, or be present in any agricultural or nonagricultural environment whatsoever. In layman's terms, "pesticide" includes rodenticides, herbicides, insecticides, fungicides, and disinfectants.

compounds, although nitrate is the primary compound absorbed by plants. Nitrate is also the most mobile of the nitrogen compounds in the environment. The potential for degradation depends on fertilizer application method, loading rate, crop uptake, and processes in the vadose zone related to immobilization and/or denitrification. The Policy requires compliance with Requirements, which include practices that limit the amount of nitrogen applied and control runoff from the cannabis cultivation area. In addition, cannabis cultivation sites that are enrolled in Tier 2 under the *General Waste Discharge Requirements for Discharges of Waste Associated with Cannabis Cultivation Activities* (Cannabis Cultivation General Order) and that have combined activities to create a cultivation area on a parcel that is equal to or larger than one acre, must submit a Nitrogen Management Plan[8]. Additional information on nitrogen is available below in the discussion of *Fertilizers, Pesticides, Petroleum Products* and Other Chemicals

- ***Pathogens and Microorganisms.*** Pathogens and other microorganisms are present in manure-based fertilizers, compost, biosolids, and soil amendments. Composting manure and/or biosolids will reduce the concentration of pathogens but not eliminate their presence. Exposure to sunlight will further reduce pathogen content. Coliform bacteria are used as a surrogate (indicator) because they are excreted by warm-blooded animals, are present in high numbers, survive in the environment similar to pathogenic bacteria, and are easy to detect and quantify. Public contact is minimized through physical controls and/or notification. The Policy requires implementation of Requirements, which include riparian setbacks, as well as other practices that limit potential for pathogen discharges from cannabis cultivation activities. Riparian setback Requirements reduce pathogenic risks by coupling pathogen inactivation rates with groundwater travel time to a well or other potential exposure route (e.g., water contact activities). In general, a substantial unsaturated zone reduces pathogen survival compared to saturated soil conditions. Fine grained (silt or clay) soil particles reduce the rate of groundwater transport and therefore are generally less likely to transport pathogens; coarse grained soil particles or fracture flow groundwater conditions may be more likely to transport pathogens.
- ***Phosphorus.*** Phosphorus compounds may exist in a number of chemical compounds (orthophosphate, polyphosphate, organic phosphate, phosphoric acid, and others). Phosphorus is quickly oxidized to phosphate, which is the compound absorbed by plants. Phosphate strongly adsorbs to soil particles and therefore has limited mobility in the environment. The potential for degradation depends on fertilizer application method, loading rate, and crop uptake. The Policy requires compliance with Requirements, which include practices that control runoff from the cannabis cultivation area.
- ***Salinity.*** Salinity is a measure of dissolved solids in water. Excessive salinity can reduce the beneficial uses of water. Salinity consists of both volatile (organic) and fixed (inorganic) fractions. In a well-operated cultivation system, volatile dissolved solids in percolate will be reduced to negligible concentrations. The best approach for addressing salinity is through source control activities. The Policy requires compliance with Requirements, which include practices that will limit the amount of salinity discharged from cultivation activities.
- ***Turbidity.*** Turbidity can be caused by suspended sediment, which can diffuse sunlight and absorb heat. This can increase temperature and reduce light available for

[8] The Nitrogen Management Plan is required to account for all of the nitrogen applied to cannabis cultivation areas (dissolved in irrigation water, originating in soil amendments, and applied fertilizers) and describe procedures to limit excessive fertilizer application.

algal photosynthesis. If the turbidity is caused by suspended sediment, it can be an indicator of erosion, either natural or manmade. In streams supporting wildlife, suspended sediments pose additional hazards. Suspended sediments can clog the gills of fish, and settled sediments can clog gravel beds, smother fish eggs, and impact aquatic life. The sediment can also carry pathogens, pollutants, and nutrients, further exacerbating water quality impacts. Excessive nutrient loads in water bodies resulting from human activities, such as agricultural discharges, can encourage the development of harmful algal blooms or cause excessive growth of algae and aquatic plants in streams, also thereby affecting turbidity. Severe algal growth blocks light that is needed for aquatic plants, to grow. When algae and aquatic plants die and decay, it leads to low levels of dissolved oxygen in the water. This in turn, can kill aquatic life. (NOAA, 2017) Most of the nine Regional Water Board's water quality objectives for turbidity require that surface waters (except ocean waters) be free of changes in turbidity that cause nuisance or adversely affect the beneficial use of water. Water quality control plans (often referred to as Basin Plans) may contain specific turbidity and suspended sediment requirements; implementation of applicable Policy Requirements will be effective in controlling turbid discharges. In some cases, the cannabis cultivator will have to implement multiple Policy Requirements, or increase the density or application of Policy Requirements (e.g., storm water measures) to achieve water quality protection.

Requirements contained in Policy Attachment A, *Section 2: "Fertilizers, Poisons, and Petroleum Products"* specifically address the impacts discussed in this *"Constituents of Concern"* section. Also see Policy Attachment A, *Section 1: "General Requirements and Prohibitions"* and *"Cannabis General Water Quality Certification."*

Cultural Resource Protection

Cannabis cultivation often occurs in undeveloped or lightly disturbed sites. Frequently, cannabis cultivation requires land clearance and ground disturbing activities as part of site preparation. As such, cannabis cultivation has a higher risk of disturbing previously undisturbed human remains, archeological resources, and sites that are of cultural value to California Native American tribes. Accordingly, the Policy includes Requirements to protect these resources from the negative impacts of cannabis cultivation.

Requirements contained in Policy Attachment A, *Section 1: "General Requirements and Prohibitions"* specifically address these impacts.

Fertilizers, Pesticides, Petroleum Products and Other Chemicals

The over or improper use and storage of potting soil, amendments, fertilizers, pesticides, poisons and petroleum products can lead to significant soil and water contamination. Each of these is discussed briefly below.

- ***Fertilizers.*** Potting soil, soil amendments, and fertilizers can contain excess nutrients, particularly nitrogen and phosphorus (see discussion under *Constituents of Concern* above), that can contribute to toxic algae blooms, and deplete the dissolved oxygen that fish and other aquatic species need to survive. Nitrogen is a primary plant nutrient that is taken up by plants as nitrate or ammonium ions. Nitrate is mobile in the environment and can move with soil water to plant roots where uptake can occur; ammonium nitrogen is sorbed to soil particles and has limited mobility in the environment. All forms of nitrogen can be converted to nitrate, by microbial activity, under the proper conditions (e.g., temperature, aeration, moisture, etc.).

- Nitrogen or nitrogen compounds may be lost to the atmosphere by the process of denitrification or by ammonia volatilization. Nitrate may be leached below the root zone by percolation. Erosion of nitrogen containing materials may transport nitrogen containing materials to surface water.
- Symptoms of nitrogen deficiency in plants include slow growth, yellow green color (chlorosis), “firing” of tips and margins of leaves beginning with more mature leaves. Chlorosis is usually more pronounced in older plant tissue since nitrogen is mobile within plants and tends to move from older to younger tissue when nitrogen availability is limited. (CPHA 1980)
- The rate of nitrogen uptake by crops changes during the growing season. For planning and nutrient balances, the rate of nitrogen uptake can be approximately correlated to the rate of plant transpiration. Consequently, the pattern of nitrogen uptake is subject to many environmental and management variables and is crop specific.
- Some forage crops can have higher nitrogen uptake rates than those in agricultural publications. “Luxury consumption” may occur in the presence of surplus nitrogen and result in higher than normal crop uptake rates.
- Generally young plants absorb ammonium more readily than nitrate; however, as the plant ages the reverse is true. Soil conditions that promote plant growth (warm and well aerated) also promote the microbial conversion of ammonium to nitrate. As a result, nitrate is generally more abundant when growing conditions are most favorable. (Brown and Caldwell, 2007)
- The Policy allows up to 1.4 times the crop uptake rate to compensate for the nitrogen that is not plant available or lost through denitrification or ammonia volatilization, and also allows for short-term additional nitrogen application if needed based on visual observation of the plant and laboratory analysis of plant tissue demonstrating limited nitrogen availability. The factor of 1.4 is designed to address the limited data regarding cannabis nitrogen uptake rates, and the variable nitrogen cycle processes described above. Other Requirements in the Policy provide adequate protection of water quality that substantiates use of the increased application factor (1.4).
- A 2004 study at the University of Northern British Columbia evaluated nitrogen uptake values for Cannabis sativa (Forrest, 2004). The study reported a nitrogen uptake rate of 228 lbs/acre/year. Using the application factor of 1.4, allows a nitrogen application rate of 319 lbs/acre/year. The application rate includes all sources of nitrogen, including soil amendments, bulk fertilizers, and liquid fertilizers. Because cannabis grown for medical or personal use is not cultivated as densely as hemp, the Policy limits nitrogen application using the units “pounds/canopy acre/year.” Typically, one canopy acre occupies more than one acre of land. Using the simpler units “pounds/acre/year” would result in the application of nitrogen beyond the crop need.

- ***Pesticides.*** Pesticides can lead to many unintended negative effects, and are easily mobilized by storm water runoff. Pesticides need to be used and stored in a manner that prevents them from entering waters of the state. Poisons used to exterminate garden pests such as rats, mice, gophers, and moles can move up through the food chain and cause secondary poisoning and mortality of family pets, and predators such as owls, bobcats, foxes, and the Pacific Fisher (P*ekania pennanti*). There are many effective practices for controlling pests and enhancing soil and plant growth that do not require chemical fertilizers or pesticides. Business and Professions Code section 26060(d) requires the California Department of Pesticides Regulation (DPR) to develop guidelines for the use of pesticides in cannabis cultivation and guidelines for maximum tolerances for pesticides and other foreign object residue in harvested cannabis. Currently no pesticides have been approved by regulatory agencies for use on cannabis. In 2015, DPR published Legal Pest Management Practices for Cannabis Growers in California (CDPR 2015), which lists active ingredients that are exempt from residue tolerance requirements. The active ingredients that can be legally used on cannabis plants in California are either exempt from registration requirements or registered for a use that's broad enough to include its use on cannabis. Federal law requires that the use of pesticides be consistent with product labeling. The Policy requires that all pesticide application is done in compliance with labelling instructions and other applicable laws and regulations. The Policy further requires that pesticides be used and stored in a manner that ensures that pesticides will not enter or be released to waters of the state.

- ***Petroleum Products.*** Petroleum products (e.g., gasoline, diesel, oil, and grease) are toxic to aquatic wildlife and commonly spill or leak from vehicles, equipment, and storage areas. If petroleum products are mobilized, they have the potential to discharge to waters of the state during rain events.

Requirements contained in Policy Attachment A, Section 5: "*Nitrogen Management Plan*" and Section 2: "*Fertilizers and Soils*" specifically address these impacts.

General Water Quality Certification

Activities that involve construction and other work in waters of the United States may require a permit from the United States Army Corps of Engineers (Army Corps) pursuant to section 404 of the Clean Water Act. Section 401 of the Clean Water Act requires every applicant for a federal license or permit to provide the licensing or permitting federal agency with a section 401 water quality certification that the project will be in compliance with state water quality standards and implementation plans promulgated pursuant to section 303 of the Clean Water Act, and other appropriate requirements of state law.

The State Water Board may issue a decision on a water quality certification application.[9] State water quality certification conditions become conditions of any federal license or permit for the project. The State Water Board may issue a general water quality certification for a class or classes of activities that, as here, are the same or similar, or involve the same or similar types of discharges and possible adverse impacts to water quality if it determines that these activities are more appropriately regulated under a general certification rather than individual certifications.[10]

<u>Dredge or Fill Materials</u>

Some activities related to establishing or maintaining cannabis cultivation sites or access roads may involve the discharge of dredge or fill material into waters of the United States (US) or waters of the state (e.g., excavation for a culvert, irrigation pipe, or pump structure installation).

[9] California Code of Regulations title 23 section 3838.
[10] California Code of Regulations title 23 section 3861.

Dredged material is material that is excavated or dredged from a waterbody.[11] Fill material is material placed into a waterbody that has the effect of either replacing any portion of the water with dry land or changing the bottom elevation of the waterbody.[12] Cannabis cultivators are required to obtain authorization for discharges of dredge or fill materials to the waters of the US or to the non-federal waters of the state as described below:

> Discharges of dredged or fill material to waters of the US are regulated by the Army Corps under section 404 of the Clean Water Act and a water quality certification under section 401 of the Clean Water Act. Exempt activities include, among other things: normal farming, ranching and silviculture activities; maintenance of currently serviceable structures such as dikes, dams, levees, bridge abutments or approaches, and transportation structures; construction or maintenance of irrigation ditches, or maintenance (but not construction) of drainage ditches; and construction of farm roads or forest roads in compliance with applicable best management practices. Converting a wetland to a non-wetland or conversion from one wetland use to another (such as from silviculture to farming) is not exempt. Dischargers, including cannabis cultivators, proposing non-exempt discharges of dredged or fill material are required to obtain a section 404 permit from the Army Corps. Section 401 of the Clean Water Act requires an applicant for a dredge and fill permit to provide certification from the state that the proposed activity also complies with state water quality standards. Any conditions in a section 401 water quality certification are incorporated into the section 404 permit. The Army Corps may not issue a section 404 permit if the state denies certification. In California, the Water Boards issue water quality certifications. California law requires dischargers of dredged or fill material to obtain waste discharge requirements for those activities, whether or not the discharger obtains a section 404 permit and section 401 water quality certification.

The Cannabis Cultivation General Order serves as waste discharge requirements for cannabis-cultivation discharges of dredge and fill materials. Cannabis cultivators enrolled in and conducting activities in compliance with the Cannabis Cultivation General Order will not be required to obtain coverage for such activities under Water Quality Order No. 2004-0004-DWQ (*Statewide General Waste Discharge Requirements for Dredged or Fill Discharges to Waters Deemed by the U.S. Army Corps of Engineers to be Outside of Federal Jurisdiction*), Water Quality Order No. 2003-0017-DWQ *(Statewide General Waste Discharge Requirements for Dredged or Fill Discharges that Have Received State Water Quality Certification*), or any successor order. Cannabis cultivators that require a section 401 water quality certification may either seek coverage under the Cannabis General Water Quality Certification or apply to the State Water Board or applicable Regional Water Board for a site-specific water quality certification.

The Policy includes a Cannabis General Water Quality Certification for cannabis cultivation activities that may require a federal permit. Cannabis cultivators seeking Clean Water Act section 401 water quality certification for a project must notify the appropriate Regional Water Board or State Water Board 60 days prior to the proposed commencement of the activity and submit information regarding the construction schedule and other relevant information.

[11] Cf. Code of Federal Regulations section 323.2(c) [defining “dredged material” under federal law].
[12] Cf. 33 Code of Federal Regulations section 323.2(e) [defining “dredged material” under federal law].

Unless the Regional Water Board or State Water Board determines that the project or activity does not meet the specified criteria for coverage under the General Water Quality Certification, the General Water Quality Certification will provide section 401 water quality certification coverage for the federal permit required for that project. Cannabis cultivators must not commence the activity until the appropriate Regional Water Board or State Water Boar notifies the cannabis cultivator that the work is authorized. A list of projects authorized by this General Water Quality Certification will be posted on the appropriate Regional Water Board and State Water Board's website and will serve as notice to the United States Army Corps of project coverage. Projects that do not meet the criteria for coverage under the General Water Quality Certification must apply for individual certification.

The General Water Quality Certification contained in the Policy does not apply to activities that will: 1) result in significant unavoidable environmental impacts including permanent impacts to wetlands and other waters from dredge and fill activities, and/or violation of water quality standards; 2) result in the potential direct or indirect take of any listed species; or 3) expose people and/or structures to potential adverse effects from flooding, landslides or soil erosion.[13]

Requirements contained in Policy Attachment A, *Section 1: "Cannabis General Water Quality Certification"* specifically address these impacts.

Indoor Cultivation Sites

Indoor cannabis cultivation using hydroponic growing systems, soil, or other growth media generate wastewater as excess irrigation water drains from the growth media or when hydroponic water is discarded. This wastewater may contain elevated amounts of salinity and nutrients, as well as pesticides, including: fungicides, herbicides, insecticides, and algicides.

Many cannabis cultivators pretreat municipal and well water to remove unwanted constituents, such as heavy metals and chloramines, using Reverse Osmosis (RO) or similar systems. This process indiscriminately strips the source water of nearly all constituents, creating a permeate and a concentrate stream. Consequently, this may increase the total volume of concentrated wastewater on site. It may also increase the amount of concentrated nutrients and salts stored onsite since the permeated blank water's chemistry must be readjusted to make it suitable for irrigation.

Some cannabis cultivators collect wastewaters, including RO brine, into an evaporation system to simultaneously reduce the volume of their waste stream and increase the humidity of their growing environment. The evaporation process, along with the RO process, may require periodic flushing or cleaning, which may increase the amount of cleaning solvents and descaling compounds in the wastewater.

Tank and Haul

To protect the quality of waters of the state from constituents generated during the indoor cultivation process, cannabis cultivators may "Tank and Haul" their industrial wastewater. This option is designed for cannabis cultivators at locations without an available service connection to a permitted wastewater treatment collection facility that accepts industrial wastewater from cannabis cultivation activities. These sites are often located in rural areas where onsite wastewater treatment systems such as septic tanks are typically used to treat domestic wastewater (i.e. sewage) in lieu of sewer systems.

[13] California Code of Regulations title 23 section 3861(d).

The industrial wastewaters generated during indoor cannabis cultivation may be collected in an appropriate tank or storage container and regularly disposed of by a permitted wastewater hauler who transports the waste from the cultivation site to a permitted wastewater treatment collection facility that accepts industrial wastewater from cannabis cultivation activities.

Riparian Setback and Tribal Buffer Exemptions

Some indoor cannabis cultivation activities may qualify for an exemption from the riparian setback and tribal buffer requirements in Attachment A of the Policy due to their low threat of environmental impact. However, if the Regional Water Board Executive Officer determines conditions are not protective of water quality, all riparian setback requirements will apply. The setback exemption applies only to the permitted structure within which cannabis cultivation activities occur. Any outdoor cannabis cultivation activities (i.e., storage of water, wastewater, composts, soil, chemicals, and equipment) are subject to the applicable riparian setback requirements in Attachment A.

To qualify for the exemption, indoor cannabis cultivation structures must have an approved building permit on file with the county, city, or local jurisdiction. The discharger must also have a current certificate of occupancy approved by the local jurisdiction for indoor cannabis cultivation. These two documents will ensure the construction of the structure is complete, built to code, and is permitted for its intended use.

If construction began on the structure before October 1, 2018, it may be eligible for the riparian setback and tribal buffer exemptions if:

1. It is connected to and discharges any industrial wastewater to a permitted wastewater treatment collection system and facility that accepts cannabis cultivation wastewater; or
2. It is connected to and discharges any industrial wastewater directly to an appropriately designed storage tank and the discharge is properly disposed of by a permitted wastewater hauler at a permitted wastewater treatment facility that accepts cannabis cultivation wastewater.

If construction began on the structure on October 1, 2018 or later, it will only be eligible for the riparian setback and tribal buffer exemption if it is connected to and discharges any industrial wastewater to a permitted wastewater treatment collection system and facility that accepts cannabis cultivation wastewater.

Requiring the structure to have a connection to a permitted wastewater treatment collection system (on or after October 1, 2018) is key to upholding two fundamental intentions of the exemptions:

1. It limits the exemptions to urban sites. The indoor exemptions are generally designed for sites in developed areas, with established infrastructure, where the threat to water quality is low despite their proximity to urban streams.
2. It maintains protection of water quality against the impacts of cannabis cultivation. Discharging wastewater to a treatment collection system eliminates the inherent risk of spills and leaks associated with storing wastewater onsite and transferring it regularly from the tank to a truck.

Cannabis cultivators with approved setback exemptions are still required to obtain all applicable permits and approvals prior to doing any work in or around waterbodies or within the riparian setbacks. Permits may include, but are not limited to section 404/401 CWA permits, and CDFW LSA Agreements.

Requirements contained in Policy Attachment A, *Section 1: "General Requirements and Prohibitions"* and Requirements contained in Policy Attachment A, *Section 2 "Cultivation-Related Waste"* specifically address these impacts.

Irrigation Runoff

Irrigation runoff occurs when water is applied at too great a rate or quantity. Because site runoff cannot be used by the plant, it is considered a waste and unreasonable use of water. Additionally, runoff has the potential to transport sediment, pesticides, fertilizers, and other harmful constituents to waters of the state. As a result, irrigation that causes runoff can be considered a waste and unreasonable use of water as well as a threat to water quality and designated beneficial uses.

Requirements contained in Policy Attachment A, *Section 2: "Irrigation Runoff"* specifically address these impacts.

Land Disturbance and Erosion Control

Sediment from erosion is a major pollutant impairing many waters of the state. Excess sediment is defined as soil, rock, sand, silt, or clay that is delivered to waters in an amount that could negatively impact aquatic life, water quality, and designated beneficial uses. Improperly constructed or maintained roads, land development, and improper site maintenance are key factors that can contribute to erosion.

Sediment may degrade water quality in numerous ways. It reduces the amount of oxygen available to plants and animals and can carry fertilizers and other chemicals mobilizing them and carrying them into waterways. Once in the stream system, sediment fills in spawning gravels and negatively impacts salmon and steelhead's ability to successfully form redds[14]. The sediment reduces the available oxygen in redds that are formed, which can result in egg mortality and lower survival rates. Sedimentation in streams can cause or contribute to flooding, impede stream flow, increase water temperatures, and promote growth of toxic algae in the summer and fall.

Requirements contained in Policy Attachment A, *Section 2: "Land Development and Maintenance, Erosion Control, and Drainage Features"* specifically address these impacts.

Onsite Wastewater Treatment Systems

The Policy does not authorize discharges of either industrial or domestic wastewater to onsite wastewater treatment systems. Treatment and disposal of domestic wastewater that uses subsurface disposal may be regulated by a local agency or a Regional Water Board, consistent with the *Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems*[15] (OWTS Policy). To date, local agencies have only been authorized to permit domestic wastewater discharges. Discharges of industrial wastewater, such as hydroponic or irrigation tail water generated in indoor cultivation activities, must be permitted by the appropriate Regional Water Board or State Water Board.

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[14] Spawning areas or nests made by a salmon or trout.

[15] The OWTS Policy is available online at: http://www.waterboards.ca.gov/water_issues/programs/owts/docs/owts_policy.pdf.

Use of cesspools is not authorized by the OWTS Policy and local agencies cannot approve their use. An outhouse may be acceptable in limited circumstances where the use is very limited, only human waste is discharged, and the use is protective of water quality. However, approval from the Regional Water Board must be obtained before initiating or continuing use of an outhouse. Factors that reduce the threat to water quality include a large property parcel size, relatively level terrain (topography), location outside flood hazard zones, very limited use, and no public access. Alternatives to an outhouse or cesspool include a properly designed septic system and leach field, a regularly serviced holding tank, or regularly serviced chemical toilets.

Requirements contained in Policy Attachment A, *Section 2: "Refuse and Domestic Waste"* specifically address these impacts.

Refuse, Domestic Waste, and Cannabis Cultivation Waste

Fish and Game Code section 5650 states that it is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of the state, any substance or material that may harm fish, plant life, mammals, or bird life. This includes sediment/soil, petroleum products, fertilizers, pesticides, and poisons. Fish and Game Code section 5652 states that it is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of the state or to abandon, dispose of or throw away, within 150 feet of the high water mark of waters of the state, any cans, bottles, garbage, motor vehicle or parts thereof, rubbish, litter, refuse, waste, debris, or the viscera or carcass of any dead mammal or the carcass of any dead bird.

Many cannabis cultivation sites are on lands that have never included permanent habitation on the property. This has led to the development of temporary facilities, both for living quarters and for human needs (bathrooms and bathing), that do not meet industry standards. Many cannabis cultivation properties were selected because they were remote and there is often a lack of county or city services like water, power, sewer, or garbage collection at these sites. Improperly stored or disposed trash and biological waste can become a source of contamination in waters of the state, either by direct leaching or mixing of fluids, or runoff from irrigation or storm events.

Additionally, cannabis cultivation, like other agricultural activities, generates waste (e.g., fertilizer containers, spent growth medium, soil amendments, etc.). If not managed properly, this waste has the potential to impact water quality and designated beneficial uses of waters of the state.

Requirements contained in Policy Attachment A, *Section 2: "Refuse and Domestic Waste"* specifically address these impacts.

Riparian and Wetland Protection and Management

Adequate riparian setbacks are the most important component to ensuring that land disturbance activities and discharges of waste do not negatively impact water quality or aquatic habitat. The Cannabis Policy establishes statewide riparian setbacks. Due to the infeasibility of setting riparian setbacks on a case-by-case basis based on site-specific conditions, setting these setbacks conservatively is appropriate to ensure that water quality and aquatic habitats will remain protected from potential cannabis cultivation impacts under a variety of site-specific conditions.

The riparian setback requirements in the Cannabis Policy reduce impacts to water quality, aquatic habitat, springs, and wetlands from clearing or conversion of riparian buffer zones or wetland areas for cannabis cultivation. Riparian buffers reduce water temperatures, provide cover for aquatic species, help to create and enhance aquatic habitat, support food production, and filter out sediment and pollution. Conversely, removal of vegetation in the riparian buffer zone can result in increased water temperatures due to solar radiation, reduction of quantity and quality of aquatic and terrestrial habitat, and increased bank instability and erosion. Disturbed areas within riparian buffer zones are more likely to discharge waste to surface water and/or result in loss of vegetation.

In general, the riparian setback requirements in the Cannabis Policy are based on the State Water Board's knowledge and expertise, information from the *California Forest Practice Rules* (FPRs) (Title 14, California Code of Regulations Chapters 4, 4.5 and 10), *North Coast Regional Water Quality Control Board Waiver of Waste Discharge Requirements and General Water Quality Certification for Discharges of Waste Resulting from Cannabis Cultivation and Associated Activities or Operations with Similar Environmental Effects in the North Coast Region* (Order No. R1-2015-0023), *Central Valley Regional Water Quality Control Board Waste Discharge Requirements General Order for Discharges of Waste Associated with Medicinal Cannabis Cultivation Activities* (Order No. R5-2015-0113), and other literature sources and laws[16].

The FPRs have different Watercourse and Lake Protection Zone (WLPZ) setbacks for Class I, II, III, and IV watercourses and for slopes less than 30 percent, 30 to 50 percent, and greater than 50 percent. The WLPZ requirements also vary based on stream size and stream channel shape. The FPRs primarily address timberland harvest and management, but also allow for timberland conversion to other uses. Cannabis cultivators typically apply for the less-than-three-acre conversion under the FPRs when establishing a cannabis cultivation site in timberland. Timber activities for these conversions are not allowed within the WLPZ unless they are specifically approved by a local permit (e.g., county or city). In establishing the WLPZ setbacks for land conversions, FPRs state "*In determining whether or not to make the written finding contained in Public Resource Code section 4621.2(a)(3)[17] [for the proposed alternate use], the Director or the Board [State Board of Forestry and Fire Protection] upon appeal shall consider the following elements: whether the soil types and characteristics can support the proposed use, the erosion potential of the soils and slopes in light of the proposed use, potential mass land movement or subsidence possible harm to quality or quantity of water produced in the watershed, fire hazard and risk to the watershed, adverse effects to fish and wildlife from removal of habitat cover, and such other elements as appropriate."* (California Code of Regulations title 14, Chapter 4. Forest Practices section 1109.4.)

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[16] Fish and Game Code section 5652(a) which states "it is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of the state or to abandon, dispose of or throwaway, within 150 feet of the high water mark of waters of the state, any cans, bottles, garbage, motor vehicle or parts thereof, rubbish, litter, refuse, waste, debris, or the viscera or carcass of any dead mammal or the carcass of any dead bird."

[17] Public Resource Code section 4621.2(a)(3) states "if the timberlands which are to be devoted to uses other than the growing of timber are zoned as timberland production zones under Section 51112 or 51113 of the Government Code, the application shall specify the proposed alternate use and shall include information the board determines necessary to evaluate the proposed alternate use. The board shall approve the application for conversion only if the board makes written findings that all of the following exist:
(1) The conversion would be in the public interest.

While the FPRs serve the primary basis for the riparian setbacks in the Cannabis Policy, the FPRs' riparian setbacks focus on sedimentation and riparian shade tree removal; they do not address the range of other potential water quality impacts associated with cannabis cultivation, including those stemming from fertilizer and pesticide use.

For example, sediment can be physically filtered out of stormwater faster than dissolved nitrogen, which requires bacterial transformation to remove it. Thus, a narrower buffer would be needed to remove sediment than that needed to remove dissolved nitrogen. In *Riparian Buffer Zones: Functions and Recommended Widths* (Hawes and Smith 2005 as cited in Pennsylvania Land Trust Association 2014), the authors summarize the results of scientific studies, identifying the buffer widths needed for a buffer to effectively serve particular functions; and report the following ranges:

- Erosion/sediment control 30 feet to 98 feet
- Water quality:
    - Nutrients 49 feet to 164 feet
    - Pesticides 49 feet to 328 feet
    - Biocontaminants 30 feet or more (e.g. fecal matter)
- Aquatic habitat:
    - Wildlife 33 feet to 164 feet
    - Litter/debris 50 feet to 100 feet
    - Temperature 30 feet to 230 feet

Existing cannabis cultivation, especially in Northern California, is located within watersheds at higher elevations than traditional agriculture. Consequently, many of these cannabis cultivation sites are located in sensitive headwaters with high ecological value that need protective riparian setbacks. Headwater streams are smaller tributaries and springs that are located in the upper reaches of watersheds and represent the majority of the stream miles in the United States (Pennsylvania Land Trust Association 2014). Headwater streams that are located in the upper watersheds are generally considered Strahler first order or second order streams[18]. Based on an assessment of the mapped first order and second order stream miles in the United States Geological Survey National Hydrography Dataset Plus version 2.1 (Medium Resolution or 1:100,000 scale) geographic information system stream layer (NHD Plus V2.1 stream layer), approximately 60 percent of the mapped stream miles in California are first order streams and 80 percent are first or second order streams. In addition, due to their small size and lack of a defined channel, many springs in the upper watersheds are not represented in the NHD Plus V2.1 stream layer. Headwater streams and springs are especially important as they contain the highest ecological value for protecting downstream aquatic health. The small size of headwater streams and springs makes them highly vulnerable to degradation as they are not as resilient to pollutants and disturbance as larger streams. Headwater streams and springs provide

(2) The conversion would not have a substantial and unmitigated adverse effect upon the continued timber-growing use or open-space use of other land zoned as timberland preserve and situated within one mile of the exterior boundary of the land upon which immediate rezoning is proposed.
(3) The soils, slopes, and watershed conditions would be suitable for the uses proposed if the conversion were approved.

[18] Strahler stream order: A numeric method to provide an approximate measure of stream size and describe the hierarchical branching complexity of a stream system. The union of two first-order streams results in a second-order stream, the union of two second-order streams results in a third-order stream, and so on. As stream order increases, so too does relative stream size. First- and second-order streams are typically small, headwater streams, each of short length and small drainage area.

important habitat for many amphibians and act as refugia for riverine species during specific life-history stages and critical periods of the year. (Pennsylvania Land Trust Association 2014.).

Water Code section 13149(a)(1)(A) directs the State Water Board to develop measures to protect springs, wetlands, and aquatic habitat from negative impacts of cannabis cultivation. The Cannabis Policy riparian setbacks for headwater streams and springs are more protective than those identified in the FPRs for non-domestic and non-fish bearing streams to ensure that cannabis cultivation does not negatively impact these sensitive, high ecological resource areas.

As outlined in the *Cannabis Policy Attachment A, Section 1. General Requirements and Prohibitions, Requirement 37*, a standard riparian setback is used for each watercourse type or class (e.g., Perennial – Class I, Intermittent – Class II, Ephemeral – Class III, and other watercourses – Class IV) regardless of site slope. Standard setbacks are established to ensure protective setbacks are implemented throughout the state and provide consistency for purposes of regulatory clarity, compliance, and enforcement. Fixed width buffers have been found to be more easily enforced, do not require regulatory personnel with specialized knowledge of ecological principles, and require less time and money to administer (Johnson & Ryba 1992). Additionally, fixed riparian buffers do not require site-specific evaluation by professionals to determine appropriate setbacks based on factors such as sediment type, slope, erosion and mass wasting potential of site, stream size and channel form, and other site-specific considerations. The riparian setback in the Cannabis Policy for perennial streams is consistent with the standard FPRs WLPZ setbacks for coastal streams that support threatened and endangered anadromous salmonids. For other watercourses, the Cannabis Policy conservatively uses the standard FPRs WLPZ setbacks for slopes greater than 50 percent. These values were chosen to reflect that the FPRs were primarily developed for timber harvest activities, not cannabis cultivation activities that are more varied and complex than timber harvest.

In some instances, the Policy includes a larger riparian setback than was included in the Regional Water Board orders. Under the Policy, cannabis cultivators enrolled in a Regional Water Board order adopting waste discharge requirements (WDRs) or a waiver of WDRs for cannabis cultivation activities prior to October 17, 2017, may retain reduced setbacks applicable under that Regional Water Board order unless the Executive Officer determines that the reduced setbacks applicable under that order are not protective of water quality. The grandfather status, while not as protective as the Policy setback, is allowed for the following reasons:

- Reconfiguring existing facilities that have already implemented mitigation measures to stabilize and reduce the potential threat of discharges of waste under the Regional Water Board' cannabis cultivation orders would generate new areas of disturbed land and require stabilization of existing disturbed areas. Requiring such work would likely require the use of heavy equipment and transportation of construction equipment to the site. In many instances, the overall impact of such activity may be greater than the benefit that would be realized by requiring the work.

- Grandfathered sites that expand their cultivation or other cannabis related activities must comply with the larger riparian setbacks for any new disturbed areas. It is anticipated that over time, some sites likely will migrate away from the waterbody and comply with the more conservative setbacks.

- Impacts from enrolled facilities that comply with the existing regional water board orders are already mitigated through implementation of technical reports submitted to and approved by Regional Water Boards.

- There are a limited number of enrolled facilities in both regions. While it is desirable for all cannabis cultivation activities to comply with the more protective riparian setbacks, the relatively small number of sites with the reduced setback under the existing Regional Water Boards' cannabis cultivation orders are not anticipated to create significant water quality degradation.

Requirements contained in Policy Attachment A, *Section 2: "Riparian and Wetland Protection and Management"* specifically address these impacts.

Road Construction and Maintenance

Proper design, location and maintenance of access roads is necessary to prevent or minimize sediment discharges to waters of the state. Poorly constructed or maintained road features, such as drainage, culverts, fill prisms, and cut slopes can significantly increase erosion and sediment discharge. Poorly constructed or maintained watercourse crossings often lead to catastrophic failures that severely damage access roads and receiving waters, degrading or eliminating habitat essential to fish and other aquatic life.

Unsurfaced logging roads and logging road watercourse crossings are generally the principle source of sediment delivered to watercourses associated with timber operations. To mitigate these impacts, the FPRs include requirements that significantly reduce sediment discharge to waters of the state (Cafferata 2015). Site development activities (e.g., road building) and timber harvest activities are subject to the California Water Code. The California Department of Forestry and Fire Protection (CAL FIRE) is the lead agency responsible for regulating timber harvesting under the FPRs. The State Water Board, California Board of Forestry and Fire Protection, and CAL FIRE entered into a Management Agency Agreement in 1988 to oversee water quality protection on Timber Harvest Plans (THPs). The FPRs require the submission and approval of a THP before the start of most timber operations. Once a THP is submitted to CAL FIRE, Regional Water Board staff review the plan along with CDFW, California Geological Survey, and CAL FIRE. Following plan approval by CAL FIRE, and prior to beginning timber harvest activities, land owners must apply to the appropriate Regional Water Board for waste discharge requirements (WDRs) or waivers of WDRs for discharges to waters of the state.

Qualified Professionals and licensed earthwork and paving contractors should be used to design, locate, construct, and inspect access roads to reduce the impacts of road construction and use. Common examples of road drainage and maintenance issues include: surface rills or ruts, cut slopes that are undercut or failing, fill prism downcutting or failure, downcutting at drainage or watercourse crossing culvert outlets, erosion around or under watercourse crossing culverts or bridges, and debris accumulation or plugging of culvert inlets. Surfacing of exposed, disturbed, or bare surfaces can also greatly reduce runoff-induced erosion from road features. Erosion control features such as vegetative ground cover, straw mulch, slash, wood chips, straw wattles, fiber rolls, hay bales, geotextiles, and filter fabric fences may be used to prevent or minimize sediment transport and delivery to surface waters. Locally native, non-invasive, non-persistent grass species may be used for temporary erosion control benefits to stabilize disturbed land and prevent exposure of disturbed land to rainfall. The *Handbook for Forest,* *Ranch & Rural Roads* (Road Handbook)[19] provides a guide for planning, designing, constructing, reconstructing, upgrading, maintaining, and closing wildland roads. Development of the Road Handbook was funded in part by the State Water Board, U.S. EPA, and CAL FIRE.

The Road Handbook recommends limited road slopes for safety, maintenance, and drainage issues. Road alignments should be designed with gentle to moderate slopes to minimize damage to the roadbed, allow for frequent and effective road surface drainage, and for safety. Roads with a slope of less than one-percent can be difficult to drain and may develop potholes and other signs of impaired drainage. Steep roads are more likely to suffer from erosion and road surface damage, especially if they are used when wet. Steep roads can be more difficult to drain because surface runoff may flow down the road in wheel ruts rather than off the outside edge where it can be discharged and dissipated. In snow zones, steep roads may represent a safety hazard if they are used during cold weather periods. New road alignments should be constructed with slopes of 3- to 8-percent, or less, wherever possible. Forest roads should generally be kept below 12-percent except for short pitches of 500 feet or less where road slopes may go up to 20-percent. These steeper road slopes should be paved or rock surfaced, and equipped with adequate drainage. Existing roads that do not comply with these limits require additional inspection by a Qualified Professional, as defined in the Policy, to determine if improvements are needed.

Requirements contained in Policy Attachment A, *Section 2: "Private Road/Land Development and Drainage"* specifically address these impacts.

Slope and Erosion Potential Relationship

The potential impacts of storm water runoff are influenced by site topography, soil type, the amount and intensity of precipitation, and erosion control measures designed to reduce storm water runoff. Fast moving water can erode and carry more sediment than slow moving water creating a greater potential for erosion and off-site discharge of turbid storm water from steep slopes than gradual slopes. The required levels of risk mitigation in the Policy and Cannabis Cultivation General Order reflect this reality by increasing the Requirements with slope steepness, as follows:

- Personal use exempt and conditionally exempt sites must comply with a more conservative slope limit (20 percent) because the sites will be subject to less oversight and have minimal reporting Requirements. If the proposed exempt site does not comply with the slope Requirement, the cannabis cultivator must apply for coverage under the Cannabis Cultivation General Order.

- Sites located on slopes up to 30 percent are classified as "low" risk. Erosion control and eroded material sediment capture can generally be accomplished through implementation of the Policy Requirements. Sites located on mild slopes (lower percent value) generally require fewer maintenance activities to maintain the effectiveness of the erosion control measures.

[19] The Handbook for Forest, Ranch, and Rural Roads (Weaver 2015) describes how to implement the Forest Practice Rules requirements for road construction and is available online at: http://www.pacificwatershed.com/sites/default/files/RoadsEnglishBOOKapril2015b.pdf.

- Sites located on slopes between 30 and 50 percent are classified as "moderate" risk. Erosion control and eroded material sediment capture can be accomplished through implementation of erosion control measures required by the Policy; however, careful design, installation, and maintenance of the erosion control measures are required to maintain water quality. An increased density of erosion control measures and engineered structures (e.g., retaining walls, terrace construction, etc.) may be required (Crozier 1986, NRCS 2005). To mitigate the risk, a Site Erosion and Sediment Control Plan and increased riparian setback is required for sites that are located on slopes measuring between 30 and 50 percent.

- Slopes over 50 percent require structures or special techniques for stabilization. (RCDMC 2014). In very steeply sloping areas (50 percent or more), vegetation is best maintained to preserve native habitat and avoid erosion. The Policy prohibits new disturbance associated with cannabis cultivation activities on slopes greater than 50 percent. Cannabis cultivators operating cultivation activities on a slope greater than 50 percent are required to stabilize the area and cease cultivation activities unless they can obtain site-specific WDRs from the appropriate Regional Water Board.

Requirements contained in Policy Attachment A, *Section 2: "Limitations on Earthmoving"* specifically address these impacts.

Soil Disposal and Storage

Cultivation activities may include the use of potting soil or the amendment of existing soil to create enhanced growing medium. Cannabis cultivation land disturbance activities can result in excess excavated soil stockpiles. Runoff from soil stockpiles, imported soil, or soil amendments that are improperly stored or disposed of can be a source of sediment discharge to waters of the state during storm events. The discharge of these materials can cause water quality impacts from the soil, itself, as well as from any residual fertilizers or pesticides it may include.

Requirements contained in Policy Attachment A, *Section 2: "Soil Disposal and Spoils Management"* specifically address these impacts.

Winterization

The outdoor cannabis cultivation growing season typically takes place between spring and fall. Most cannabis plants are cultivated as annuals, which mean the plant material is removed at the end of harvest to make space for new plants in the next growing cycle. Cannabis cultivators that do not establish a permanent homestead within the same parcel where cultivation takes place typically do not tend or visit the site as frequently as they do during the active cannabis cultivation period. During this inactive period, if winterization measures are not in place, potential pollutants (e.g. fertilizers, sediment, etc.) can be mobilized by precipitation and runoff and contaminate waters of the state, including groundwater and surface water sources.

Completion of winterization measures prior to the beginning of winter will minimize the risk of discharge of sediments and other waste constituents that can be easily mobilized. Post-harvest, bare soil can be a source of sediment during storm events. Properly installed erosion control measures, such as mats/blankets, wattles, or mulch, are the best means to prevent erosion or sediment discharges to waters of the state. Blocking or closing temporary access roads, in addition to application of erosion control measures, will preserve road slopes and prevent tire rutting and sedimentation. Use of heavy equipment on unpaved sites during rainy winter months may cause unnecessary sediment runoff. Restricting the use of heavy equipment during the winter period to emergencies only and applying appropriate erosion and sediment control measures when heavy equipment is used will minimize sediment discharge. Maintaining water drainage structures, (e.g., culverts, drop inlets, trash racks, and similar devices) in good operational condition will reduce damage caused by storm water runoff.

Requirements contained in Policy Attachment A, *Section 2: "Winterization"* specifically address these impacts.

Water Diversion, Storage, and Use

Bypass

A diversion without means to bypass water has the potential to impact downstream water rights and negatively affect water quality and aquatic habitat. All water diversions must include means for bypassing water to satisfy downstream prior rights and any requirements of polices for water quality control, water quality control plans, water quality certifications, waste discharge requirements, or other local, state or federal instream flow requirements.

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* and *Section 3: "Instream Flow Requirements for Surface Water Diversions"* specifically address these impacts.

Fish Screens and Diversion Structures

Instream water diversions have the potential to entrain fish and increase fish mortality. Entrainment of a species occurs when the diversion of water allows or causes the species in question to enter any off-stream portion of the diversion system and causes mortality, either due to the diversion process or because access back to the stream system is denied. The threat of entrainment remains even if exclusion devices, such as screens, are present, as the screen must be sized and maintained correctly for the species being excluded in that stream. The Policy requires cannabis cultivators to consult with CDFW to ensure the fish screens and other exclusion devices are designed and sized appropriately and prevent listed and sensitive species from becoming entrained. Diversion structures in fish bearing streams also have the potential to prevent or impede the passage of fish up and down stream. These impediments can have negative impacts on fish by limiting access to habitat for spawning and rearing and can lead to fish mortality.

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* specifically address these impacts.

Groundwater Diversions, Wells, and Exempt Springs[20]

Diversions from groundwater can have negative impacts on the quantity and quality of groundwater aquifers, as well as surface water supplies, if not properly managed. The legalization of cannabis cultivation could lead to an increase in groundwater diversions from groundwater and exempt springs.

The proper installation, maintenance, and abandonment of wells are essential to protect groundwater quality. All wells used for cannabis cultivation must follow local ordinances as well as the California Well Standards as stipulated in California Department of Water Resources Bulletins 74-90 and 74-81.

[20] All groundwater Requirements apply to exempt springs. See the Springs section for more information on exempt springs.

To address potential impacts of groundwater diversions on surface flow, the Policy includes a provision that allows the State Water Board to require a forbearance period or other measures for cannabis groundwater diversions in areas where such restrictions are necessary to protect instream flows. To evaluate these potential groundwater impacts, the State Water Board established aquatic base flows (described below in the Section below titled: *"Aquatic Base Flows"*). Such areas may include watersheds with: high surface water-groundwater connectivity; large numbers of cannabis groundwater diversions; and/or groundwater diversions in close proximity to streams.

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* and *Section 3: "Requirements for Groundwater Diversions and Springs Qualifying for an Exemption under Narrative Instream Flow Requirement 3 (Exempt Springs)",* specifically address these impacts.

Measuring and Reporting Water Diversions

Diversion measurement and reporting information will be used to monitor compliance with the flow requirements and forbearance period and account for water diverted and used for cannabis cultivation versus other beneficial uses. Requirements to use measurement devices and report water diverted for cannabis cultivation will improve Policy administration allowing the State Water Board and water users to more efficiently manage use of available water supplies while also protecting public trust resources. Accurate water diversion measurements are necessary to monitor and evaluate instream flows in localized areas and reduce localized impacts to sensitive species and habitat, impacts to headwater streams, and to prevent injury to downstream senior water right holders. Cannabis cultivators with onstream reservoirs are required to install a staff gage in addition to a measurement device that monitors and records the rate of diversion, the rate of collection to storage, the rate of withdrawal or release from storage, and the total volume of water collected in the onstream reservoir. Onstream reservoirs block sediment transport during high flow events and will fill in with sediment deposits over time. Staff gages are required to assess the continued accuracy of depth readings recorded by the measurement device and the area-capacity curve and evaluate whether a new area-capacity curve needs to be developed for the onstream reservoir.

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* and *Section 3: "Gage Installation, Maintenance, and Operation Requirements"* specifically address these impacts.

Off-stream Storage Reservoirs

Off-stream storage reservoirs that are open to the environment can serve as a breeding ground for bullfrogs and a hospitable environment for a proliferation of other invasive species. Further, unmanaged overflow from off-stream storage reservoirs can negatively impact surface water quality through the transport of sediment, pesticides, fertilizers, and other harmful constituents to waters of the state, as well as potential channelization (and mobilization of sediment) in the surrounding area. To reduce environmental impacts, off-stream storage facilities that are open to the environment must be designed and managed to control invasive species, disperse overflows (to discourage channelization and promote infiltration), and maintain sufficient freeboard (to capture rainfall and incidental runoff).

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* specifically address these impacts.

Onstream Reservoirs

Onstream reservoirs substantially alter watercourses and have the potential to disrupt the natural hydrograph and act as barriers to fish passage. Onstream reservoirs can have the effect of dampening or eliminating hydrograph peaks and flow variability, most notably during the initial fall storms when reservoirs are relatively empty. The potential localized impacts of new onstream reservoirs cannot be mitigated under the Policy. Water Boards staff conducted statewide initial Policy outreach meetings from August 31 – October 4, 2016, which included notification to stakeholders of the state and federal law and permitting requirements associated with instream work and water diversions. The Policy reinforces existing state laws and requires that cannabis cultivators obtain an appropriative water right under the State Water Board's Water Rights Permitting and Licensing Program prior to constructing and diverting from a new onstream reservoir. Cannabis cultivators that divert and store water to an onstream reservoir constructed after October 1, 2016 may be subject to enforcement and be required to remove the reservoir and restore the site to pre-disturbance conditions at the cannabis cultivators' expense and in compliance with all applicable laws for such work.

In certain situations, onstream reservoirs that existed prior to October 1, 2016, may be allowed to remain in place, and in use, if it is determined, by the Deputy Director for Water Rights (Deputy Director) (or designee) and CDFW, that removing the existing onstream reservoir or installing off-stream storage will cause a greater environmental impact than modifying the onstream reservoir to operate in compliance with all Policy Requirements. Existing onstream reservoirs that may be approved for continued operation under the Cannabis Small Irrigation Use Registration (SIUR) Program will primarily be small capacity reservoirs located on small ephemeral (Class III) streams or swales with small drainage areas. Only under unique circumstances would an existing onstream reservoir be approved for continued operation on Class I or Class II streams. These existing onstream reservoirs may have an existing valid water right registration for storage that does not allow for commercial irrigation (e.g., Livestock Stockpond Use Registrations, Small Domestic Use Registrations) or be unpermitted, pre-existing onstream reservoirs constructed prior to October 1, 2016. Withdrawal of water for cannabis cultivation activities from an onstream reservoir, approved under a Cannabis SIUR Certificate, will only be allowed during the surface water forbearance period to minimize the impacts of the reservoir on high flow variability during the wet season. Cannabis cultivators with existing onstream reservoirs may be required to submit more information about the onstream reservoir with the initial filing of the Cannabis SIUR than filers with off-stream storage. Additional information about the onstream reservoir may include, but is not limited to, the following: agreement to the terms of Policy Attachment A, Section 2, Requirement 82; date of construction with supporting evidence; photos of the reservoir and associated facilities; estimated capacity of the reservoir; existing outlet structure and bypass capabilities; and any existing basis of right for storage of water.

Cannabis cultivators with unpermitted onstream reservoirs that existed prior to October 1, 2016, that do not qualify for a Cannabis SIUR may be required to: (1) provide evidence satisfactory to the Deputy Director (or designee) that demonstrates the reservoir does not store water, or can be operated without storing water subject to the State Water Board's permitting authority; or (2) remove or otherwise render the reservoir incapable of storing water. Any modifications to an onstream reservoir shall be completed in compliance with all applicable laws for such work.

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* specifically address these impacts.

Rain Water Catchment

Rain water catchment systems can reduce reliance on surface and ground water resources. When properly implemented, rain water catchment systems that collect runoff from permanent, impermeable surfaces also have the potential to reduce the amount of storm water runoff. Capturing storm water runoff helps to reduce the transport of pollutants such as sediment, pesticides, fertilizers, and petroleum products to waters of the state. The State Water Board encourages methods of water collection from impervious surfaces, such as rooftop rainwater harvest, which reduce demand on streams and reduce water quality problems associated with storm water runoff.

Springs

The State Water Board has determined that all diversions for cannabis cultivation, even those that historically have not been required to file statements of water diversion and use per section 5101, subdivision (a) of the Water Code, may affect the quality of waters of the state. Many springs support their own aquatic and riparian habitats that may be threatened by excessive diversions. As already noted, Water Code section 13149 expressly directs the State Water Board to adopt a policy for water quality control to ensure that cannabis cultivation does not negatively impact springs, wetlands, and aquatic habitat. Certain springs may be exempt from the Policy's Narrative Instream Flow Requirement 4 (Surface Water Dry Season Forbearance Period) and Requirement 5 (Surface Water Wet Season Diversion Period – Numeric Instream Flow Requirements). An exempt spring is a spring that does not flow off the cannabis cultivator's property by surface or subterranean (subsurface) means in the absence of diversions during any time of year in any water year type. Diversions from exempt springs may impact surface water flows on a different magnitude and temporal scale than diversions from springs that flow off a property. Additionally, diversions from exempt springs may not directly contribute to the flows that the forbearance period and numeric flow requirements are intended to protect. To qualify as an exempt spring the cannabis cultivator must submit information and receive approval from the Deputy Director for Water Rights, as specified in Section 3 of Attachment A of the Policy. Springs that are deemed exempt shall comply with the Policy's 50 percent visual bypass requirement (Narrative Instream Flow Requirement 6) to support the spring's aquatic and riparian habitat. In addition, springs that are deemed exempt shall be subject to the Requirements for Groundwater Diversions (Narrative Instream Flow Requirement 8) to address the potential cumulative impacts of groundwater diversions, to which diversions from the spring may contribute.

Storage Bladders

Storage bladders have not been proven to be reliable long-term water storage solutions. The State Water Board has documentation of numerous instances in which water storage bladders have failed and caused significant environmental impacts. Failure of bladders can result in: discharges of sediment, high temperature water, and other constituents to waterbodies; localized mortality of aquatic species; and impairment of aquatic habitat and water quality in downstream reaches. Regular inspection can help reduce the instances of storage bladder failure.

Sufficient secondary containment can reduce the environmental impacts in the event of bladder failure. Generally accepted secondary containment design criteria is 110% of water storage volume (U.S. EPA 2013). Proper design and management practices to prevent overfilling the bladder may also reduce bladder failure.

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* specifically address these impacts.

Winterization Requirements

In California, rainstorm events that create sediment transporting flows on upland slopes and in channels typically occur during the winter period or non-growing season for outdoor cannabis cultivation. One of the main water quality concerns during the winter period is the increased potential for sediment transport due to storm water or water flow from cannabis cultivation activities, especially in areas that are considered "hilly" or "mountainous". The frequency and risk of erosion or sediment transport on upland slopes can be correlated to average slope of the land. As summarized in Table 4. Slope Gradient Thresholds for Erosion and Deposition, the risk of erosion, potential for sediment transport into stream channels, and the need for additional best management practices proportionately increases as slope increases above five percent (5%).

Table 4 – Slope Gradient Thresholds for Erosion and Deposition

Average Land Slope	**Expected Sediment Transport Type**
>20%	Erosion: Flows with enough magnitude to transport sediment should result in erosion without significant deposition. Land management goals need to cover significant erosion.
5% – 25%	Transitional (Erosion and Deposition): Flows with enough magnitude to transport sediment should result in both erosion and deposition as land slopes decrease. Land management goals need to cover both erosion and deposition.
<10%	Depositional: Flows from higher slopes transporting sediment become primarily depositional, with the most deposition occurring between 2% - 6% slope. Land management goals need to cover deposition of sediment from higher properties.

Benda et al. (2005) "Geomorphology of Steepland Headwaters: The Transition from Hillslopes to Channels."

The State Water Board has determined that the use of heavy equipment (e.g., agriculture equipment) during the winter period for soil preparation and planting activities on land with average slopes equal to or less than five percent (5%) have a lower risk for erosion and sediment transport and that risk can be mitigated through best management practices developed as part of a Site Management Plan approved by the applicable Regional Water Board. In addition, this requirement is consistent with the California Regional Water Board San Francisco Bay Region's General Waste Discharge Requirements for Vineyard Properties in the Napa River and Sonoma Creek Watersheds (Order No. R2-2017-0033), which requires additional performance standards to control storm runoff from vineyards and sediment discharge from roads on hillslope vineyard parcels where the average slope of the planted area is greater than five percent (5%) (California Regional Water Quality Control Board, San Francisco Region, 2017).

BACKGROUND AND RATIONALE FOR INSTREAM FLOW AND GAGING REQUIREMENTS

The Policy generally employs three types of Requirements to ensure sufficient instream flows for aquatic resources:

- dry season forbearance period and limitations on the wet season diversion period,
- narrative instream flow Requirements, and
- numeric instream flow Requirements.

These three protections work in concert to ensure that water diversions for cannabis cultivation do not affect the: instream flows needed for fish spawning, migration, and rearing; natural flow variability; or flows needed to maintain aquatic habitat and support aquatic resources. The instream flow Requirements apply statewide and may be modified overtime, as needed, as more information becomes available on cannabis cultivation water demand, the location and density of cannabis cultivation, and protectiveness of the instream flow Requirements. The Policy may be updated to incorporate, among other things:

- long-term, region-specific instream flow requirements for cannabis cultivation,
- watershed-specific studies that demonstrate more relaxed instream flow requirements or seasons of diversion will be as or more protective, or
- watershed-specific studies that demonstrate more protective instream flow requirements or diversion periods are needed to protect public trust resources.

Wet Season Diversion Period: As early as November 1 to March 31

The individual and cumulative effects of water diversions for cannabis cultivation during the dry season are likely to significantly decrease instream flow and, in some instances, reduce hydrologic connectivity or completely dewater streams. During the recent drought, in many locations where cannabis was densely cultivated, stream dewatering occurred for multiple years. Minimum flows that provide for habitat connectivity are needed to maintain juvenile salmonid intra-stream passage conditions in early summer. Instream flows are also needed to maintain habitat conditions necessary for juvenile salmonid viability throughout the dry season, including adequate dissolved oxygen concentrations, low water temperatures, and high rates of invertebrate drift from riffles to pools. Juvenile salmonids require adequate dissolved oxygen concentrations and other water quality parameters to survive the stressful summer months.

During the summer rearing period, juvenile salmonids are dependent on an input of dissolved oxygen from upstream. Riffles and pools may lose hydrologic connectivity at low flows, which causes dissolved oxygen concentrations to drop in pools. When riffles and pools lose hydrologic connectivity, dissolved oxygen concentrations in pools begins to drop within days. Low dissolved oxygen concentrations can negatively impact juvenile salmonid growth, development, and behavior and can lead to fish mortality. Low flows, coupled with elevated stream temperatures, tend to cause stressful conditions for cold water aquatic species, such as anadromous salmonids. Elevated stream temperatures can decrease salmonid growth and viability. Prolonged periods of stressful stream temperatures or short-term periods of extremely high temperatures can both lead to fish mortality.

Currently, water diverted for cannabis cultivation is causing the most significant impacts during the dry season, when stream flows are low and water demand is high. A typical outdoor cannabis cultivation site requires the most water at the same time that the majority of the state's water bodies are in their lowest flow period (summer to fall). Increased diversion during this period greatly affects the quantity and quality of water available, negatively impacts designated beneficial uses, and threatens the survival of endangered salmon, steelhead, and other aquatic life.

Minimum flows that provide for habitat connectivity are needed to maintain juvenile salmonid intra-stream passage conditions in early summer, which allow juvenile salmonids to move from their spawning grounds to suitable summer rearing habitat. Instream flows are also needed to maintain habitat conditions necessary for juvenile salmonid viability throughout the dry season, including adequate dissolved oxygen concentrations, low water temperatures, and invertebrate drift from riffles to pools.

To ensure protection of salmonid species from the adverse effects of diversions during low flow periods, diversions are not permitted during the late spring, summer, or fall months, when streamflow is especially important to anadromous salmonid populations. The wet season diversion period (diversion period) is therefore restricted to the period of higher flows, from as early as November 1 to March 31, when water is most available and impacts on fishery resources will be minimized.

During development of the State Water Board's *Policy for Maintaining Stream Flows in Northern California Coastal Streams* (Instream Flow Policy) (State Water Board 2014), multiple diversion periods were evaluated with regard to impacts on anadromous salmonid populations. While a diversion period start date of October 1 was determined to be sufficiently protective of their upstream migration needs, it was noted that "the majority of channel and riparian maintenance flows occur after the first few fall storms, usually after October 1 and before March 31" (R2 Consulting, 2007). The Instream Flow Policy research also concluded that traditional agricultural diversions permitted to divert during the dry season would be reduced or ceased by October 1 of each year, which would further diminish the impacts from cannabis cultivation diversions occurring after this period. No sooner than November 1 was selected as the beginning of the diversion period for the Policy to allow time for:

- winter base flows to stabilize prior to diversion,
- fall flushing flows to pass through stream channels prior to diversion, and
- early fall spawning salmonid species to begin establishing redds in streams.

The Instream Flow Policy designated December 15 as the start of the diversion period based on peer review and public comments specific to the coastal streams and species located in the Instream Flow Policy area. The main concern was that the anadromous fish migrated during high flow events (between October and December 15) and diversions, in particular onstream reservoirs, had the potential to dampen high flow events and impede migration. However, it is not anticipated that diversions for cannabis cultivation will significantly dampen high flow events, because the Policy only allows onstream reservoirs under certain circumstances with site-specific conditions to protect anadromous salmonids and other aquatic species and has a maximum diversion rate of 10 gallons per minute for diversions to off-stream storage. With these extra protections (which are not included in the Instream Flow Policy) the Policy sets the start date of the diversion period as early as November 1. This diversion period (as early as November 1 – March 31) provides a reasonable period of diversion while being sufficiently protective of aquatic species. Additionally, the Policy may be updated with a more restrictive diversion period or additional requirements to address protection of high flow events if it is determined that diversions for cannabis cultivation are having negative localized impacts on high flow events.

To ensure the above-stated goals are accomplished by the beginning of the diversion period, cannabis cultivators are not authorized to begin diverting between November 1 and December 14 until after seven consecutive days in which the surface waterbody's daily average flow is greater than the numeric instream flow Requirement. The diversion period ends on March 31 because many streams begin to see flows drop in April, as spring storms decrease and temperatures begin to rise. Setting the end of the diversion period on March 31 will help protect the spring recession flow. Many aquatic species depend on the spring recession flow for life history cues such as spawning and breeding. The spring recession flow is an important trigger for anadromous salmonids, both for smolt outmigration and for juvenile salmonids that over summer in the stream to initiate movement from the spawning grounds to summer rearing habitat. In dry years the spring recession flow is also protected since the diversion period may end earlier than March 31 if the surface waterbody's daily average flow drops below the minimum monthly instream flow requirement.

Requirements contained in Policy Attachment A, Section 3: "*Instream Flow Requirements for Surface Water Diversions"* specifically address these impacts.

Diversion Rate

Maintaining variability of natural stream hydrographs is extremely important for preserving both the form and function of water sources and the aquatic and riparian communities they support. Storm events and the associated peak flows are important for sediment distribution and riparian recruitment along streams. A maximum diversion rate of 10 gallons per minute was developed in consultation with CDFW because it is not anticipated that this rate will adversely affect the natural high flows needed for forming and maintaining adequate channel structure and habitat for fish. Lower volume diversion rates can also reduce cumulative impacts that may occur when multiple water users are diverting at the same time. The maximum diversion rate set forth in the Policy will reduce the potential cumulative impacts of diversions and protect aquatic habitat and designated beneficial uses.

Requirements contained in Policy Attachment A, *Section 2: "Water Supply, Diversion, and Storage"* specifically address these impacts.

50% Visual Bypass Requirement

The instream flow Requirement compliance gages are located in areas that are generally reflective of the water availability and total demand occurring upstream of the gaging location or in a similar watershed. However, impacts may still occur in areas where there is significant localized cannabis cultivation compared to water availability or in areas where the compliance gage does not adequately reflect the demand in a paired watershed. To help ensure diversion of water for cannabis cultivation does not negatively impact flows needed for fish spawning, migration, and rearing, and the flows needed to maintain natural flow variability, the Policy requires that the cannabis cultivator bypass a minimum of 50% of the streamflow past the cannabis cultivator's point of diversion, as estimated based on the cultivator's visual observation.

The 50% visual bypass Requirement is intended to protect smaller water sources and headwater streams from localized cumulative effects of diversions and ensure adequate minimum flows are maintained. For example, if diversions are allowed in a watershed based on the assigned compliance gage, but the stream being diverted from is only flowing at 15 gallons per minute, the diverter would not be able to take the full 10 gallons per minute (as that would represent 67% of the streamflow). The amount of "50%" was selected for the following reasons:

- The Tessmann method, on which the flow Requirements are based, in general, suggests during the wet season that 40% of mean annual flow or mean monthly flow should remain instream at all times. Based on this, 50% represents a protective flow level; and
- 50% of streamflow is relatively easy to visually estimate when flows are low. A diverter should be able to compare the rate of water being diverted with the rate of water passing the diversion and easily determine which is greater. If the amount of water being diverted is less than the amount of water flowing past the point of diversion, then the 50% bypass requirement is being met.

Requirements contained in Policy Attachment A, *Section 3: "Instream Flow Requirements for Surface Water Diversions"* specifically address these impacts.

Methodology for Development of Numeric Instream Flow Requirements

The State Water Board evaluated methodologies to develop instream flow Requirements that:

- used existing information,
- could be applied throughout the state,
- could accommodate seasonal flow patterns,
- had the flexibility to develop a flow regime at established or new gage locations, and
- could meet the geographic scope and timelines of the legislative directives.

The State Water Board, in consultation with CDFW, determined that using the Tessmann Method to develop short-term, interim instream flow Requirements was the best methodology to meet the timeline, scale, and goals of this effort. In general, the Tessmann Method was used to generate minimum monthly instream flow Requirements based on natural monthly streamflows and natural annual flow metrics. For the development of long-term flow requirements[21], the State Water Board, in consultation with CDFW, will evaluate more scientifically robust methods that are more reflective of regional variability and the needs of target species.

The Tessmann method is an adaptation of the Tennant desktop flow regime methodology that was modified to generate minimum monthly instream flow recommendations based on natural monthly flow and natural annual flow metrics (Tessmann 1979). Below is a brief overview of the Tennant Methodology and Tessmann's adaptation.

Tennant Methodology

The Tennant Method, as outlined in Donald Tennant's "*Instream Flow Regimes for Fish, Wildlife, Recreation, and Related Environmental Resources*" (Tennant 1976), develops instream flow regimens for the protection of fish and wildlife by using percentages of annual average natural streamflow. The average annual flow is calculated from recorded or estimated hydrologic records. Once average annual flow has been determined, a base flow schedule can be created using Table 4. Tennant recommends using the "most appropriate and reasonable flow(s) that can be justified to provide protection and habitat for all aquatic resources."

[21] Water Code section 13149(b)(5).

Table 4. Instream Flow Regimens for Fish, Wildlife, Recreation, and Related Environmental Resources

Description of Flow	**Recommended Base Flow Regimens** (Percent of Average Annual Flow)	
	October – March	**April – September**
Flushing or Maximum	200%	
Optimum Range	60%-100%	
Outstanding	40%	60%
Excellent	30%	50%
Good	20%	40%
Fair or Degrading	10%	30%
Poor or Minimum	10%	10%
Severe Degradation	10% - 0	10% - 0

The Tennant Method was tested through detailed field studies conducted on 11 streams in three states between 1964 and 1974. The work involved "physical, chemical, and biological analyses of 38 different flows at 50 cross sections on 196 stream miles, affecting both coldwater and warmwater fisheries."

Based upon his studies, Tennant came to the following conclusions which should be taken into consideration when implementing the Tennant Method:

- Ten percent of the average flow: Minimum instantaneous flow recommended to facilitate short-term survival for most aquatic organisms.
- Thirty percent of the average flow: Base flow recommended to sustain good survival habitat for most aquatic life forms.
- Sixty percent of the average flow: Base flow recommended to provide excellent to outstanding habitat for most aquatic life forms during primary periods of growth. Supports majority of recreational uses.

Tessmann Methodology – A Common Modification of the Tennant Method

The *Environmental Assessment Technical Appendix E,* "*Reconnaissance Elements of the Western Dakotas Region of South Dakota Study*" published in 1979 by Stephen A. Tessmann details how the Tessmann method was developed, including limitations and considerations. When reviewing existing flow prescription methods to incorporate into his own analysis, Tessmann generally preferred the Tennant method due to simplicity, ease of implementation and the ability to mimic, to a certain degree, the natural hydrograph and maintain flushing flow requirements. Tessmann found that, although the Tennant Method would be the most appropriate approach for his endeavor, it was not well adapted to the prairie rivers of Western South Dakota, which are characterized by great natural fluctuations of flow. Taking into consideration the importance of flow cycles and silt load, Tessmann made several modifications to the Tennant Method to adjust for watersheds with more varying seasonality or for flashy stream systems.

While the Tennant method specified dividing the water year into two six month periods with a recommendation of 30% and 50% of mean annual flow to maintain "Excellent conditions" for fish, wildlife and recreation, Tessmann sought to develop a method using specific monthly periods.

As taken from Tessmann's study, "Extreme fluctuations in periodicity are accommodated by applying a compromise value of 40% on a monthly basis, with some stipulations." The Tessmann method flow requirement criteria is shown in Table 5.

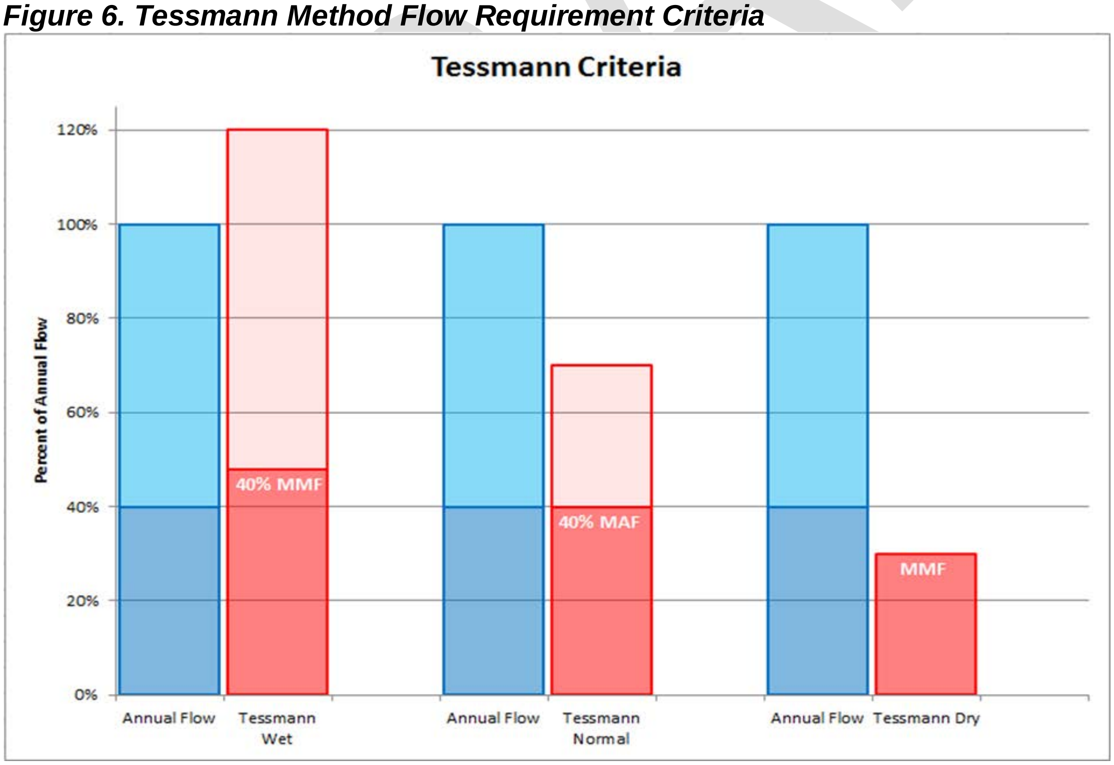
Table 5. Tessmann Method Flow Requirements

Situation	Minimum Monthly Flow
40% Mean MF > 40% Mean AF	40% Mean MF
Mean MF > 40% Mean AF *and* 40% Mean MF < 40% mean AF	40% Mean AF
Mean MF < 40% Mean AF	Mean MF

*MF = Monthly Flow, AF = Annual Flow

As depicted in Figure 6, the Tessmann method analyzes each individual monthly mean flow and places it in one of three categories (dry, wet or normal) with respect to the mean annual flow. In a "dry month," the mean monthly flow will be less than 40% of mean annual flow and, therefore, the mean monthly flow will be assigned as the minimum flow requirement. In a "wet month," mean monthly flow will exceed mean annual flow and, therefore, 40% of the mean monthly flow will be assigned as the minimum flow requirement. If the month is neither "dry" nor "wet," consider it "normal" and, therefore, 40% of the mean annual flow will be assigned as the minimum flow requirement. See figure below to aid visualization of this concept. Additionally, Tessmann's Method prescribes a 14-day period of 200% of mean annual flow during the month of highest runoff for the purpose of flushing the stream's silt load and flooding streamside habitat.

Figure 6. Tessmann Method Flow Requirement Criteria



* Blue bar represents the mean annual flow, light red bar represents the mean monthly flow, and the dark red bar represents the Tessmann flow requirement.
** MMF = Mean Monthly Flow; MAF = Mean Annual Flow

Flow Model for Estimating Natural Monthly Streamflows in California

The majority of established desktop methods use a hydrologic standard setting approach that develops flow requirements based on natural streamflow metrics. The State Water Board applied the Tessmann Method using predicted historical flow data sourced from a flow modeling effort conducted by USGS in cooperation with The Nature Conservancy (TNC) and Trout Unlimited (USGS model). The USGS flow modeling effort developed empirical flow models that predicted the natural (unaffected by land use or water management) monthly streamflows from 1950 to 2012 for the majority of the USGS National Hydrologic Database stream reaches in California (Carlisle 2016). The natural monthly streamflow metrics were used to develop the mean monthly and mean annual flows used in the Tessmann Method.

As described in more detail in the USGS *Open-File Report* (Carlisle 2016), the concept of the reference-condition was used where a set of reference sites with known gage flow hydrologic record data were used to develop models that were subsequently applied to non-reference sites (such as ungaged stream systems or highly modified systems where hydrologic disturbance is known or suspected). The approach used is based on statistical models of related observed data generally consisting of two types of indicators: static variables that describe watershed features (topography, geology, soils, etc.); and time-series variables, primarily consisting of antecedent precipitation and air temperature.

Six different types of statistical models were compared in developing the final model, including five machine-learning models and one multiple linear regression. The random forest machine learning technique proved to perform substantively better than all other modeling approaches.

A separate model was developed for each month in each region to predict natural monthly flows for any specific year from 1950 to 2012, resulting in 36 separate sub models. The final data matrix for developing models of natural monthly flows included every year for which each reference site had a measured monthly flow value, the set of weather data and modeled runoff associated with each year's measured monthly flow plus the previous 12 months, as well as the full set of static physical watershed characteristics.

As summarized in the USGS *Open File Report* (Carlisle 2016), the "models developed to estimate natural monthly flows performed well and should provide a useful baseline for future studies for how stream flows in California respond to changes in land use, water management, and climate."

The State Water Board evaluated a subset of the final reference gages used to build the natural flow prediction model. For each Cannabis Policy region, the State Water Board evaluated gages that were used both as USGS final reference gages in the modeling effort and as Cannabis Policy compliance gages. The number of gages evaluated for each region is shown in Table 6.

Table 6. Number of Reference Gages used in USGS Model and Cannabis Policy Compliance Gages by Region*	
Region	**Number of Gages**
Klamath	7
Upper Sacramento	0
N. East Desert	0
North Coast	9
Middle Sacramento	0
Southern Sacramento	2
N. Central Coast	4
Tahoe	4
S. Central Coast	12
San Joaquin	7
Mono	1
Kern	3
South Coast	7
S. Eastern Desert	5

* The State Water Board selected the four gages with the longest period of no hydrologic alteration in each region for analysis, or all of the gages in regions with less than four overlapping gages.

Up to four reference/compliance gages were selected for each region and the USGS monthly mean historical record for each gage was downloaded from the USGS website for each gage and imported into a spreadsheet for comparison with the outputs in the USGS streamflow dataset. An index/match function of observed over expected (O/E), or the observed historical gage data over the expected or predicted USGS streamflow dataset, was analyzed for six factors for each gage. The six factors analyzed were the mean flow values for November, December, January, February, March, and mean annual flow. The flow data was averaged over the entire period of record for which there was minimal or no hydrologic alteration. In addition to O/E values, percent difference values were calculated by subtracting the expected value from the observed value and dividing the difference by the expected value to provide a percent inflation or deflation in the model predictions relative to the historical gage record. Table 7 displays the percent accuracy of the gages used in the analysis by region.

In general, based on this specific sample size, the average statewide reference gage record was 3.6 percent higher than what the model predicted statewide for the same period (+3.6 percent). This means that the USGS flow dataset, on average, predicted 3.6 percent more mean flow than the mean flow recorded at the reference gages. The Upper Sacramento, North East Desert, and Middle Sacramento Regions did not have any gages that overlapped between the USGS reference gages and the State Water Board's Cannabis Policy compliance gages and therefore data are not available to analyze percent error or O/E values for these regions. On average, the selected gages in the Klamath, North Coast, Southern Sacramento, North Central Coast, Tahoe, South Central Coast, San Joaquin, and Mono Regions ranged from 3.1 percent below (-3.1 percent) to 5.3 percent above (+5.3 percent) predicted values, while gages within the Kern, South Coast, and South Eastern Desert Regions averaged respectively 12.4 percent (+12.4 percent), 10.9 percent (+10.9 percent), and 13.4 percent (+13.4 percent) above predicted values. The mean annual flow for the Kern, South Coast, and South Eastern Desert Regions were predicted more accurately than the mean monthly flows, indicating that overall total annual runoff was relatively more accurate than monthly predictions. This may be an indication that the USGS natural flow prediction model did not predict timing of the surface water to groundwater interactions of the dry desert areas as well as other regions of the state. As described on page 8 in the USGS Open File Report, "Model performance was marginally higher in both mountainous regions than in the xeric region" (Carlisle 2016). Please refer to this report for further details on the model's use of surrogate variables as predictors for groundwater contributions to streamflow and other model performance metrics.

Zimmerman et. al. (2017) notes in their analysis of the USGS flow dataset that "these results indicate that arid basins are underrepresented in the stream gaging network of California, and that our flow predictions for the NHD network in arid areas should be interpreted with caution. Nevertheless, given the low likelihood that additional stream gages will be installed in arid areas, our predictions represent the best available estimates of natural flows for the time being." The State Water Board will consider the relative accuracies of these monthly and annual USGS streamflow dataset statistics when implementing the Cannabis Policy Numeric Instream Flow Requirements, with a focus on the Kern, South Coast, and South Eastern Desert Regions. The State Water Board will also monitor the number of surface water diversions and consider stakeholder input in these regions to reevaluate whether the flow requirements should be adjusted to reflect the percent difference in O/E. If stakeholders believe the Numeric Instream Flow Requirement is over protective or under protective in their localized area they can develop a local natural or unimpaired flow model or conduct a local instream flow study and submit it to the State Water Board for consideration in the next update to the Cannabis Policy.

Table7. Percent Accuracy of Model Predictions Relative to Historical Gage Record of Select Gages in each Region

Cannabis Policy Region	USGS Gage Number	Reference Period Begin	Reference Period End	November Percent Difference	December Percent Difference	January Percent Difference	February Percent Difference	March Percent Difference	Mean Annual Percent Difference
Klamath	11522500	1949	2014	6.6%	4.0%	2.2%	2.3%	1.3%	2.1%
Klamath	11523200	1956	2014	-5.2%	-0.1%	0.2%	2.1%	-1.9%	-1.2%
Klamath	11528700	1964	2014	15.3%	13.4%	3.5%	1.8%	0.7%	4.7%
Klamath	11532500	1949	2014	-2.7%	-0.5%	-1.9%	-2.2%	-1.8%	-1.4%
N. East Desert	11476600	1959	2014	-5.4%	-6.1%	-5.1%	-4.7%	-3.3%	-4.2%
N. East Desert	11478500	1949	2014	-5.8%	-5.0%	-3.8%	-3.6%	-3.6%	-4.1%
N. East Desert	11481200	1954	2014	-5.1%	-0.7%	-1.1%	-0.7%	-0.8%	-1.1%
N. East Desert	11482500	1952	2014	3.8%	1.9%	2.9%	0.5%	1.3%	1.7%
Southern Sacramento	11449500	1949	2014	-3.3%	-2.5%	-0.3%	2.3%	-0.5%	-0.7%
Southern Sacramento	11451100	1970	2015	14.4%	4.1%	0.0%	-2.4%	-2.8%	0.1%
N. Central Coast	11467200	1958	2014	13.4%	-14.6%	12.2%	-5.0%	-11.7%	-2.6%
N. Central Coast	11468000	1949	2013	-0.3%	2.0%	0.6%	-0.5%	0.4%	0.6%
N. Central Coast	11468500	1950	2014	4.2%	1.6%	1.2%	1.6%	0.3%	1.1%
N. Central Coast	11468900	2000	2014	-11.6%	-16.9%	-15.6%	-9.2%	-12.1%	-11.6%
Tahoe	10308200	1959	2014	5.9%	0.4%	-5.9%	-3.8%	-2.7%	-2.1%
Tahoe	10336645	1979	2014	-1.5%	-10.2%	1.4%	0.7%	-6.3%	1.2%
Tahoe	10336660	1959	2014	-3.7%	-8.4%	-11.0%	-4.0%	-3.8%	-6.5%
Tahoe	10343500	1952	2014	9.6%	4.1%	2.6%	5.0%	4.0%	7.1%
S. Central Coast	11143000	1949	2014	-0.5%	1.8%	-2.2%	-3.5%	-3.4%	-2.0%
S. Central Coast	11151300	1957	2014	16.7%	11.9%	13.8%	20.3%	30.1%	27.4%
S. Central Coast	11162500	1950	2014	7.1%	-0.4%	-1.3%	-5.3%	-4.5%	-2.0%
S. Central Coast	11180500	1958	2015	3.5%	5.0%	3.7%	7.8%	6.0%	7.0%
San Joaquin	11264500	1949	2014	9.2%	12.9%	17.1%	9.8%	4.8%	1.5%
San Joaquin	11266500	1949	2014	4.8%	10.6%	14.3%	6.5%	1.4%	2.0%
San Joaquin	11274500	1949	2014	17.6%	-11.7%	-8.1%	-13.9%	-6.8%	-8.9%
San Joaquin	11274630	1964	2014	4.6%	12.7%	8.0%	0.4%	-2.1%	1.8%
Mono	10263500	1949	2014	-1.6%	1.7%	-7.4%	-3.9%	-4.3%	-3.9%
Kern	11203580	1999	2014	-47.6%	-1.8%	-5.3%	5.8%	-7.7%	-6.5%
Kern	11224500	1949	2014	27.7%	38.2%	17.2%	14.8%	16.5%	19.7%
Kern	11253310	1965	2014	62.2%	27.5%	13.1%	18.4%	6.9%	13.5%
South Coast	11098000	1949	2014	-5.0%	-8.1%	-8.5%	-3.3%	-7.5%	-4.7%
South Coast	11120500	1949	2014	-5.9%	-7.2%	17.3%	-4.3%	3.0%	3.7%
South Coast	11124500	1949	2014	49.0%	24.3%	24.1%	23.6%	25.7%	23.4%
South Coast	11138500	1949	2014	38.3%	14.4%	16.3%	9.4%	21.6%	16.0%
S. Eastern Desert	10257600	1966	2015	15.6%	63.6%	52.9%	36.4%	37.9%	32.1%
S. Eastern Desert	10258000	1949	2015	16.1%	19.5%	20.0%	26.5%	31.0%	15.7%
S. Eastern Desert	10259000	1949	2015	0.7%	-2.7%	-8.7%	-6.0%	-14.2%	-6.4%
S. Eastern Desert	10259200	1961	2015	-0.6%	-8.4%	-5.3%	-7.6%	0.4%	-4.9%

Applying the Tessmann Methodology to USGS Monthly Flow Data

To facilitate the applied approach, filtered USGS monthly natural flow prediction data records were used to calculate monthly minimum instream flow recommendations for a given "ComID segment" (a unique segment identifier), as identified from the NHDPlusV2 database[22], by applying the Tessmann methodology. The USGS data, as received, has a row entry for each unique segment identifier, year, month, and for four different flow statistics (maximum, mean, median and minimum) an estimated average value, a lower 10th percentile value and an upper 90th percentile value of what the model projected.

For the purposes of the monthly minimum instream flow calculations, the only value used for each unique segment identifier, year and month, was the estimated mean flow. The estimated mean monthly flow values from each year were averaged over the period of record, by month, resulting in one mean monthly flow value for each month. All monthly flow values were averaged over the entire period of record to calculate the mean annual flow value. Tessmann's equations were applied to the mean monthly flow values and then compared to the mean annual flow value resulting in a minimum instream flow target for each month for each unique segment identifier in the calculations.

The calculations were used to generate instream flow Requirements for the unique segment identifiers represented by the compliance gages (see "Rationale and Methodology for Compliance Gage Assignments," Section below for details regarding compliance gage selection). Cannabis diverters will be required to monitor these gages to ensure they are in compliance with the Policy's numeric flow Requirements. The calculations may be used to generate minimum monthly instream flow requirements at additional compliance gages, as identified or required, on stream systems impacted by cannabis cultivation.

Aquatic Base Flows

The State Water Board recognizes that in some locations groundwater diversions are having a significant impact on surface flows. The expansion of cannabis cultivation has and will continue to increase the amount of groundwater diverted, as a source for both new cannabis cultivators as well as existing surface water diverters that switch to groundwater diversions. To evaluate these groundwater impacts, the State Water Board, in consultation with CDFW, established aquatic base flows using the USGS flow modeling data to calculate mean monthly flows using the New England Aquatic Base Flow Standard methodology (USFWS 1999) at compliance gages throughout the State. The aquatic base flow, amongst other information, will be used to evaluate whether groundwater diversions for cannabis cultivation are potentially having a significant impact on surface flows. To address these potential impacts, the State Water Board's Deputy Director for Water Rights may require a forbearance period or other measures for cannabis groundwater diversions in areas where such restrictions are necessary to protect surface flows.

Requirements contained in Policy Attachment A, *Section 3: "Requirements for Groundwater Diversions and Springs Qualifying for an Exemption under Narrative Instream Flow Requirement 3 (Exempt Springs)"* and *Section 4: "Watershed Compliance Gage Assignments"* specifically address these impacts.

[22] The United States Geological Survey (USGS) National Hydrography Database Plus Version 2 (NHD Plus V2)

Methodology for Development of Dry Season Aquatic Base Flow Values

The New England Aquatic Base Flow (ABF) Standard was developed in 1981 and implemented as an internal United States Fish and Wildlife Service (USFWS) directive that establishes standard procedures for USFWS personnel when reviewing water development projects in New England (USFWS 1999). The USFWS directive uses a bifurcated approach to developing instream flow recommendations. A choice must be made between using the ABF Standard versus site-specific studies such as the Instream Flow Incremental Method (IFIM). Complex circumstances often necessitate site-specific studies. However, the ABF Standard is implemented in situations when: a project is relatively straightforward; the waters are not over-allocated to uses such as water supply, hydropower or irrigation; a single flow recommendation is sufficient; the administrative process is straightforward; time and cost constraints are significant issues; or a goal of the parties involved is to minimize risk and provide certainty during the regulatory process.

The ABF Standard is applied in one of two ways, depending on whether the stream system in question meets certain criteria. In general, the criteria include a minimum size drainage area of 50 square miles, a period of record for each stream gaging station of at least 25 years, gaging records of good-to-excellent quality, a basically free flowing or unregulated stream, and median monthly flow values calculated by taking the median of monthly average flows for the period of record. If these requirements are not met, a default flow is selected as the flow requirement. A default flow is simply a generic flow criterion applicable to a stream that does not meet the minimum ABF criteria (e.g., 25 years of records, etc.) as discussed previously. The default flows are developed from the flow statistics from 48 stream gages in New England. If hydrologic statistics are unavailable, or other criteria are not met, default values for April/May, August and February are assumed to be 4.0, 0.5 and 1.0 cubic feet per second per square mile of drainage. These ABF default flows are based on New England hydrology (developed statistically in the Connecticut River basin on a reach level), however, and should not be blindly used in other regions, such as those in California.

The State Water Board has determined that the ABF Standard of selecting the median of mean monthly flows is appropriate for setting a dry season aquatic base flow for each compliance gage location. While a 25-year historical gage record of actual flows is not available at all gage locations, the State Water Board has chosen to use the USGS mean natural monthly streamflow predictions over the 65-year period observed in the dataset for the ABF calculations. Median monthly flow values were calculated by taking the median of predicted natural monthly mean flow.

The ABF Standard, as developed for the New England region, uses the limiting factors concept to identify critical life cycle functions, temporal periods, and chemical and physical parameters that could function as limiting factors on aquatic life. Low flow conditions in August typically represent a natural limiting period because of high stream temperatures and diminished living space, dissolved oxygen and food supply. The median flow for August was therefore designated as the ABF. Some applications in the southeastern United States have calculated the ABF using September rather than August median flow, since September was the month with the lowest median flow in those regions.

A review of the mean monthly flow statistics for the gages in which the aquatic base flow Requirements will be implemented indicate that the month of September is often the lowest flowing month for locations with median flows greater than 1.0 cubic feet per second (cfs), accounting for approximately 41 percent of the dataset. The second most frequently occurring lowest flow month is August, at 16 percent, followed by October at 15 percent. The remaining 28 percent of occurrences were in April, May, June, and July combined. California has vast diversity in its hydrology throughout the state and strictly applying the August median flow as an ABF threshold would not meet the intent of the original New England ABF policy.

The aquatic base flow for each compliance gage is calculated based on the mean monthly flow of the lowest flowing month from April through October to account for the varying hydrology throughout California. In general, in California, the lowest flows and highest temperatures occur during August, September, and October. However, a relatively small subset of streams represented by the Cannabis Policy compliance gages stop flowing or nearly stop flowing (less than 1.0 cfs) during the dry season based on predicted historical modeling. To address these intermittent stream systems that are predicted to reach zero or near zero flows during the dry season, the aquatic base flow is calculated by taking the median of the mean monthly flow (over the predicted historical modeling period) of the lowest non-zero flow month that is greater than 1.0 cfs. In the case that the stream does not have a predicted median of the mean monthly flow greater than 1.0 cfs during the dry season (April through October), the groundwater aquatic base flow will default to 1.0 cfs for that stream. While the ABF Standard is traditionally applied to watershed drainage areas greater than 50 square miles, the State Water Board applied to ABF Standard throughout California, including watershed drainage areas of less than 50 square miles.

Requirements contained in Policy Attachment A, *Section 3: "Requirements for Groundwater Diversions and Springs Qualifying for an Exemption under Narrative Instream Flow Requirement 3 (Exempt Springs)"* and *Section 4: "Watershed Compliance Gage Assignments"* specifically address these impacts.

RATIONALE AND METHODOLOGY FOR COMPLIANCE GAGE ASSIGNMENTS

Identifying Appropriate Compliance Gages

Compliance with the numeric instream flow Requirements identified in the Policy is based on hydrology at selected gages chosen to represent watersheds throughout California. To determine which existing gages could serve as compliance gages, State Water Board staff reviewed active gage networks in California. Numerous federal, state and local agencies, and nongovernmental organizations (NGOs) operate streamflow gages in California with varying levels of data availability, reporting frequency, and data quality control. Due to time limitations, only the gages that reported on the National Water Information System (NWIS) or California Department of Water Resources - California Data Exchange Center (CDEC) websites were selected for use.

Once the gage networks and data sources were selected, a list of the active gages was created. The NWIS website[23] was queried on May 7, 2018 for the California Statewide Streamflow table, which returned 498 gages.

[23] http://waterdata.usgs.gov/nwis/dv/?referred_module=sw

A similar query of the CDEC website[24] on May 7, 2018, for Status=Active, and Sensor Type= Flow, Full Natural; Full Natural Flow; Flow, River Discharge; Flow, River Discharge Precise, returned approximately 418 gages (including duplications of NWIS gages). After removing duplicates, a list of 752 gages was established for further investigation.

The active gage names were manually reviewed, and any gage with the term "canal," "spillway," "diversion," or similar terms were categorized as an "Excluded Gage," that do not provide information on natural streamflow. All remaining gages were categorized as a "Potential Compliance Gage" and subjected to additional review.

The potential compliance gages were evaluated for use as compliance gages based on location, stream flow data collected, sensor type, reporting frequency, and any notes (e.g., potential loss of funding). Based on this evaluation, the gages were placed into three main categories: compliance gage, compliance gage downstream of a dam, or excluded gage. Gages were excluded if they were not active, were slated for de-activation, did not report discharge, did not measure streamflow, or were heavily impacted by anthropogenic actions. The compliance gages were then subdivided into "reference" and "non-reference" sites, based on data provided by the University of California at Davis, which identified sites with little to no upstream impacts as "reference gages." The Tessmann Method was used to develop Numeric Flow Requirements at each gage that was categorized as either a compliance gage or a compliance gage downstream of a dam.

The gages were then plotted in GIS along with the USGS National Hydrography Dataset (NHD) [NHDPlusV2] and the USGS Watershed Boundary Dataset (WBD). The geospatial review included verification of the plotted location of the gage in relation to the NHD, the nearest stream or river type reach (COMID) selected to represent flow at the gage, and the condition of the watershed (e.g., agricultural and urban development, inter-basin water transfers, and storage reservoirs) above the gage. The coordinates provided by the operator for each gage was plotted in GIS. The COMID was identified and checked for each gage to ensure that the COMID was represented by the gage. The watershed area contributing flow to the gage was evaluated, as well as notes from USGS gage reviews (including Gages-II analysis) and remarks from USGS operators, to determine the general level of impairment in the flow record. Gages which were heavily impacted or where the extent of impacts was unclear were generally excluded, gages with upstream dams were identified as below dams, and gages with moderate to no impairment were retained as compliance gages.

Gages identified as being below dams were further divided into two categories: (1) gages below dams with existing instream flow requirements through the Federal Energy Regulatory Commission (FERC) licensing program, through Biological Opinions issued by the National Marine Fisheries Service or the United States Fish and Wildlife Service, or through water right decisions; and (2) gages without an existing flow requirement. For gages below dams where flow requirements could not be identified, a polygon was created to represent the stream segments most impacted by the dam. Polygon widths were set to 300 feet (to match the riparian setback distance of 150 feet for class 1 watercourses) and follow the NHD representation of the watercourse location as opposed to the current actual alignment that appears in current aerial imagery (some actively meandering rivers may not align completely within the mapped polygons). Generally, gages represented only the reaches between the dam and the gage; however, in cases where additional downstream gages did not exist, the polygons extended downstream of the gage to a point where modeled flows were greater than 133

[24] http://cdec.water.ca.gov/cgi-progs/staSearch

percent of the modeled flow at the gage. This point usually occurred at the confluence with another stream or river and represented a point where the impact of the dam on mean annual streamflow was considerably reduced.

For gages below dams with an identified existing flow requirement, a polygon was created for each associated stream reach. In general, the length of stream below the dam that was included in each flow requirement polygon was based on the reach description in the regulatory document (e.g., FERC license, Biological Opinion). In cases where the requirement is to release a certain flow from the dam or diversion structure, but the downstream reach to which the requirement applies was not defined, an attempt was made to reflect the intent of the regulatory document, based on language in the document and staff's knowledge of the project or dam. The width of each polygon varies depending on the size of the stream and how closely the NHD stream lines tracked the stream channel, as it appears in current aerial imagery.

Identifying Ungaged Watershed Boundaries

Cannabis cultivators diverting from within a watershed represented by one of the compliance gages (including those compliance gages below dams) listed in the Policy, Attachment A, Section 4 will be monitoring that gage to comply with the Policy's numeric flow Requirements. There are a limited number of usable existing compliance gages throughout the state. The limited existing compliance gages do not directly measure runoff from all geographic areas. The State Water Board used a pairing process to assign the "best" gage to every HUC12 sized watershed boundary throughout the state regardless of whether a gage actually exists in that watershed boundary. This makes it possible to assign instream flow requirements (Tessmann or existing flow requirements) to every geographic area in the state.

Paired Watershed Gage Approach – General Pairing Procedure

Cannabis cultivators diverting from surface water are required to monitor the assigned compliance gage (or an assigned backup) for that location and comply with the Policy's numeric flow Requirements. Diversions from stream reaches located within watersheds that do not have a designated compliance gage within the watershed area are paired with a compliance gage from another watershed area, as designated by the State Water Board. Only the gages that were categorized as "non-reference" compliance gages were used for the watershed pairing. Reference gages were not used for pairing because they represent natural streamflow and would not represent watersheds with existing diversions.

The pairing procedure is based on dividing the state into HUC12 sized watershed boundaries and then matching the "best" compliance gage to every HUC12 watershed throughout the state. A python script run in ArcGIS was used to select the COMID of the NHDPlusV2 stream segment with the largest cumulative drainage area to hydrologically represent its corresponding HUC12. Only stream segments that had predicted natural flow values from the USGS model (Carlisle 2016) were used in this selection process. HUC12's that did not have stream segments with predicted natural flow values from the USGS model were paired using the same procedure, excluding the hydrograph comparison.

Once a NHDPlusV2 stream segment was selected to represent each HUC12, the general pairing procedure paired watersheds based on a set of weighted criteria to best correlate an ungaged watershed to one with a designated compliance gage.

Four factors were evaluated in the watershed pairing procedure: hydrograph, proximity, drainage area, and a measure of similarity based on the HUC12 numbering convention as follows:

- ***Hydrograph*** - Using available data from the USGS model (Carlisle 2016), the normalized annual hydrograph (mean monthly predicted flow, normalized by mean annual flow, plotted over time) was generated for each gage station and each ungaged watershed. A similarity coefficient between the normalized hydrographs was calculated for each gaged and ungaged watershed pair. The coefficient was derived by taking Euclidian distances between each variable pair using the R statistical package 'pdist' version 1.2, developed by The R Project for Statistical Computing (https:www.R-project.org). The distances were standardized using the function 'scale' (base R package) which results in unitless scores. The inverse of each score was converted to a decimal between 0 and 1 with 1 being a theoretically perfect match, or the coefficient that would arise between a watershed and itself.
- ***Proximity*** - The geographic coordinates of the centroid of each watershed boundary area were determined using GIS software, thus allowing calculation of the average estimated distance between each watershed. The distances were standardized and coefficients were computed as described in the Hydrograph Section above. The assumption is that geographically proximate watersheds will share relatively more similar geological and climatic attributes, resulting in generally stronger hydraulic and hydrologic correlations.
- ***Drainage Area*** - A coefficient of similarity was calculated between the two watershed surface areas using the method described in the Hydrograph Section above. The assumption is that watersheds with more similar surface areas will have relatively more similar runoff response times, among other hydraulic and hydrologic correlations.
- ***Measure of Similarity (HUC12 Numbering)*** *Score* - A similarity coefficient was derived by determining whether a watershed and gage pair shared the same HUC4, HUC6, HUC8, HUC10, or HUC12. A higher score was given to pairs within smaller shared watersheds (i.e., a pair falling in a HUC10 has a higher score than a pair that shared a (larger) HUC8, but fell in different HUC10 watersheds). A higher score was also given to an upstream ungagged HUC 12 if the downstream HUC12 contained a gage.

Each of the four factors were calculated, and then standardized and converted to a range from 0 to 1. Then calibrated weights were computed and used to calculate a weighted average of similarity. Of the resulting calculations, the pair with a matching factor closest to 1 represents the best available match between watershed and compliance gage.

State Water Board staff arrived at these weighting factors based on several iterations of running the matches and manually analyzing results for proper matching. These weighting factors can be adjusted in the future, if necessary.

Gage Assignments Map

The current list of active compliance gages and associated instream flow Requirements are available at:
https://www.waterboards.ca.gov/water_issues/programs/cannabis/tessmann_instream_flow_requirements.html.

WATER QUALITY ANTIDEGRADATION ANALYSIS

State Water Board Resolution No. 68-16, the *Statement of Policy with Respect to Maintaining High Quality of Waters in California* (the Antidegradation Policy), requires that the discharge of waste to the waters of the state be regulated to achieve the highest water quality consistent with the maximum benefit to the people of the state. The quality of some waters is higher than established by adopted policies and that higher quality water must be maintained to the maximum extent possible consistent with the Antidegradation Policy. The Antidegradation Policy requires the following:

- Whenever the quality of water is better than the quality established in policies as of the date on which such policies become effective, such high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies.
- Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur, and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

To obtain coverage under the Cannabis Cultivation General Order, cannabis cultivators must self-certify that all applicable Requirements have been, or will be implemented by the onset of the winter period following the enrollment date. Those cannabis cultivators that cannot implement all applicable Requirements by onset of the winter period, must submit a proposed time schedule and scope of work to the Regional Water Board for use in preparing a time schedule order. Interim Requirements must also be implemented to prevent unseasonable precipitation events from resulting in discharges of waste constituents. Interim Requirements are those that can be implemented immediately following site development. Furthermore, to avoid water quality degradation from erosion and sedimentation, construction and grading activities must not occur during the winter period, as defined in the Policy. Emergency construction and site grading activities are subject to authorization by the applicable Regional Water Board Executive Officer or designee on a site-specific basis. The Regional Water Board Executive Officer may require a separate work plan, compliance schedule, and require that all work is supervised a Qualified Professional, as defined in the Policy.

Although background water quality varies significantly in those areas covered by the Policy, most receiving waters are considered high quality waters for one or more constituent of concern. The Requirements of the Policy represent the best practicable treatment or control of discharges from cannabis cultivation sites. To the extent a discharge may be to high quality waters, the Policy authorizes limited degradation consistent with the Antidegradation Policy.

State taxes will be imposed on growing and selling cannabis beginning January 1, 2018. In addition, local governments are authorized to add additional local taxes. The annual state and local tax revenue is forecast to be approximately $1 billion. The revenue will address social, legal, and environmental issues related to cannabis. (LAO 2016)

Limited degradation of groundwater by some waste constituents associated with discharges from cannabis cultivation activities, after effective Requirements are implemented, is consistent with the maximum benefit to the people of the state. The economic benefit described above and the need to provide a safe supply of cannabis is of maximum benefit to the people of the state and provides sufficient justification for allowing limited water quality degradation that may occur pursuant to the Policy, Cannabis Cultivation General Order, and Cannabis General Water Quality Certification provided the terms of the applicable water quality control plans (commonly referred to as Basin Plans), and other applicable policies and plans of the Water Boards are consistently met.

The State Water Board anticipates most cannabis cultivation canopy areas (as defined by CDFA) will be less than one acre. Because most cannabis cultivation sites will be relatively small, they are inherently less of a threat to water quality. However, cumulative impacts from a regional concentration of small cultivation sites may result in significant water quality impacts if applicable Requirements are not implemented. All cannabis cultivators must certify that they are in compliance with Requirements (or a Regional Water Board compliance schedule) associated with their cannabis cultivation site tier ranking. Cannabis cultivators that are not in compliance with the Policy are subject to enforcement actions, including imposition of administrative civil liabilities.

All cannabis cultivators must comply with the minimum riparian setback Requirements in the Policy. High risk sites (any portion of the disturbed area is located within the riparian setback Requirements), with the exception of activities authorized under 404/401 CWA permits, a CDFW LSA Agreement, coverage under the Cannabis Cultivation General Order water quality certification or grandfathered sites provision, or site-specific WDRs issued by the Regional Water Board, will be assessed the high-risk fee until the activities comply with the riparian setback Requirements. It is the cannabis cultivator's responsibility to notify the Regional Water Board of compliance with the riparian setback Requirements to reassess the annual fee. If the site is unable to meet the compliance schedule contained in the Cannabis Cultivation General Order for complying with the riparian setback Requirements, the Regional Water Board may issue a site-specific enforcement order and compliance schedule.

Water Code section 13276 identifies 12 types of waste discharge that may result from cannabis cultivation. The 12 types can be grouped according to type of discharge and are described below.

a. Discharges of sediment from roads, improperly constructed or maintained stream crossings, drainage culverts, disturbed areas, or cultivation sites to surface water. Discharges of sediment can be controlled through compliance with Policy Requirements.

b. Discharges resulting from development within and adjacent to wetlands and riparian zones. Discharges to wetlands and riparian zones can be controlled through compliance with Policy Requirements.

c. Discharges of fertilizers, pesticides (including herbicides and rodenticides) to surface water or groundwater. Discharges of the chemicals described can be controlled through compliance with Policy Requirements.

d. Spills or leaks of fuels, lubricants, hydraulic oil, or other chemical associated with pumps, construction, or other equipment. Discharges of these waste materials can be controlled through compliance with Policy Requirements.

e. Discharges of trash, household refuse, or domestic wastewater. Discharges of these waste materials can be controlled through compliance with Policy Requirements.

Cannabis cultivators enrolled in the Cannabis Cultivation General Order must submit a Site Management Plan that describes how they are complying with Policy Requirements.

See information presented in the previous sections ("*Constituents of Concern*" and "*Slope and Erosion Potential Relationship")* under the broader Background and Rationale for Requirements to Address Water Diversion and Waste Discharge Associated with Cannabis Cultivation section of the Staff Report for further information supporting this Antidegradation Analysis.

Compliance with the Policy and any water quality related mitigation measures in other current, future, and/or location-specific California Environmental Quality Act (CEQA) documents addressing cannabis cultivation and associated activities will ensure compliance with the applicable water quality control plans.

Cannabis cultivators that want to terminate coverage under the Cannabis Cultivation General Order must submit a Notice of Termination (NOT). The NOT must include a Site Closure Report (described in Policy Attachment A, Section 5: *Permitting and Reporting* ") and a final monitoring report. The Regional Water Board reserves the right to inspect the site before approving a NOT.

REFERENCES

Bauer, S., Olson, J., Cockrill, A., van Hattem, M., Miller L., Tauzer M., and Leppig, G. 2015. Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds. PLoS ONE 10(3): e0120016. Available at: https://doi.org/10.1371/journal.pone.0120016

Benda et al. 2005. "Geomorphology of Steepland Headwaters: The Transition from Hillslopes to Channels." Journal of the American Water Resources Association. Available at: http://geog.uoregon.edu/amarcus/geog607w09/Readings/Benda-et-al2005_JAWRA.pdf

Bentrup, G. and Hoag, J.C. 1998. The Practical Streambank Bioengineering Guide. United States Department of Agriculture, Interagency Riparian/Wetland Plant Development Project. Available at: http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpu116.pdf

Brown and Caldwell, Kennedy/Jenks Consultants. 2007. Manual of Good Practice of Land Application of Food Processing/Rinse Water. California League of Food Processors. Available at: http://clfp.com/documents/Manualofgoodpractice/CLFP%20Manual_COMPLETE_FINAL_3-14-07%20(2).pdf

Cafferata, P. 2015. California Road Rules for 2015 and Beyond. Associated California Loggers Annual Meeting January 15, 2015. California Department of Forestry and Fire Protection. Available at: http://www.fire.ca.gov/resource_mgt/downloads/Cafferata_RoadRules2013_ACL-talk_January2015(final).pdf. Accessed May 4, 2017.

California Department of Fish and Wildlife (CDFW). 2017a. Fish Species of Special Concern. Available at: https://www.wildlife.ca.gov/Conservation/SSC/Fishes. Accessed March 15, 2017.

California Regional Water Quality Control Board, San Francisco Region. 2017. "General Waste Discharge Requirements for Vineyard Properties in the Napa River and Sonoma Creek Watersheds". Available at: https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/agriculture/vineyard/final_docs/Vineyard%20General%20WDRs%20-%207-17.pdf

CDFW. 2017b. State & Federally Listed Endangered & Threatened Animals of California. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405&inline. Accessed January 23, 2017.

CDFW. 2015. California State Wildlife Action Plan, 2015 Update: A Conservation Legacy for Californians. Edited by Armand G. Gonzales and Junko Hoshi, PhD. Prepared with assistance from Ascent Environmental, Inc., Sacramento, CA. https://www.wildlife.ca.gov/SWAP/Final

California Department of Fish & Game (CDFG). 2003. Atlas of the biodiversity of California. Sacramento, CA. 103. pp. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=116547. Accessed March 10, 2017.

CDFG. 2002. California climate based on the Köppen Classification System. GIS coverage. Wildlife and Habitat Data Analysis Branch. Sacramento, CA.

California Department of Transportation (Caltrans). 2017. Construction Site BMP Fact Sheets. Division of Construction. Sacramento, CA. Available at: http://www.dot.ca.gov/hq/construc/stormwater/factsheets.htm

Caltrans. 2003. Solid Waste Management, Construction Site Best Management Practices Manual. Available at: http://www.dot.ca.gov/hq/construc/stormwater/WM-05.pdf

California Department of Water Resources (DWR). 2013. Division of Safety of Dams Jurisdiction Over Dams and Reservoirs. Division of Safety of Dams. Sacramento, CA. Available at: https://water.ca.gov/Programs/All-Programs/Division-of-Safety-of-Dams/Jurisdictional-Sized-Dams

California Geologic Survey (CGS). 2002. Map of California Geomorphic Provinces, Note 36. California Department of Conservation, California Geological Survey. Sacramento, CA. Available at: http://www.conservation.ca.gov/cgs/information/publications/cgs_notes/note_36/Documents/note_36.pdf. Accessed March 10, 2017.

California Plant Health Association (CPHA). 1980. Western Fertilizer Handbook Sixth Edition. Soil Improvement Committee.

California Regional Water Quality Control Board, Central Coast Region. 2016. "Water Quality Control Plan for the Central Coastal Basin". Available at http://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/index.shtml.

California Regional Water Quality Control Board, Central Valley Region. 2016. "Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region". Available at http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/index.shtml.

California Regional Water Quality Control Board, North Coast Region. 2011. "Water Quality Control Plan for the North Coast Region". Available at http://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/.

California Storm Water Quality Association. 2003. Section 4: Source Control BMPs and California Stormwater BMP Handbook. Available at: https://www.casqa.org/resources/bmp-handbooks

Carlisle, D.M., Wolock, D.M., Howard, J.K., Grantham, T.E., Fesenmyer, K., and Wieczorek, M. 2016. Estimating natural monthly streamflows in California and the likelihood of anthropogenic modification: U.S. Geological Survey Open-File Report 2016–1189, 27 p., Available at: https://doi.org/10.3133/ofr20161189.

Cobourn, J. 2011. How to Install Residential Scale Best Management Practices (BMPs) in the Lake Tahoe Basin. University of Nevada Cooperative Extension. Available at: http://www.tahoebmp.org/Documents/Contractors%20BMP%20Manual.pdf

Critchfield, H. J. 1983. General Climatology, 4th Ed. Englewood Cliffs: Prentice Hall.

Crozier, C. 1986. Soil Conservation Techniques for Hillside Farms, A Guide for Peace Corps Volunteers. Peace Corps Information Collection and Exchange Reprint Series No.R-62. November 1986. Available at: http://files.eric.ed.gov/fulltext/ED288044.pdf.

Five Counties. 2002. A Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California Watersheds. Five Counties Salmon Conservation Program. Available at: http://www.5counties.org/roadmanual.htm.

Forrest, C. and Young, J.P. 2006. The Effects of Organic and Inorganic Nitrogen Fertilizer on the Morphology and Anatomy of Cannabis sativa "Fédrina" (Industrial Fibre Hemp) Grown in Northern British Columbia, Canada. Journal of Industrial Hemp Vol. 11, Iss.2, 2006.

Freeze, A. and Cherry, J. 1979. Groundwater, 604 pp. Available at: http://hydrogeologistswithoutborders.org/wordpress/1979-toc/.

Gale, D.B., Hayden T.R., Harris, L.S., and Voight, H.N. 1998. Assessment of anadromous fishstocks in Blue Creek, lower Klamath River, California, 1994-1996. Yurok Tribal Fisheries Program.

Griggs, F. T. 2009. California Riparian Habitat Restoration Handbook. River Partners. Available at: https://water.ca.gov/LegacyFiles/urbanstreams/docs/ca_riparian_handbook.pdf

Hausback, B.P., Muffler, L.J.P, and Clynne, M.A. 2011. Sutter Buttes- The Lone Volcano in California's Great Valley, United States Geological Survey Fact Sheet 2001-3024, Menlo Park, CA.

Haver, D. 2007. Best Management Practices; A Water Quality Field Guide for Nurseries. University of California Cooperative Extension. Available at: http://www.waterboards.ca.gov/sandiego/water_issues/programs/wine_country/docs/updates081910/ucce_bmps.pdf.fRiparian

Hawes, E. and Smith, M. 2005. Riparian Buffer Zones: Functions and Recommended Widths. Prepared for the Eightmile River Wild and Scenic Study Committee. April, 2005. Available at: http://eightmileriver.org/resources/digital_library/appendicies/09c3_Riparian%20Buffer%20Science_YALE.pdf

Johnson, A.W., and Ryba D.M. 1992. A Literature Review of Recommended Buffer Widths to Maintain Various Functions of Stream Riparian Areas. Prepared for King County Surface Water Management Division. February, 1992. Available at: https://salishsearestoration.org/wiki/File:Johnson_%26_Ryba_1992_king_county_recommendations_for_buffer_width.pdf

Johnson, Richard Arnold. and Wichern, Dean W. 2002. Applied Multivariate Statistical Analyses, fifth ed. Prentice Hall.

Lane, B., Dahlke, H., Pasternack, G., and Sandoval-Solis, S. 2017. Revealing the Diversity of Natural Hydrologic Regimes in California with Relevance for Environmental Flows Applications. Journal of the American Water Resources Association, JAWRA-16-0071-P.

Lane, B., Sandoval, S., and Stein, E. 2017. Characterizing diverse river landscapes using hydrologic classification and dimensionless hydrographs. In Prep

Legislative Analyst's Office (LAO). 2016. Ballot Analysis Proposition 64 Marijuana Legislation Initiative Statute. Available at: http://www.lao.ca.gov/BallotAnalysis/Proposition?number=64&year=2016. Accessed January 17, 2017.

Ludington, S., Moring, B., Miller, R., Stone, P., Bookstrom, A., Bedford, D., Evans, J., Haxel, G., Nutt, C., Flyn, K., and Hopkins, M. 2007. Preliminary Integrated Geologic Map Databases for the United States: Western States, United States Geologic Survey Open File Report 2005-1305, Version 1.3, December 2007. Available at: https://pubs.usgs.gov/of/2005/1305/. Accessed March 10, 2017.

Markham, C. 1970. Seasonality of Precipitation in the United States. *Annals of the Association of American Geographers* 60(3):593-597.

Michigan Department of Environmental Quality. 1992. Spoil Piles. Available at: http://michigan.gov/documents/deq/deq-wb-nps-sp_250905_7.pdf

Moores, E.M., and Twiss, T.J. 1995. Tectonics. W.H. Freeman and Company, New York.

Moyle, P.B., P.I. Samuel, and R. Lusardi. 2017. State of the Salmonids II: Fish in Hot Water by California Trout and UC Davis Center for Watershed Sciences. San Francisco, CA.

National Marine Fisheries Service (NMFS). 2017. Proactive Conservation Program: Species of Concern. Accessed at http://www.westcoast.fisheries.noaa.gov/protected_species/species_of_concern/species_of_concern.html. Accessed March 15, 2017.

NMFS. 2015. Public Draft Coastal Multispecies Recovery Plan. National Marine Fisheries Service, West Coast Region, Santa Rosa, California.

NMFS. 2014a. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (*Oncorhynchus kisutch*). National Marine Fisheries Service. Arcata, CA.

NMFS. 2014b. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. California Central Valley Area Office. July 2014.

NMFS. 2013. South-Central California Coast Steelhead Recovery Plan. West Coast Region, California Coastal Area Office, Long Beach, California.

NMFS. 2012a. Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

NMFS. 2012b. Southern California Steelhead Recovery Plan. Southwest Region, Protected Resources Division, Long Beach, California.

NMFS. 2007a. 2007 Federal Recovery Outline for the Distinct Population Segment of Central California Coast Steelhead. National Marine Fisheries Service, Southwest Regional Office, Long Beach, California.

NMFS. 2007b. 2007 Federal Recovery Outline for the Distinct Population Segment of Northern California Steelhead. National Marine Fisheries Service, Southwest Regional Office, Long Beach, California.

NMFS. 1998. “Factors Contributing to the Decline of Chinook Salmon: An Addendum to the 1996 West Coast Steelhead Factors for Decline Report,” Portland, Oregon: Protected Resources Division, National Marine Fisheries Service.

NMFS. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon and California. NOAA [National Oceanic and Atmospheric Administration] Technical Memorandum NMFS-NWFSC-27.

National Oceanic and Atmospheric Administration (NOAA). 2017. What is nutrient pollution? National Oceanic Service Website. Available at: https://oceanservice.noaa.gov/facts/nutpollution.html. Accessed on October 8, 2017.

Natural Resources Conservation Service. 2005. Prevent Soil Erosion on Your Property. California Watershed Recovery Project. Available at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_063808.pdf

Pennsylvania Land Trust Association. 2014. The Science Behind the Need for Riparian Buffer Protection. ConservationTools.org. Available at: http://conservationtools.org/guides/131

PRISM Climate Group. 2016. 30-year Normals (1981-2010) Annual: Precipitation, Minimum Temperature, Maximum Temperature; Elevation. Available at: http://prism.oregonstate.edu/. Retrieved December 5, 2016.

R Core Team (2017). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

R2 Resource Consultants, Inc. and Stetson Engineers, Inc. 2007. North Coast Instream Flow Policy: Scientific Basis and Development of Alternatives Protecting Anadromous Salmonids.

Resource Conservation District of Monterey County (RCDMC) and Monterey County Agricultural Commissioner’s Office. 2014. Hillslope Farming Runoff Management Practices Guide. Available at: http://www.rcdmonterey.org/pdf/rcdmc-hillslope-guide-rvsd-2.11.14.pdf.

Ricketts T. H. 1999. Terrestrial Ecoregions of North America: A Conservation Assessment. Washington (DC): Island Press.

Ruddiman, W.F. 2001, Earths Climate, Past and Future. W.H. Freeman and Company, New York.

Sanctuary Forest. 2008. Water Storage Guide; Storing water to benefit streamflows and fish in North Coast creeks and rivers. Available at: https://greywateraction.org/wp-content/uploads/2014/11/SantuaryForrest_Water_Storage_Guide.pdf.

Santos, N.R., Katz, J.V. E., Moyle, P., and Viers, J.H. 2014. A programmable information system for management and analysis of aquatic species range data in California. Environmental Modelling & Software, Vol. 53, 13-26. Retrieved from http://www.sciencedirect.com/science/article/pii/S1364815213002673.

Snyder Industries, Inc. 2008. Guidelines for Use and Installation of Above Ground Water Tanks. Available at: http://www.waterandseptictanks.com/Portals/0/files/GUIDELINES-FOR-INSTALLATION-OF-WATER-TANKS-_rev1_-03-20-08-_2_.pdf.

State Water Resources Control Board (State Water Board). 2014. Policy for Maintaining Instream Flows in Northern California Coastal Streams. Available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/instream_flows/docs/adopted_policy.pdf

State Water Board. 2012. Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems. Available at: http://www.waterboards.ca.gov/water_issues/programs/owts/docs/owts_policy.pdf

State Water Board. 2010. Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem. Sacramento, CA. August 3, 2010. Available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf

Tennant, D.L. 1976. Instream flow regimens for fish, wildlife, recreation and related environmental resources.

Tessman, S.A. 1979. Environmental Assessment. Technical Appendix E, in "Reconnaissance Elements" of the Western Dakotas Region of South Dakota Study. Water Resource Research Institute, South Dakota University.

United States Department of Agriculture. 1997. Ponds – Planning, Design, Construction, Agriculture Handbook. Natural Resources Conservation Service. Available at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_030362.pdf.

United States Environmental Protection Agency (U.S. EPA). 2013. SPCC Guidance for Regional Inspectors. Office of Emergency Management. Available at: http://www2.epa.gov/sites/production/files/2014-04/documents/spcc_guidance_fulltext_2014.pdf

U.S. EPA. 2006. The Volunteer Estuary Monitoring Manual, Ch. 15 Turbidity and Total Solids. EPA-842-B-06-003. Available at: https://www.epa.gov/sites/production/files/2015-09/documents/2009_03_13_estuaries_monitor_chap15.pdf.

U.S. EPA. 1999. Riparian Forest Buffer. Chesapeake Bay Foundation.

United States Fish and Wildlife Service. 2001. Juvenile salmonid monitoring on the mainstem Klamath River at Big Bar and mainstem Trinity River at Willow Creek, 1997-2000. Annual Report of the Klamath River Fisheries Assessment Program. Arcata Fish and Wildlife Office, Arcata, CA.

United States Geological Survey (USGS) National Hydrography Dataset. Available at: https://nhd.usgs.gov/.

Weaver, W., Weppner, E., and Hagans, D. 2015. Handbook for Forest, Ranch & Rural Roads. The Mendocino County Resource Conservation District. Ukiah, CA. Available at: http://www.pacificwatershed.com/sites/default/files/RoadsEnglishBOOKapril2015b.pdf.

Wenger, S. J. and Fowler, L. 2000. Protecting Stream and River Corridors: Creating Effective Local Riparian Buffer Ordinances. Carl Vinson Institute of Government, University of Georgia. Available at: http://www.ohioenvironmentallawblog.com/uploads/file/UGA%20riparian_buffer_guidebook.pdf.

Western Regional Climate Center (WRCC). 2015. California Climate Data Archive, National Weather Service- Cooperative Observer Program data. Available at: http://www.calclim.dri.edu/. Last updated July 21, 2015, data retrieved December 6-13, 2016.

Whittaker, R. H. 1960. Vegetation of the Siskiyou Mountains, Oregon and California. Biology Department, Brooklyn College, New York.

Whittaker, R. H. 1961. Estimation of Net Primary Production of Forest and Shrub Communities. Biology Department, Brooklyn College, New York.

Wong, Jeffrey (2013). pdist: Partitioned Distance Function. R package version 1.2. https//CRAN.R-project.org/package-pdist

Yarnell, S.M., Viers, J.H., and Mount, J. 2010. Ecology and Management of the Spring Snowmelt Recession. Bioscience 60(2):114-127.

Zimmerman, J.K.H., Carlisle, D.M., May, J.T., Howard, J.K., Klausmeyer, K.R., Brown, L.R., and Grantham, T.E. 2017. Patterns and Magnitude of Flow Alteration in California, USA.

State Water Resources Control Board

Cannabis Cultivation Policy

Staff Report

Appendix 1
Regional Descriptions

February 5, 2019

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1.0 REGIONAL DESCRIPTIONS

This appendix to the Cannabis Cultivation Policy (Policy) Staff Report provides an overview of the 14 regions for which instream flow Requirements and associated gage implementation plans have been developed. Maps and figures for each region are located at the end of each regional description and include maps of the regional areas, elevation, climate, precipitation, hydrologic classifications, and anadromous fish distribution, and graphs of monthly average temperature and precipitation patterns.

For the purposes of the Policy, the term special-status refers to species or distinct populations that are federally listed as threatened or endangered, listed as threatened or endangered by the state of California, listed as a species of concern by the National Marine Fisheries Service (NMFS), or listed as species of special concern by the California Department of Fish and Wildlife (CDFW)[1]. The presence of special-status anadromous salmonid populations within the nine cannabis policy regions was determined based on anadromous salmonid population distribution information obtained from the University of California, Davis (UC Davis) PISCES database, a compilation of data describing California's native fishes (Santos et al. 2014).

1.1 Klamath Region

The Klamath Region covers approximately 10,897 square miles in northern California and southern Oregon (Figure A-1). Elevations in this region range from sea level to over 7,500 feet in the Klamath Mountains and Trinity Alps, and over 14,000 feet at the peak of Mount Shasta (Figure A-2). The region includes the major watersheds of the Smith River, as well as the Klamath River and its main tributaries, the Trinity, Salmon, Scott, and Shasta Rivers. Although the Klamath Region spans portions of northern California and southern Oregon, only the portion of the Klamath Region located in California will be subject to this cannabis policy.

1.1.1 Climate and Precipitation

The climate of the Klamath Region varies according to the two major terrain types: mountains and plateau. The western portion of the Klamath Region is generally characterized by a Mediterranean climate, and the eastern portion of the Klamath Region is generally characterized by a Cool Interior climate (Figure A-3). The western portion of the Klamath Mountains are characterized by a Mediterranean climate with cool summers, coastal areas and the lower Smith River watershed are characterized by a Mediterranean climate with summer coastal fog, and the upper Trinity River watershed is characterized by a Mediterranean climate with hot summers. The Modoc Plateau geomorphic province and the mountain ranges flanking the Scott River watershed are characterized by cool continental climates with dry summers.
Temperatures patterns vary within the Klamath Region, and inland areas tend to exhibit more significant temperature extremes compared to coastal areas. The lower Klamath and Trinity River watersheds exhibit average annual maximum temperatures above 75 degrees Fahrenheit, while the Modoc Plateau and coastal areas in this region remain cooler, with average annual maximum temperatures of 60 degrees Fahrenheit in most locations, or 40 degrees Fahrenheit at high elevations. Average annual minimum temperatures near the Klamath Region coast and in low lying areas are tempered by the ocean influence and remain above freezing, while average annual minimum temperatures further inland and at high elevations drop below freezing.

[1] No California salmonids were federally proposed for listing as threatened or endangered or designated as a State Candidate for threatened or endangered listing by the state of California at the time of the preparation of this report (CDFW 2017b).

Precipitation patterns also vary within the Klamath Region, and the Klamath Mountains tend to receive a much larger amount of precipitation annually compared to the Modoc Plateau. The Klamath Mountains tend to receive an average of over 120 inches of precipitation annually, while the Modoc Plateau tends to receive an average of less than 15 inches of precipitation annually (Figure A-4). The Modoc Plateau receives a significant portion of precipitation as snowfall, and snow also falls in high elevation areas in the central Klamath Mountains. Precipitation generally falls in the Klamath Mountains from October to May, and peaks in December and January (Chart A-1). Precipitation generally falls in the Modoc Plateau from November to March (Chart A-2). (WRCC 2016)

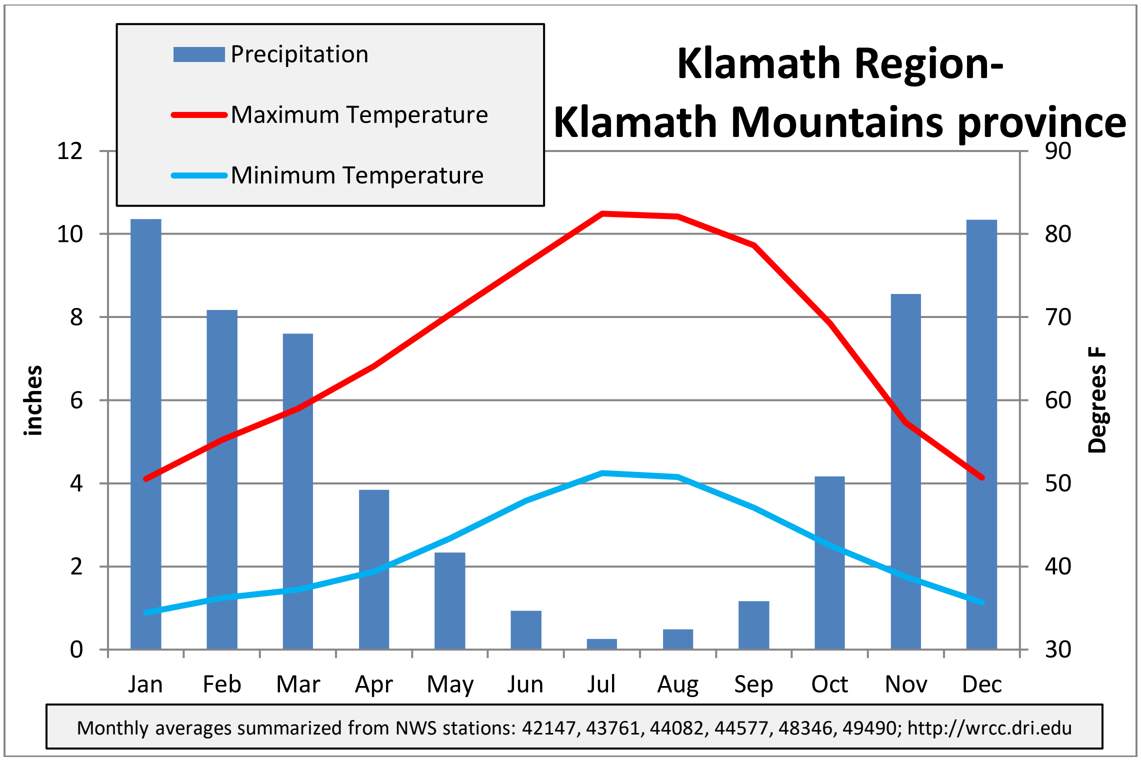

Chart A-1. Average annual patterns of temperature and precipitation in the Klamath Region, Klamath Mountains province.

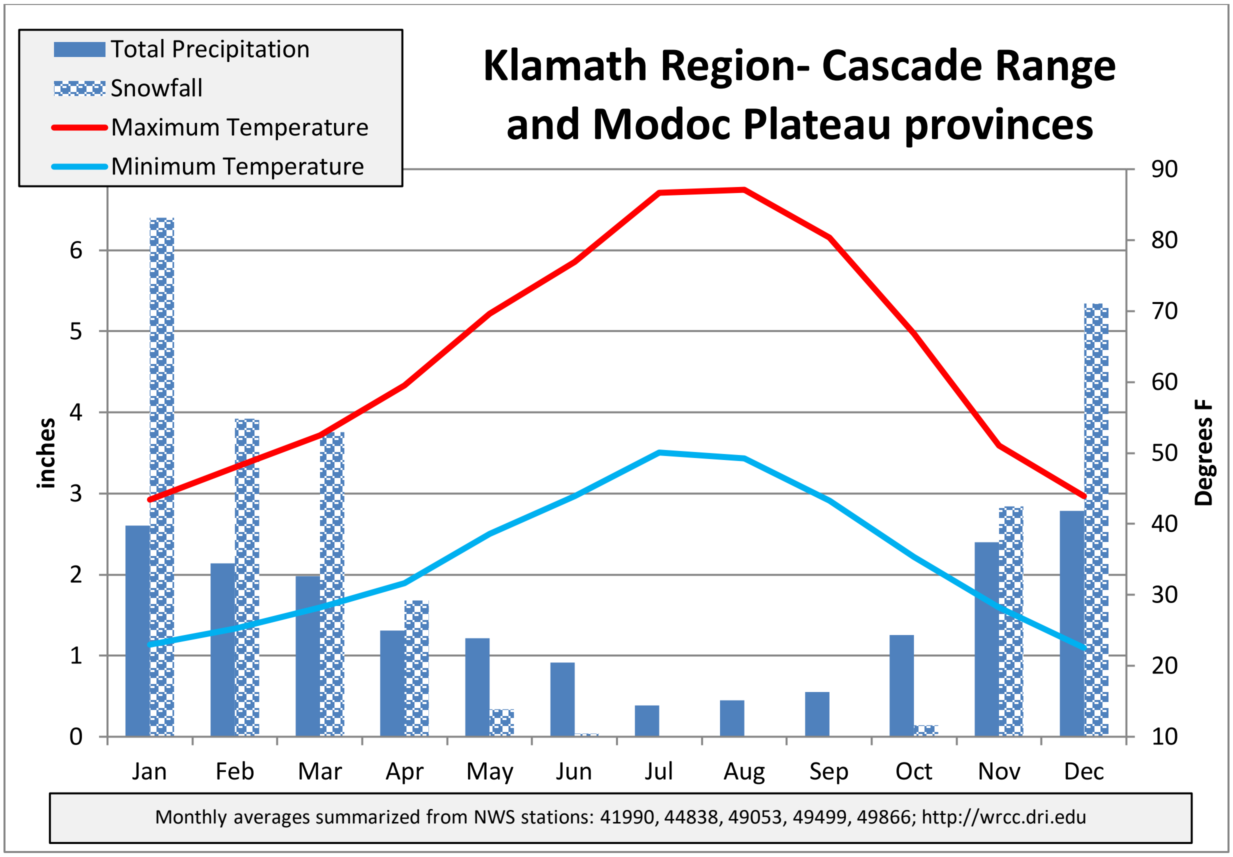

Chart A-2. Average annual patterns of temperature and precipitation in the Klamath Region, Cascade Range and Modoc Plateau provinces.

1.1.2 Hydrology

The hydrology of Klamath Region streams varies greatly from west to east, and several UC Davis hydrologic classifications exist for stream reaches in this region (Lane et al 2016). Many stream reaches located near the coast, within the Smith and lower Klamath River watersheds, are primarily classified as Winter Storm (WS) systems. Further inland, most tributaries to the Klamath River are classified as Low-Volume Snowmelt and Rain (LSR) systems. The mainstem Trinity River, located in the southern portion of the Klamath Region, is classified as High-Volume Snowmelt and Rain (HSR) system, and some tributaries in the Trinity River watersheds are classified as Perennial Groundwater and Rain (PGR) systems. Most stream reaches on the Modoc Plateau are classified as High Elevation and Low Precipitation (HELP) systems; however, Modoc Plateau streams generally exhibit low stream densities due to the Modoc Plateau's underlying porous volcanic geology.

Please refer to Figure A-5 for a stream classification map of the Klamath Region.

1.1.3 Geology

The Klamath Region is predominantly located in the Klamath Mountains, Cascade Range, and Modoc Plateau geomorphic provinces. The Klamath Mountains and Cascade Range are rugged mountain ranges, and the Modoc Plateau is an elevated volcanic plateau located in the northeastern corner of California. The western portion of the Klamath Mountains are underlain by marine sedimentary units with areas of igneous intrusive units, the central Klamath

Mountains are underlain primarily by metamorphosed sedimentary and volcanic rock, and the upper Trinity, Scott and Salmon watersheds are underlain by intrusive igneous rock. The portion of the Cascade Range located in the Klamath Region contains the stratovolcano Mount Shasta. The Cascade Range is generally underlain by igneous rock, including lava flows, pyroclastic flows, and alluvium eroded from volcanic features. The Modoc Plateau is a volcanic table land consisting of lava flows, tuff beds and small volcanic cones. Significant subterranean streamflows occur through porous volcanic features in the Modoc Plateau (CGS 2002).

1.1.4 Anadromous Salmonid Population

Five special-status evolutionarily significant units (ESUs), distinct population segments (DPSes), or distinct taxonomic entities[2] (DTEs) are currently extant within the Klamath Region (Figure A-6):

- the Southern Oregon/Northern California Coastal (SONCC) Chinook salmon ESU,
- the Upper Klamath-Trinity fall-run (UKTR FR) Chinook salmon DTE[3],
- the Upper Klamath-Trinity spring-run (UKTR SR) Chinook salmon DTE,
- the Klamath Mountains Province (KMP) steelhead DPS, and
- the Southern Oregon/Northern California Coast (SONCC) coho salmon ESU.

The SONCC coho salmon ESU is currently listed as threatened under the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA) (CDFW 2017b). The SONCC Chinook salmon, UKTR FR Chinook salmon, UKTR SR Chinook salmon, and the KMP steelhead populations are listed as species of special concern by CDFW (Moyle et al. 2015).

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[2] The term Distinct Taxonomic Entity (DTE) is applied in this document in reference to salmonid populations given consideration by CDFW as distinct, or separate, taxa, but that are not currently designated as individual ESUs or DPSes by NMFS.

[3] UKTR FR and UKTR SR Chinook salmon together constitute a single ESU; however, CDFW treats the two runs as distinct taxonomic entities based upon their distinct life-history strategies and in consideration of the unique management concerns of each run (Moyle et al. 2015).

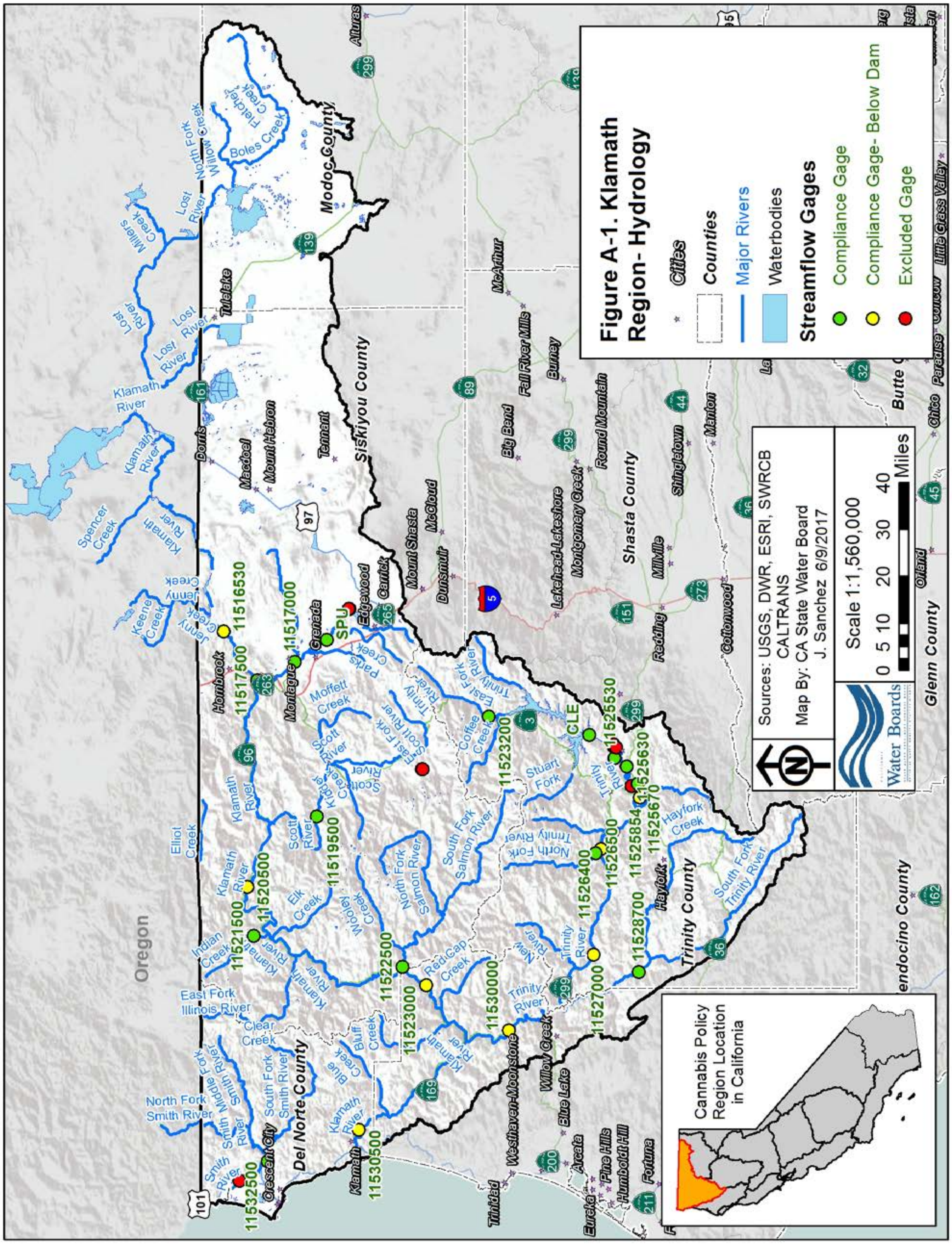


Figure A-1. Klamath Region- Hydrology
Cities
Counties
Major Rivers
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,560,000
0 5 10 20 30 40 Miles
Cannabis Policy Region Location in California
Oregon
Siskiyou County
Modoc County
Del Norte County
Trinity County
Shasta County
Glenn County
Klamath River
Trinity River
Salmon River
Scott River
Smith River
Lost River
11532500
11530500
11530000
11523000
11522500
11521500
11520500
11519500
11517500
11516530
11517000
11523200
11525530
11525630
11525670
11525854
11526500
11526400
11527000
11528700
SPU
CLE

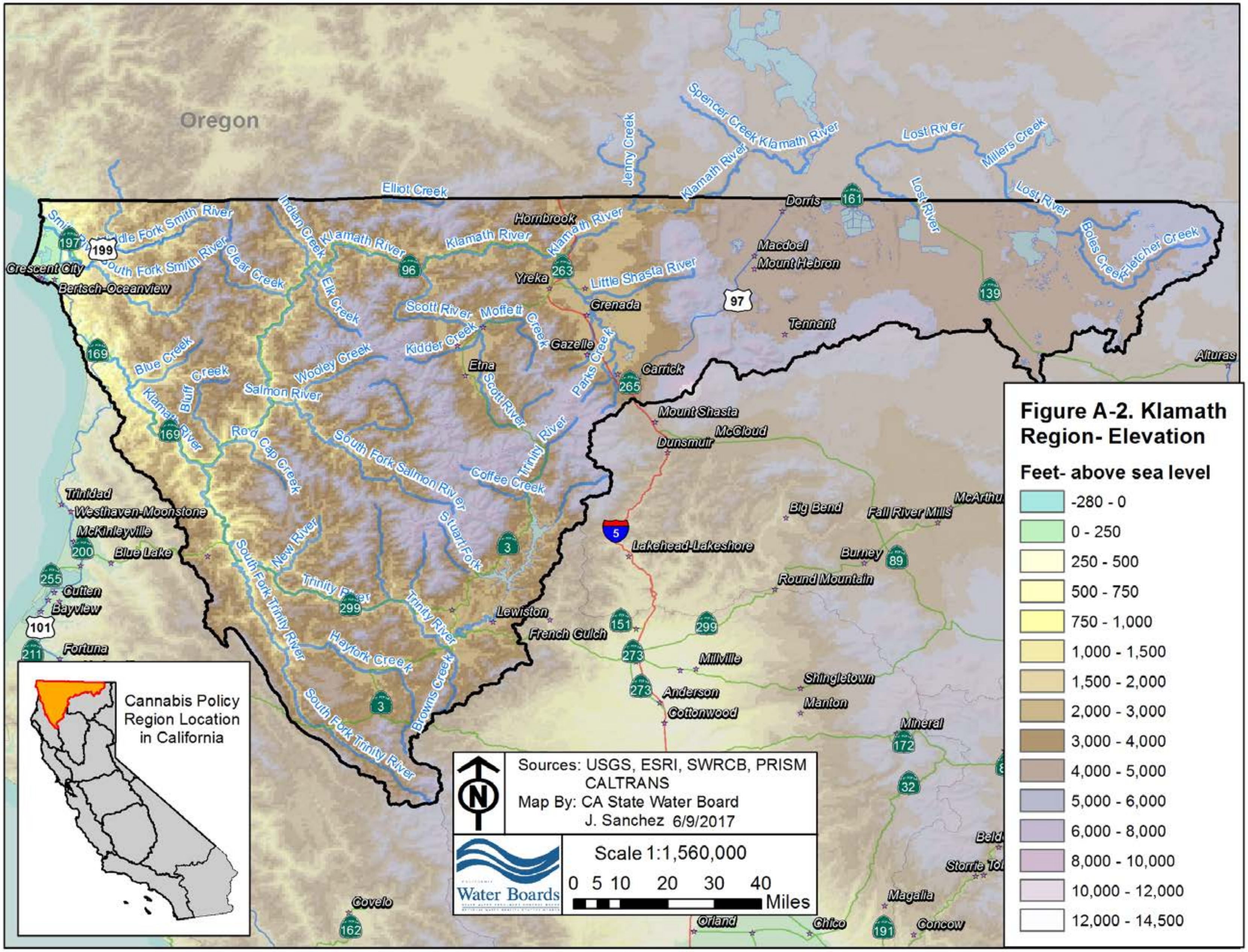


Figure A-2. Klamath Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
10,000 - 12,000
12,000 - 14,500
Sources: USGS, ESRI, SWRCB, PRISM CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,560,000
0 5 10 20 30 40 Miles
Water Boards
Cannabis Policy Region Location in California
Oregon
Elliot Creek
Jenny Creek
Spencer Creek
Klamath River
Lost River
Millers Creek
Boles Creek
Fletcher Creek
Indian Creek
Clear Creek
Elk Creek
Scott River
Moffett Creek
Kidder Creek
Wooley Creek
Salmon River
Blue Creek
Bluff Creek
Red Cap Creek
South Fork Salmon River
Coffee Creek
Trinity River
Parks Creek
Little Shasta River
Stuart Fork
New River
Hayfork Creek
Browns Creek
South Fork Trinity River
Crescent City
Bertsch-Oceanview
Hornbrook
Yreka
Grenada
Gazelle
Etna
Carrick
Dorris
Macdoel
Mount Hebron
Tennant
Alturas
Mount Shasta
McCloud
Dunsmuir
Lakehead-Lakeshore
Big Bend
Fall River Mills
Burney
Round Mountain
Lewiston
French Gulch
Millville
Shingletown
Manton
Anderson
Cottonwood
Mineral
Trinidad
Westhaven-Moonstone
McKinleyville
Blue Lake
Cutten
Bayview
Fortuna
Covelo
Orland
Chico
Magalia
Concow

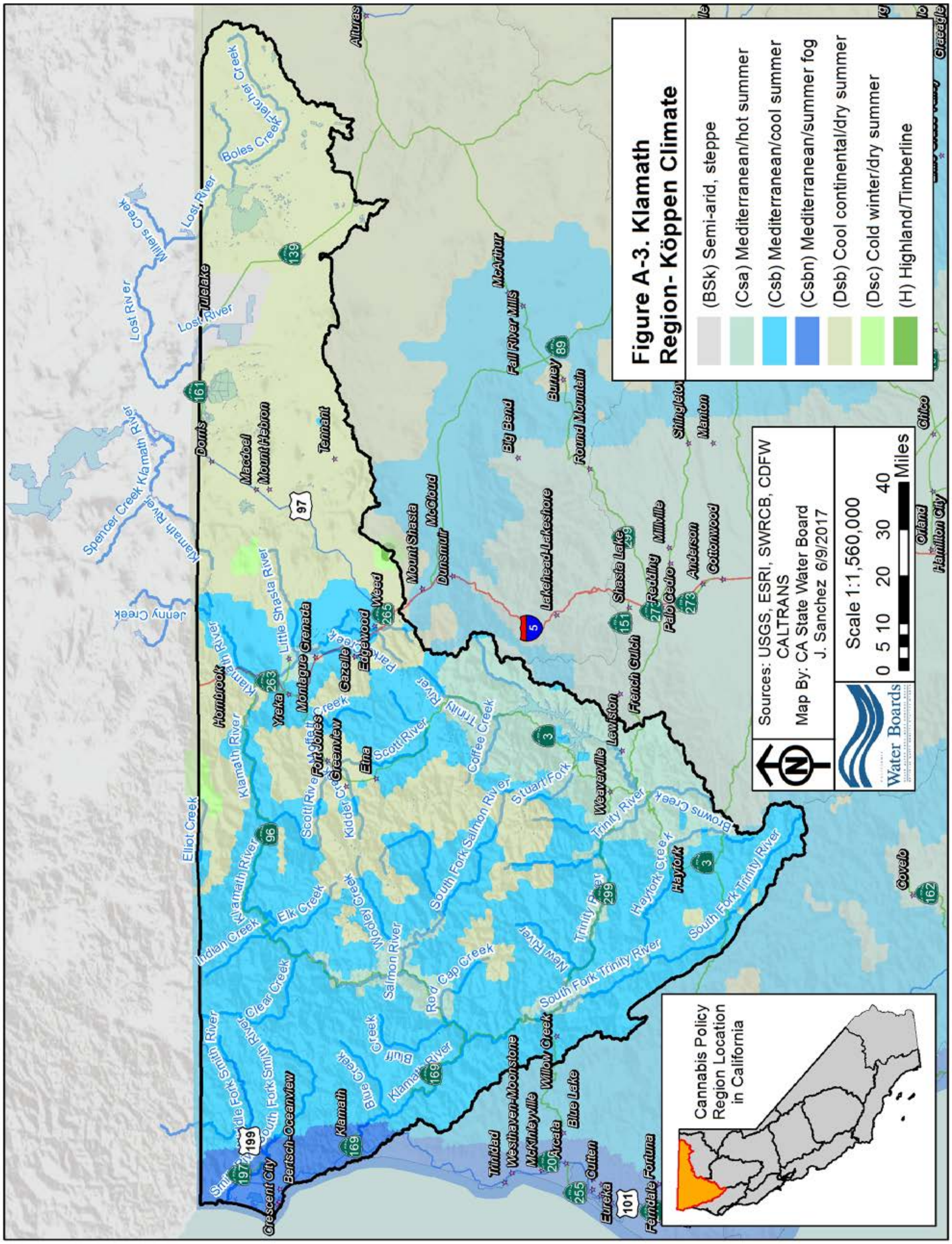


Figure A-3. Klamath Region- Köppen Climate
(BSk) Semi-arid, steppe
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Csbn) Mediterranean/summer fog
(Dsb) Cool continental/dry summer
(Dsc) Cold winter/dry summer
(H) Highland/Timberline
Sources: USGS, ESRI, SWRCB, CDFW
CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,560,000
0 5 10 20 30 40
Miles
Cannabis Policy
Region Location
in California
Water Boards

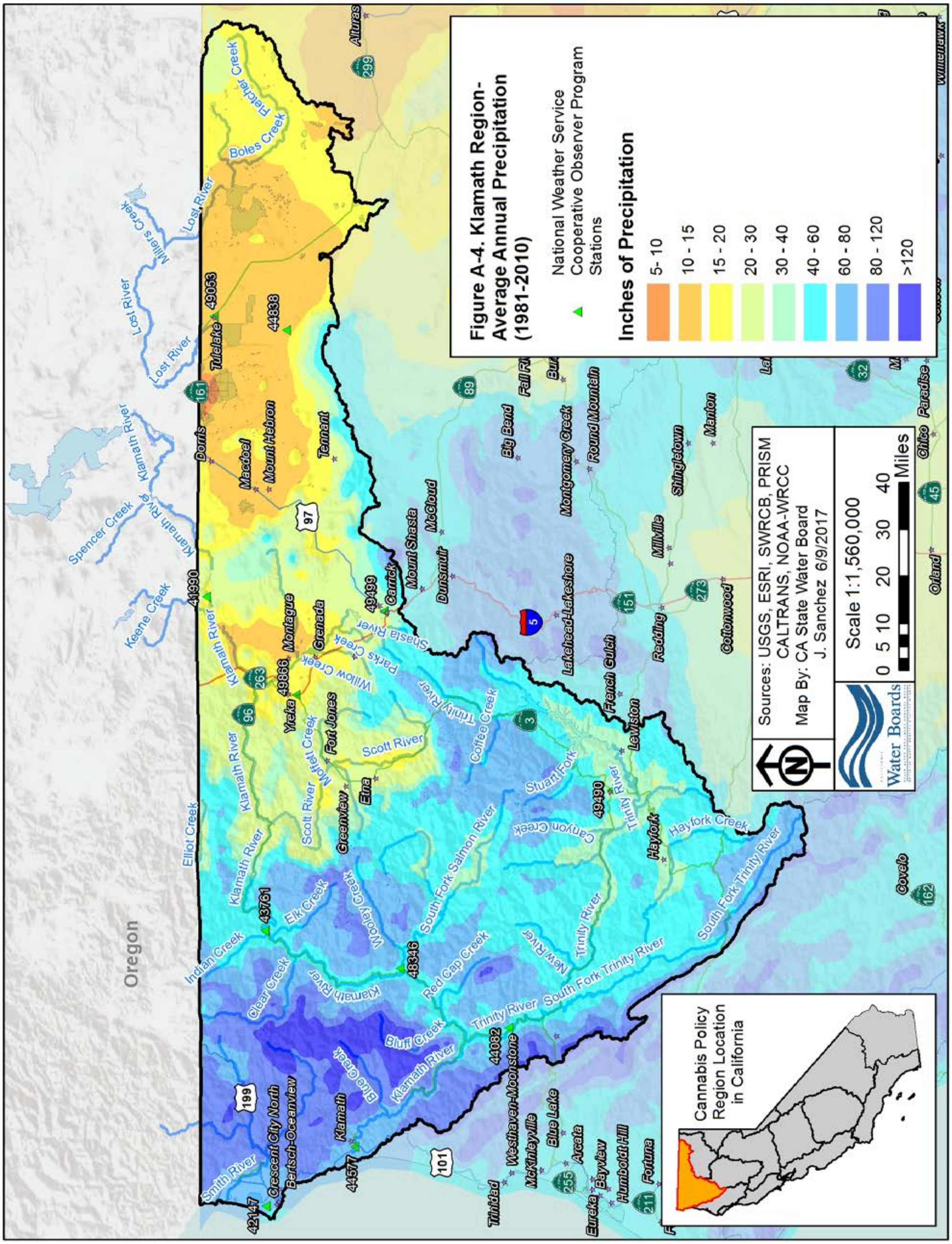


Figure A-4. Klamath Region-
Average Annual Precipitation
(1981-2010)
National Weather Service
Cooperative Observer Program
Stations
Inches of Precipitation
5-10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
80 - 120
>120
Sources: USGS, ESRI, SWRCB, PRISM
CALTRANS, NOAA-WRCC
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,560,000
0 5 10 20 30 40
Miles
Cannabis Policy
Region Location
in California
Oregon

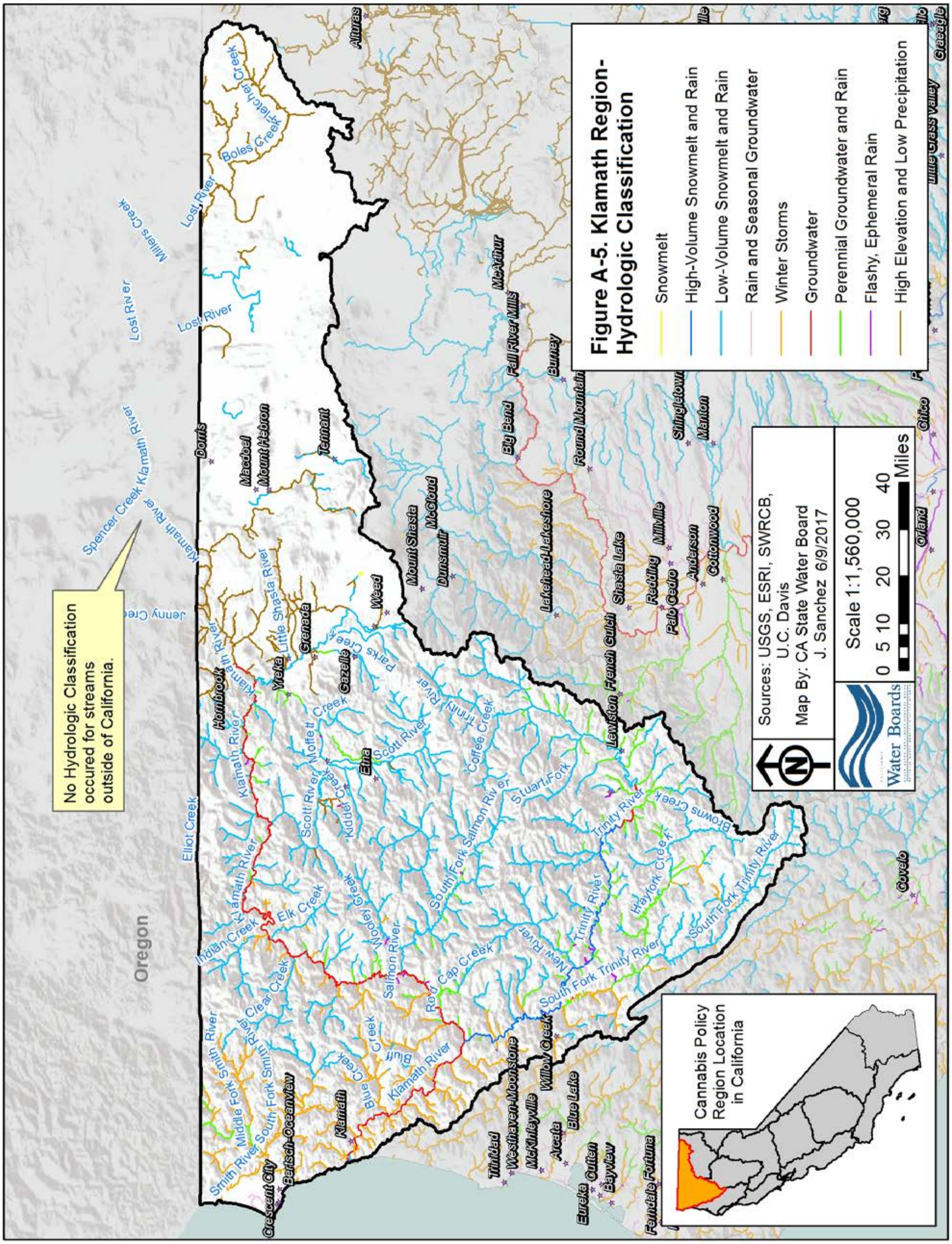


Figure A-5. Klamath Region-
Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
High Elevation and Low Precipitation
Sources: USGS, ESRI, SWRCB,
U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,560,000
0 5 10 20 30 40
Miles
Water Boards
Cannabis Policy
Region Location
in California
No Hydrologic Classification
occured for streams
outside of California.
Oregon
Crescent City
Klamath
Yreka
Weed
Mount Shasta
Redding
Eureka
Arcata
Klamath River
Trinity River
Salmon River
Scott River
Shasta River
Lost River
Smith River

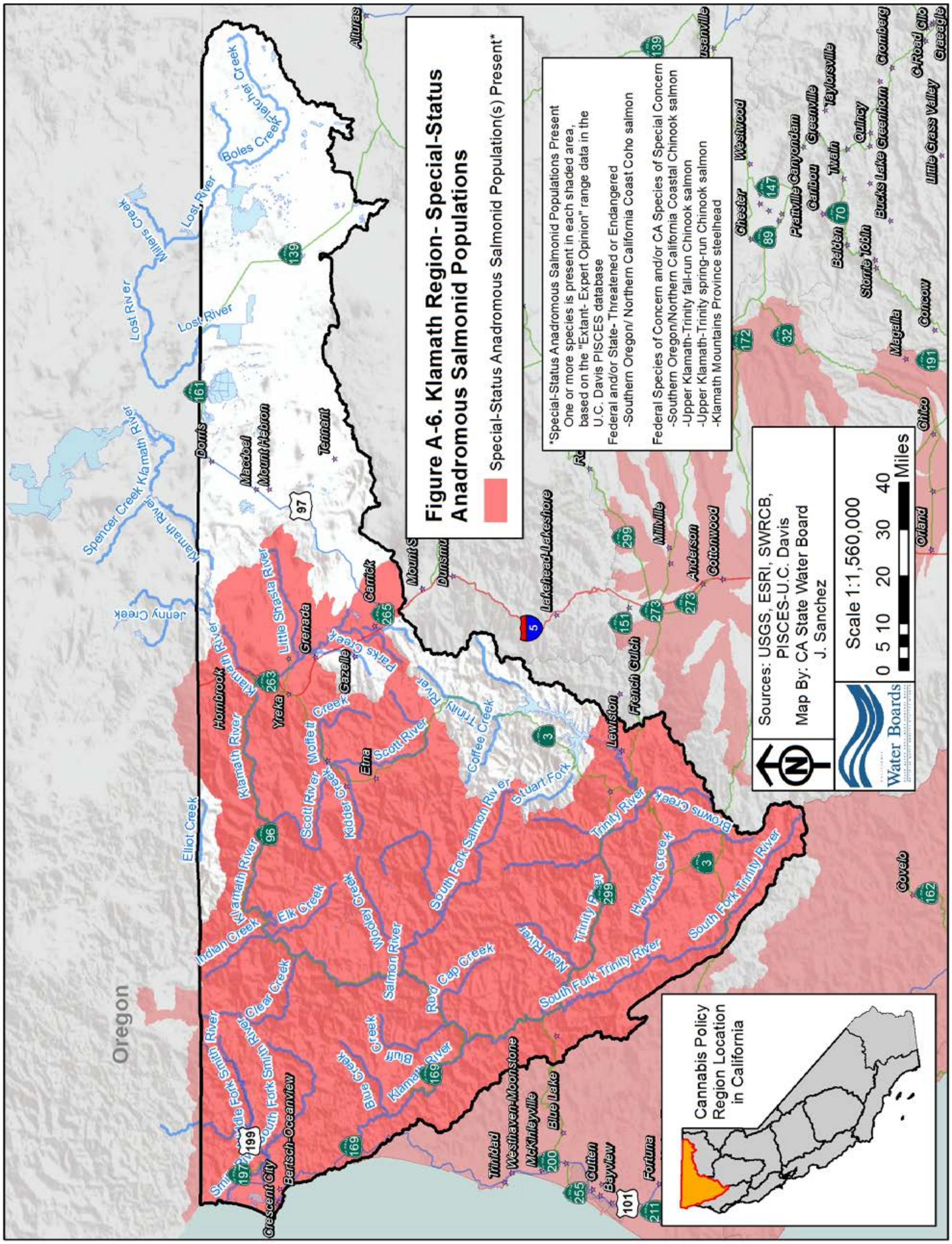


Figure A-6. Klamath Region- Special-Status Anadromous Salmonid Populations
Special-Status Anadromous Salmonid Population(s) Present*
*Special-Status Anadromous Salmonid Populations Present
One or more species is present in each shaded area, based on the "Extant- Expert Opinion" range data in the U.C. Davis PISCES database
Federal and/or State- Threatened or Endangered
-Southern Oregon/ Northern California Coast Coho salmon
Federal Species of Concern and/or CA Species of Special Concern
-Southern Oregon/Northern California Coastal Chinook salmon
-Upper Klamath-Trinity fall-run Chinook salmon
-Upper Klamath-Trinity spring-run Chinook salmon
-Klamath Mountains Province steelhead
Sources: USGS, ESRI, SWRCB, PISCES-U.C. Davis
Map By: CA State Water Board
J. Sanchez
Scale 1:1,560,000
0 5 10 20 30 40 Miles
Cannabis Policy Region Location in California
Oregon

1.2 Upper Sacramento Region

The Upper Sacramento Region covers approximately 6,956 square miles in north-central California, as shown in attached (Figure A-7). Elevations in the region range from 1,000 feet near Lake Shasta, to over 6,000 feet in the mountains bordering the Modoc Plateau. The elevation of Mount Lassen, located on a southern boundary of the region, exceeds 10,400 feet, while the peak of Mount Shasta, located on a northern boundary of the region, reaches over 14,000 feet. Please refer to Figure A-8 for an elevation map of the Upper Sacramento Region. The major watershed comprising the region is the Sacramento River and its significant tributaries of the Upper Sacramento, McCloud and Pit Rivers.

1.2.1 Climate and Precipitation

The climate of the Upper Sacramento Region varies substantially between the western and eastern portions of the region. The western portion of the Upper Sacramento Region, located in the Cascade Range geomorphic province, is characterized by a Mediterranean climate, while the eastern portion of the region, located in the Modoc Plateau geomorphic province, is characterized by a Cool Interior climate. The areas surrounding Shasta Lake and the lower tributary canyons are characterized by Mediterranean climates with hot summers. Between Mount Shasta and the town of Burney, the Cascade Range transitions to the Modoc Plateau, and the climate in this transitional area is characterized as Mediterranean with cool summers. The Modoc Plateau geomorphic province is characterized by a Cool Interior climate; specifically, cool, continental climate with dry summers. Please refer to Figure A-9 for a climatic map of the Upper Sacramento Region.

Temperature conditions also vary greatly from southwest to northeast within the Upper Sacramento Region. Temperatures tend to be higher in the Cascade Range, located in the western portion of the Upper Sacramento Region, compared to the Modoc Plateau, located in the eastern portion of the region. Average annual maximum temperatures near Shasta Lake, in the southwestern portion of the Upper Sacramento Region, exceed 70 degrees Fahrenheit. To contrast, average annual maximum temperatures on the Modoc Plateau exceed 60 degrees Fahrenheit and high elevation temperatures exceed 50 degrees Fahrenheit. Average annual minimum temperatures near Lake Shasta typically fall below 50 degrees Fahrenheit, while average annual minimum temperatures on the Modoc Plateau and at high elevations are typically below freezing.

Average annual precipitation amounts and snowfall patterns also vary greatly from west to east within the Upper Sacramento Region. The western portion of the Upper Sacramento Region tends to receive higher precipitation amounts than the eastern portion of the Upper Sacramento Region; nearly 120 inches of annual precipitation tends to fall around Mount Lassen and Mount Shasta in the central portion of the region, while under 15 inches of annual precipitation tends to fall on the Modoc Plateau. The Cascade Range typically receives moderate amounts snowfall during the winter months, extreme amounts of snowfall tend to occur further east and near Mount Lassen, and the Modoc Plateau typically receives a moderate amount of snowfall. Precipitation events generally occur from November to April in both the Cascade Range and Modoc Plateau provinces.

Please refer to Figure A-10 for a precipitation map of the Upper Sacramento Region. Charts A-3 and A-4 below, illustrate precipitation and temperature patterns in the Upper Sacramento Region for the Cascade Range geomorphic province and for the Modoc Plateau geomorphic province, and illustrate the key differences in precipitation and temperature conditions between the two regions.

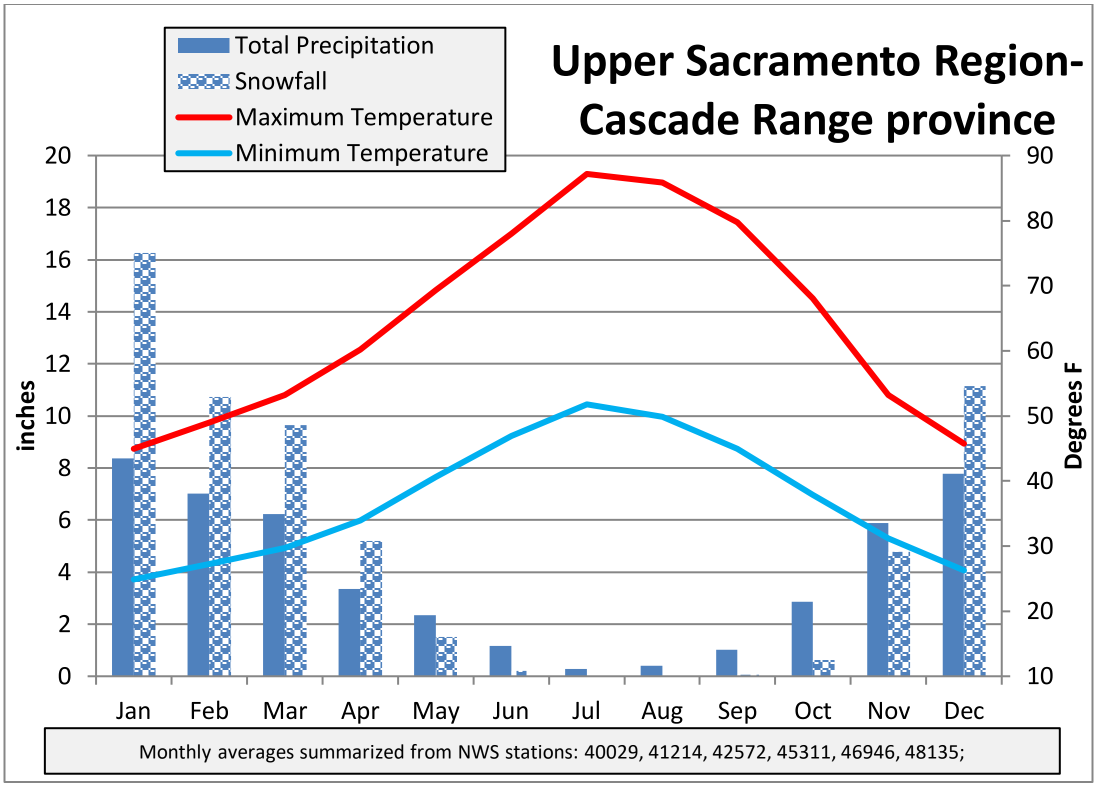


Chart A-3. Average annual patterns of temperature and precipitation in the Upper Sacramento Region, Cascade Range province.

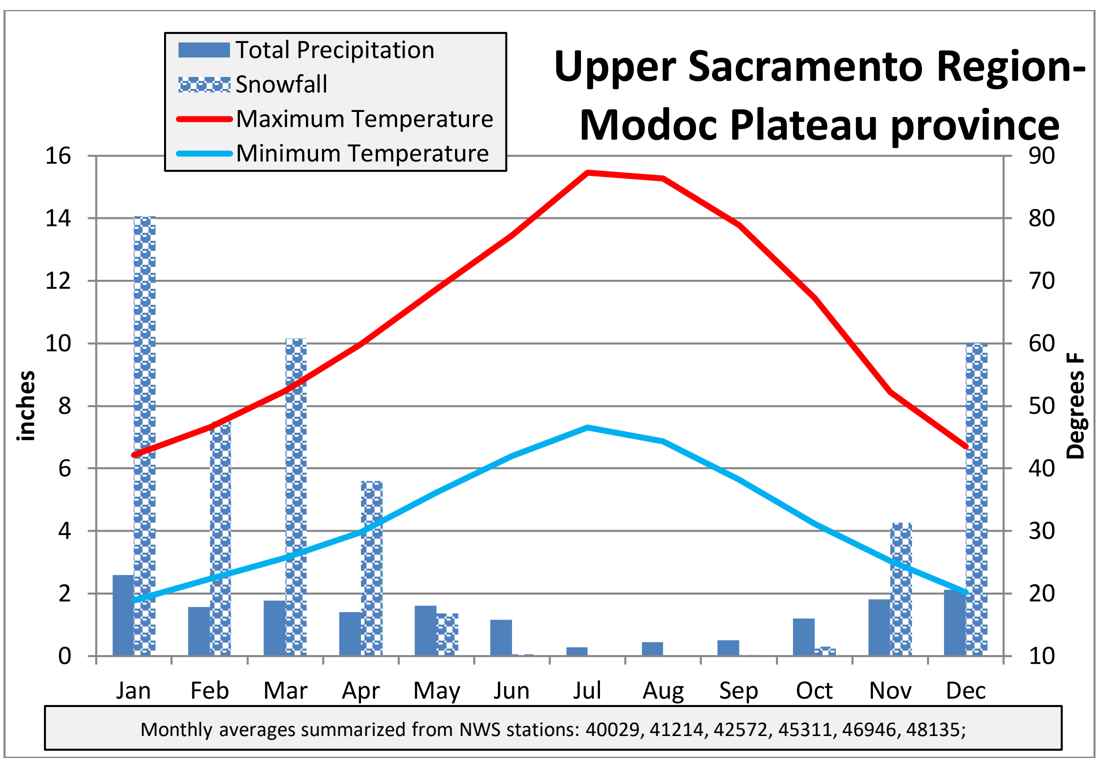


Chart A-4. Average annual patterns of temperature and precipitation in the Upper Sacramento Region, Modoc Plateau province.

1.2.2 Hydrology

The hydrology of stream reaches in the Upper Sacramento Region varies from west to east, and stream reaches in this region are described by several UC Davis hydrologic classifications. Stream reaches in the Cascade Range geomorphic province are generally categorized by Winter Storms (WS) and Low-Volume Snowmelt and Rain (LSR) hydrologic classifications. Small tributaries surrounding Shasta Lake, in the southwest portion of the Upper Sacramento Region, are primarily classified as WS systems. The Upper Sacramento and McCloud River watersheds, located in the Cascade Range geomorphic province, primarily contain stream reaches that are classified as LSR systems. Most stream reaches on the Modoc Plateau, including tributaries in the middle and upper Pit River watershed, are classified as High Elevation and Low Precipitation (HELP) stream reaches. The mainstem Pit River below Lake Briton is classified as a Groundwater (GW) system. Please refer to Figure A-11 for a depiction of the stream classifications within the Upper Sacramento Region. (Lane et al 2016)

1.2.3 Geology

The Upper Sacramento Region is primarily underlain by the Cascade Range geomorphic province in the western portion of the region, and by the Modoc Plateau geomorphic province in the eastern portion of the region. Very small areas of the Klamath Mountains and the Basin and Range geomorphic provinces are located at the western and eastern margins of the Upper Sacramento Region, respectively. (CGS 2002).

Volcanic geology dominates the Upper Sacramento Region. The Cascade Range geomorphic province is characterized by extrusive volcanic activity, and the active volcano Mount Lassen and the potentially active Mount Shasta are located on the boundaries of the Upper Sacramento Region. The Cascade Range is generally underlain by igneous rock, including lava flows, pyroclastic flows and alluvium eroded from volcanic features. The Modoc Plateau is a volcanic table land underlain by lava flows, tuff beds and small volcanic cones. Significant subterranean streamflows occur through porous volcanic features of the Modoc Plateau. (CGS 2002)

1.2.4 Anadromous Salmonid Population

No anadromous salmonid populations are currently extant within the Upper Sacramento Region. Keswick Dam, located on the mainstem Sacramento River near Redding, currently blocks upstream migration into the Upper Sacramento Region. Historically, populations of Sacramento River Winter Run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley fall-run Chinook salmon, Central Valley late fall-run Chinook salmon, and California Central Valley steelhead inhabited the Upper Sacramento Region.

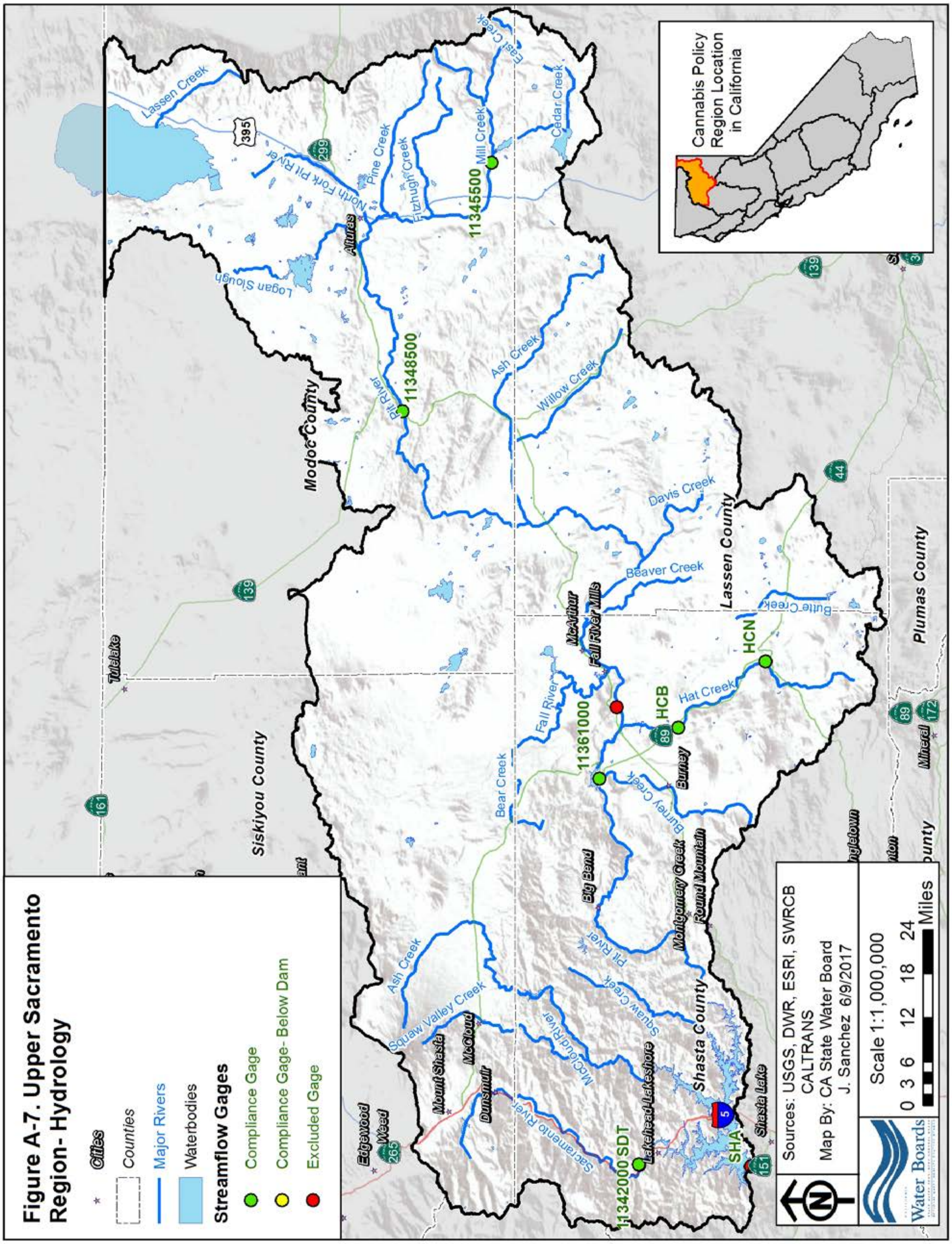


Figure A-7. Upper Sacramento Region- Hydrology

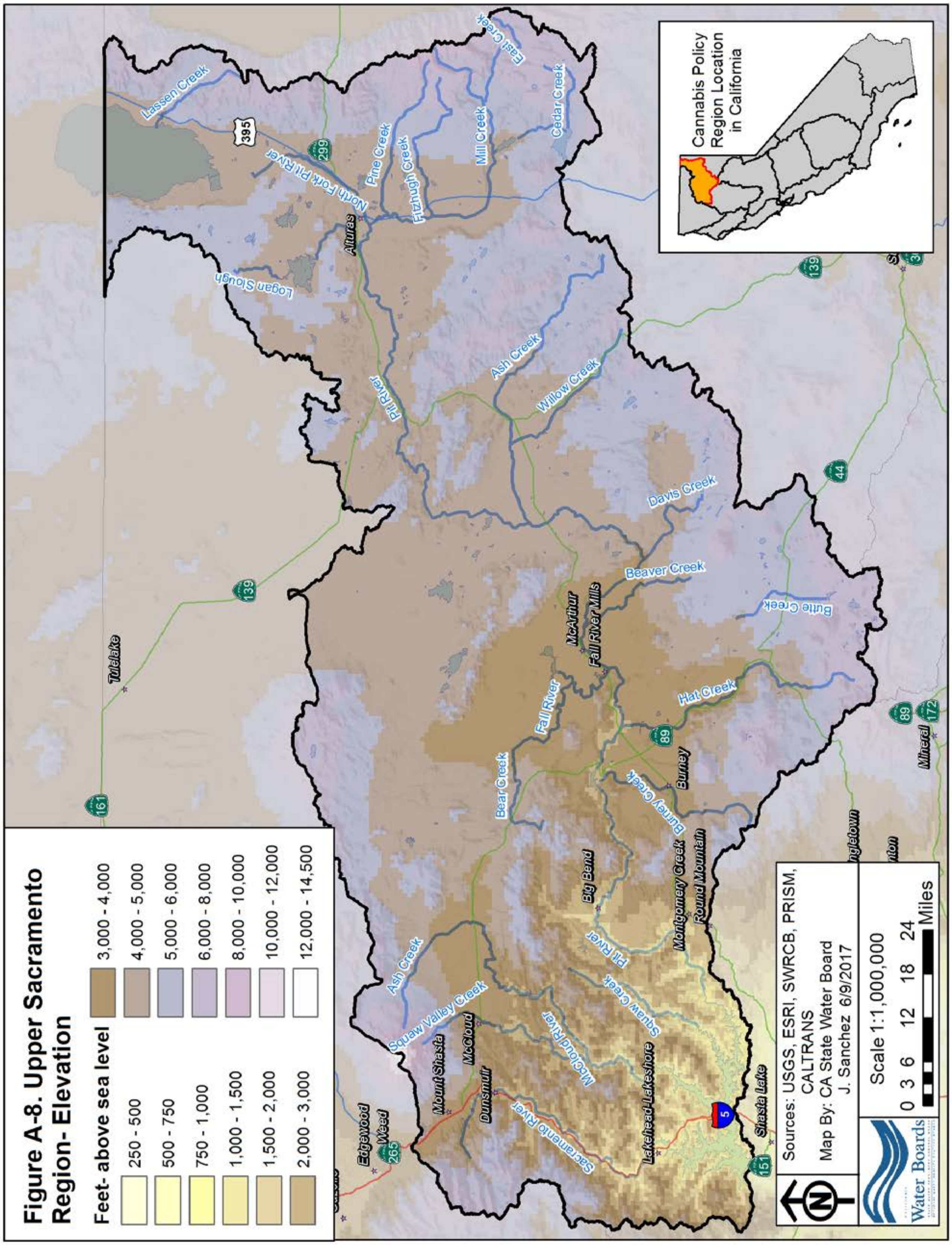


Figure A-8. Upper Sacramento Region- Elevation
Feet- above sea level
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
10,000 - 12,000
12,000 - 14,500
Tulelake
Edgewood
Weed
Mount Shasta
McCloud
Dunsmuir
Lakehead-Lakeshore
Shasta Lake
Big Bend
Montgomery Creek
Round Mountain
Burney
McArthur
Fall River Mills
Alturas
Mineral
Lassen Creek
Logan Slough
North Fork Pit River
Pine Creek
Fitzhugh Creek
Mill Creek
East Creek
Cedar Creek
Pit River
Ash Creek
Willow Creek
Squaw Valley Creek
Bear Creek
Fall River
Sacramento River
McCloud River
Squaw Creek
Burney Creek
Hat Creek
Beaver Creek
Davis Creek
Butte Creek
161
139
395
299
265
5
151
89
44
172
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Water Boards
Scale 1:1,000,000
0 3 6 12 18 24 Miles

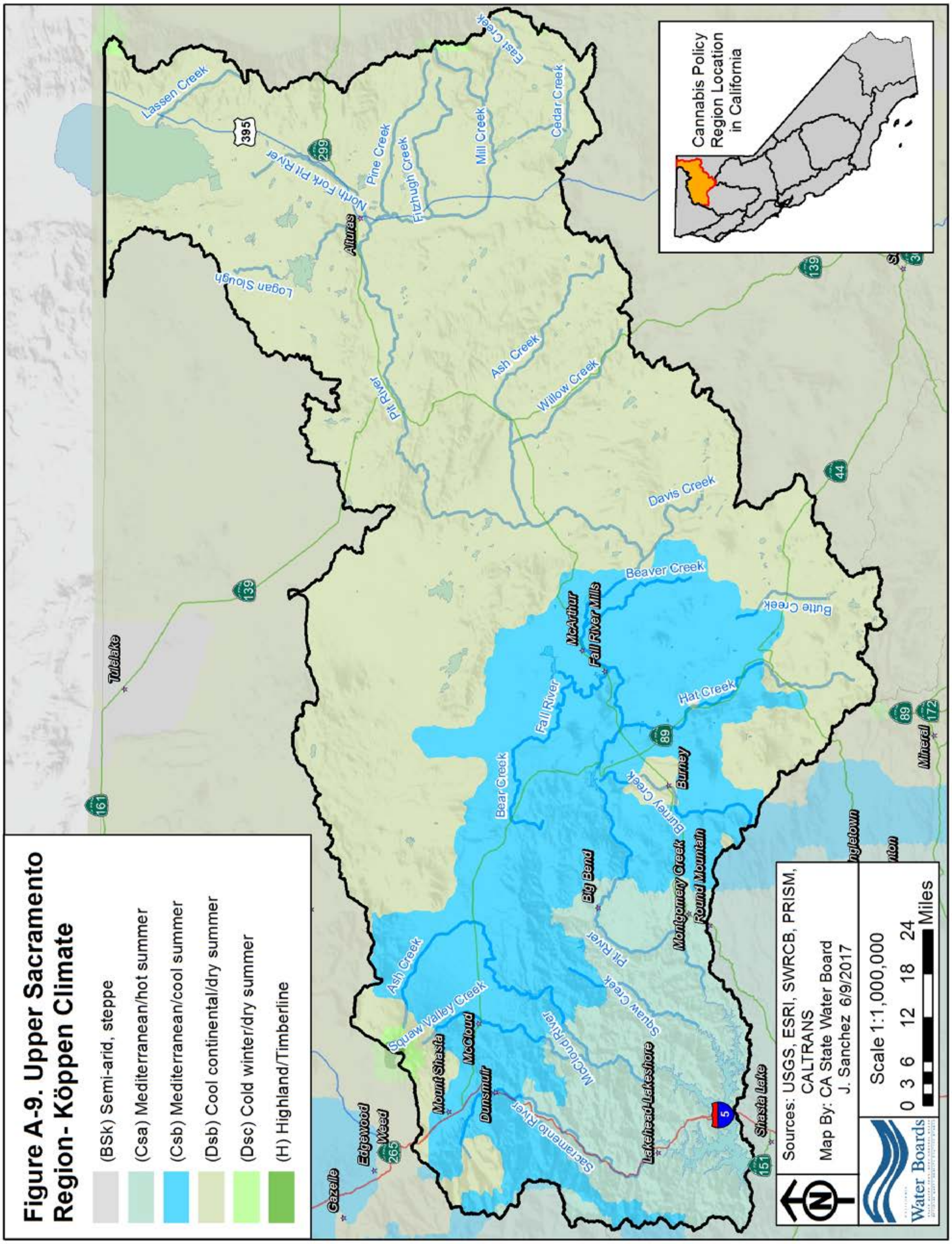


Figure A-9. Upper Sacramento Region- Köppen Climate

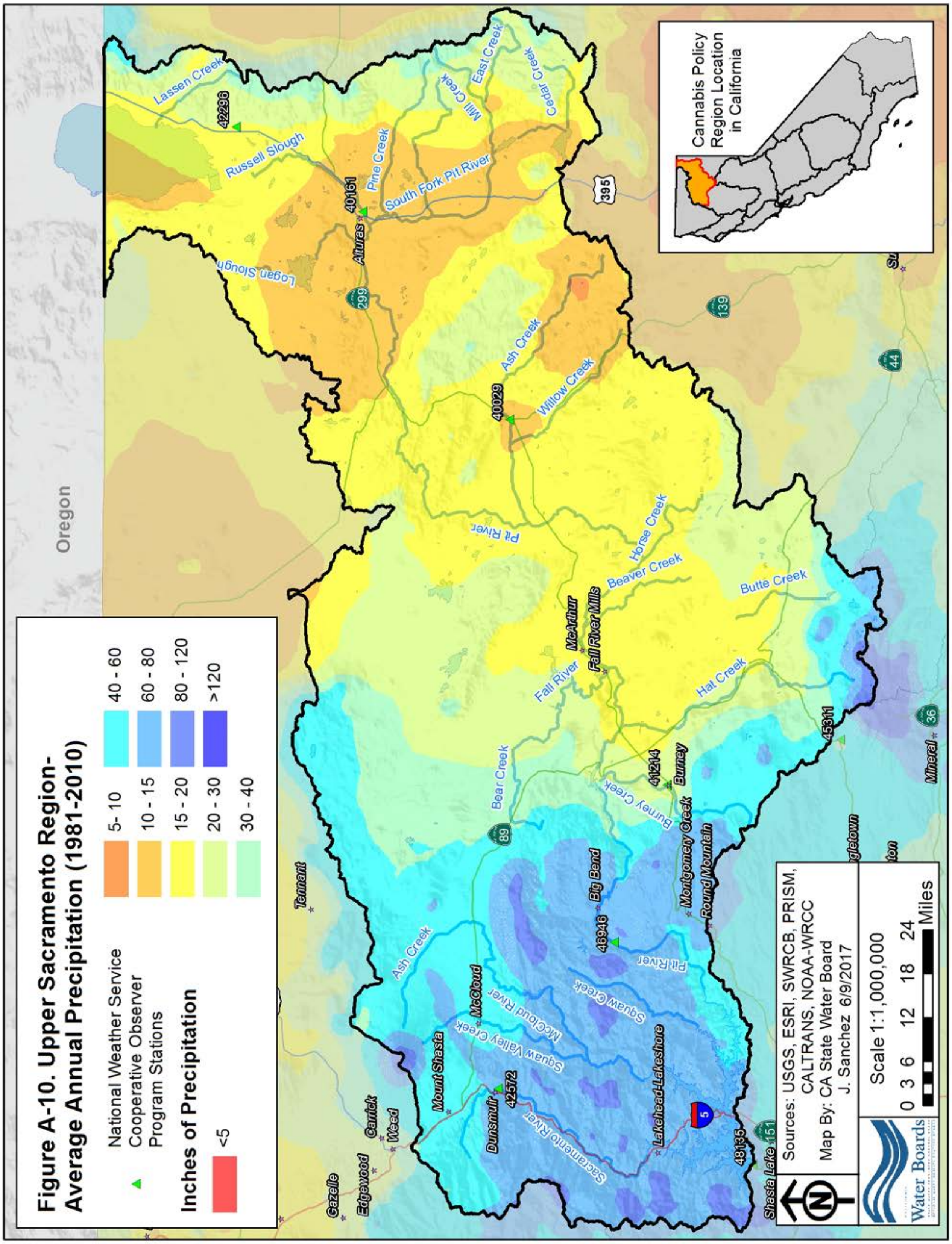


Figure A-10. Upper Sacramento Region- Average Annual Precipitation (1981-2010)

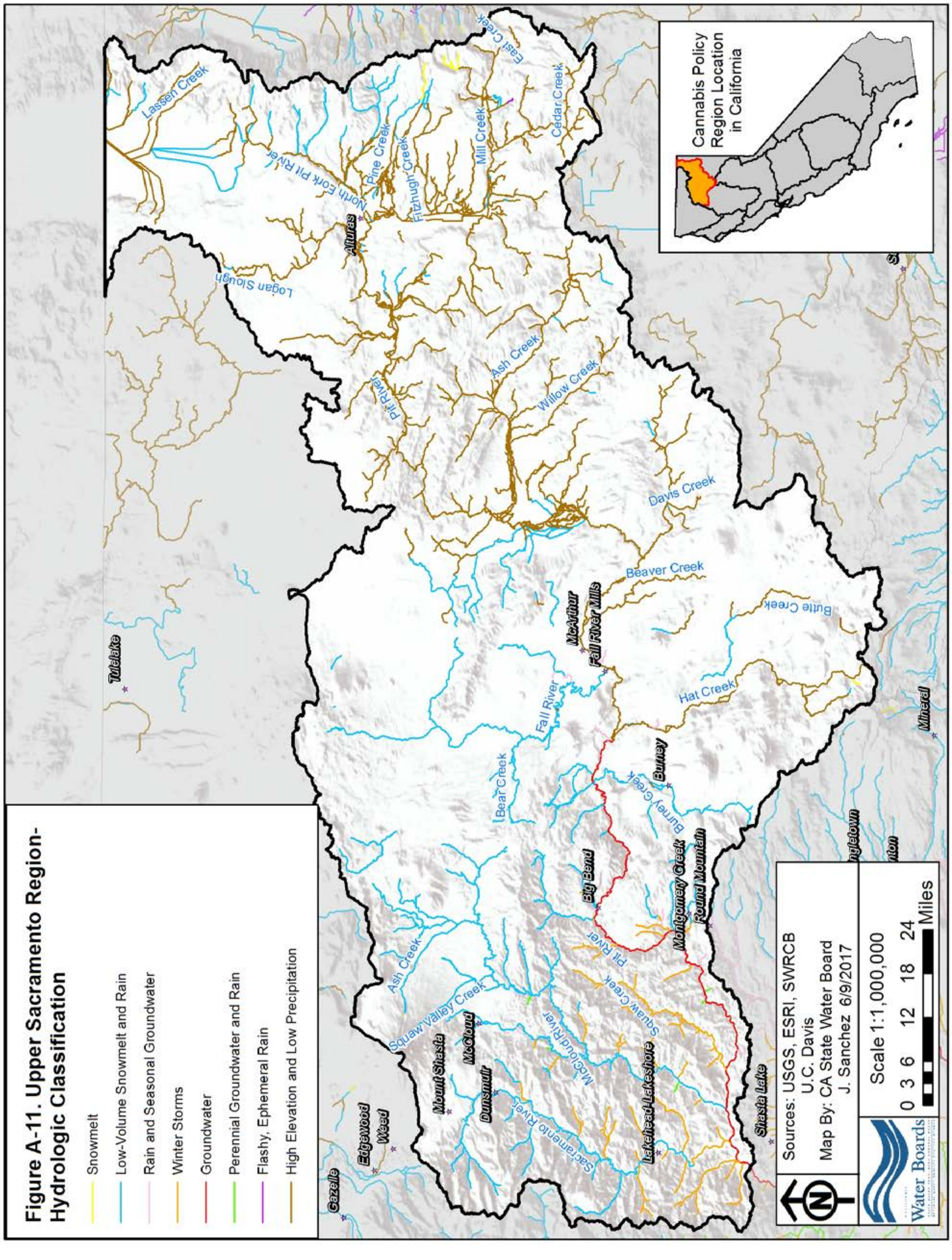


Figure A-11. Upper Sacramento Region-Hydrologic Classification

1.3 North Coast Region

The North Coast Region covers approximately 4,947 square miles along the northern coast of California, as shown in attached (Figure A-12). Elevations in the North Coast Region range from sea level to over 7,000 feet along the eastern margin of the region; please refer to (Figure A-13) for an elevation map of the North Coast Region. The North Coast Region includes the major watersheds of Redwood Creek in the north, the Mad River near the middle of the region, and the Eel River and its tributaries in the south.

1.3.1 Climate and Precipitation

The climate of the North Coast Region is described as Mediterranean, with dry summers and moist to wet winters. Please refer to Figure A-14 for a climatic map of the North Coast Region.

Precipitation and temperatures patterns vary within the North Coast Region based on proximity to the coast and on elevation. Temperatures in coastal areas of the North Coast Region are generally less variable compared to temperatures in areas further inland, and the ocean influence in the coastal areas tends to buffer temperature variations. Temperatures also tend to be cooler overall at higher elevation in the North Coast Region compared to lower elevations. Average annual maximum temperatures in the North Coast Region range from over 60 degrees Fahrenheit near the coast to over 70 degrees Fahrenheit inland, with slightly cooler maximum temperatures at the higher elevations. Average annual minimum temperatures in the North Coast Region range from below 40 degrees Fahrenheit at high elevations to below 50 degrees Fahrenheit in coastal areas and at lower elevation areas further inland.

The North Coast Region tends to receive precipitation during the months of October through May, and typically receives the largest amounts of precipitation in December and January. Average annual precipitation in the North Coast Region ranges from 40 inches in valleys and at lower elevations to over 120 inches in the Coast Range mountains. Precipitation falls primarily as rain in the North Coast Region, although small amounts of snow occasionally fall at peak elevations. (WRCC 2016)

Please refer to Figure A-15 for a precipitation map of the North Coast Region. Please refer to Chart A-6 below, for an illustration of typical precipitation and temperature patterns in the North Coast Region.

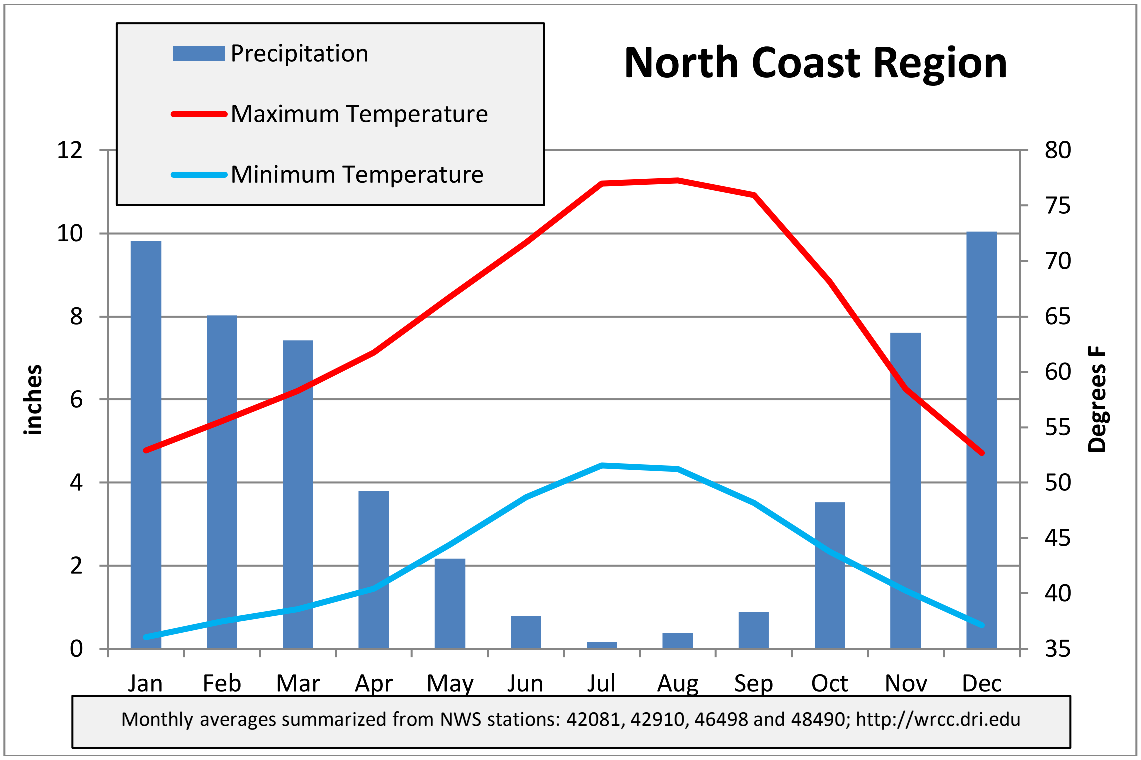


Chart A-5. Average annual patterns of temperature and precipitation in the North Coast Region.

1.3.2 Hydrology

The North Coast Region contains many stream reaches that are hydrologically classified as Winter Storm (WS) systems, although several other UC Davis hydrologic classifications exist for stream reaches in the North Coast Region. WS stream reaches are generally found at lower elevations in the North Coast Region. Several additional hydrologic classifications are also present in the North Coast Region. Many higher elevation stream reaches fall into the Low-Volume Snowmelt and Rain (LSR) class. Some stream reaches in the southern portion of the North Coast Region are hydrologically classified under the Flashy, Ephemeral Rain (FER) classification. Finally, a smaller number of stream reaches located throughout the North Coast Region fall into the Perennial Groundwater and Rain (PGR) stream class. (Lane et al 2016)

Please refer to Figure A-16 for a hydrologic classification map for the North Coast Region.

1.3.3 Geology

The North Coast Region is located in the Coast Ranges geomorphic province. The San Andreas Fault is a prominent feature in the Coast Ranges and is the driving force responsible for much of the existing topography. The Coast Ranges in the North Coast Region are dominated by irregular, knobby, landslide topography. The North Coast Region is comprised of sedimentary and metamorphic rock, with areas of unconsolidated alluvium in valley floors and along the coastline. (CGS 2002) The region also contains soft, easily eroded soils, allowing the rivers to carry high sediment loads and carve extensive floodplains that support riparian habitats.

1.3.4 Anadromous Salmonid Population

Three special-status ESUs, DPSes, or DTEs are currently extant within the North Coast Region (Figure A-17):

- the California Coastal (CC) Chinook salmon ESU,
- the Northern California (NC) steelhead DPS, and
- the SONCC coho salmon ESU.

The CC Chinook salmon ESU, NC steelhead DPS, and SONCC coho salmon ESU are all currently listed as threatened under the ESA (CDFW 2017b). In addition, the SONCC coho salmon ESU is currently listed as threatened under the CESA (CDFW 2017b).

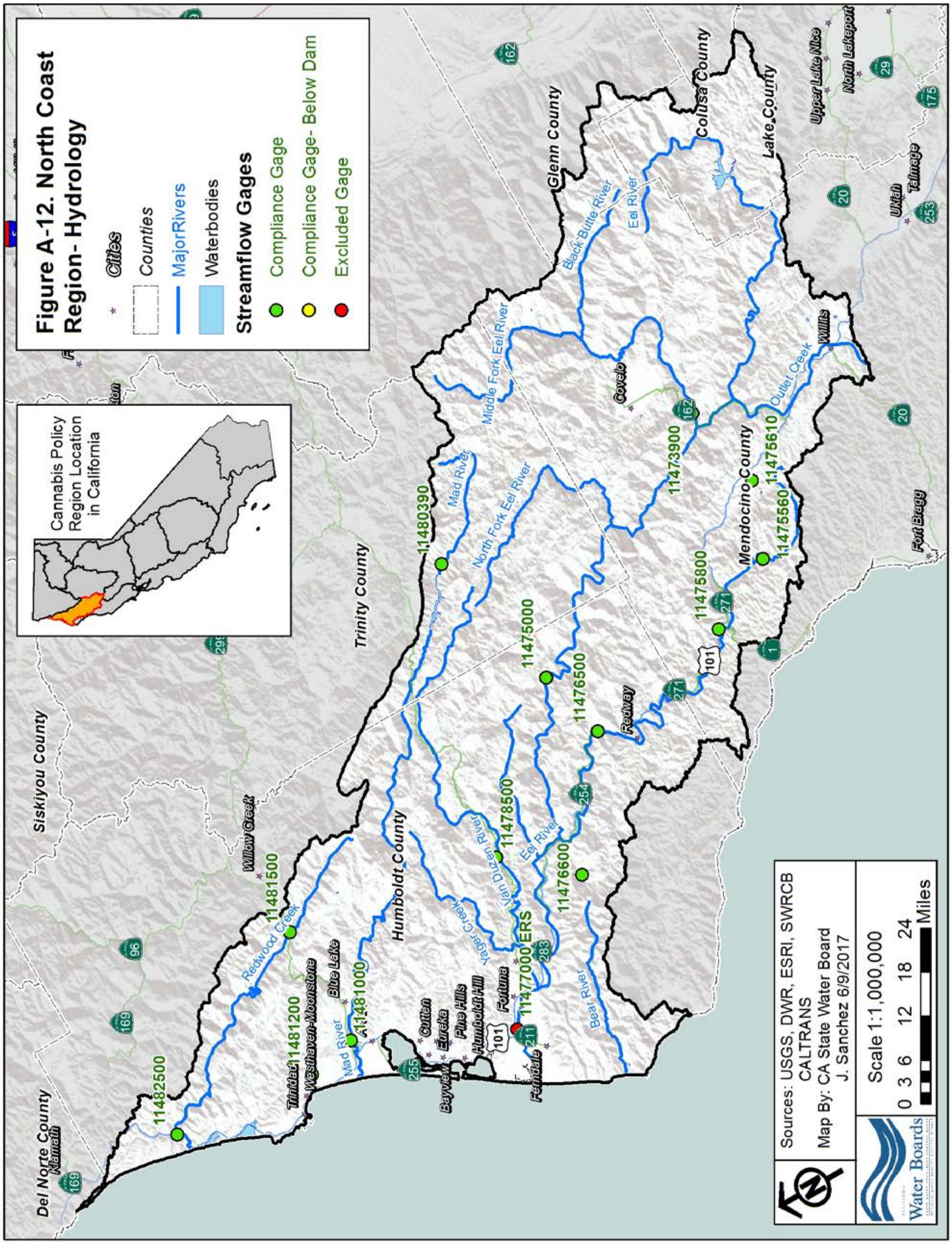


Figure A-12. North Coast Region- Hydrology
Cities
Counties
MajorRivers
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Cannabis Policy Region Location in California
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,000,000
0 3 6 12 18 24 Miles
Water Boards
Del Norte County
Siskiyou County
Trinity County
Humboldt County
Glenn County
Colusa County
Lake County
Mendocino County
11482500
11481500
11481200
11481000
11480390
11478500
11477000
11476600
11476500
11475000
11475800
11475560
11475610
11473900
ERS
Redwood Creek
Mad River
Mad River
North Fork Eel River
Middle Fork Eel River
Black Butte River
Eel River
Van Duzen River
Yager Creek
Bear River
Outlet Creek
Trinidad
Westhaven-Moonstone
Blue Lake
Cutten
Eureka
Bayview
Pine Hills
Humboldt Hill
Fortuna
Ferndale
Redway
Covelo
Willits
Fort Bragg
Ukiah
Talmage
Upper Lake Nice
North Lakeport
Willow Creek

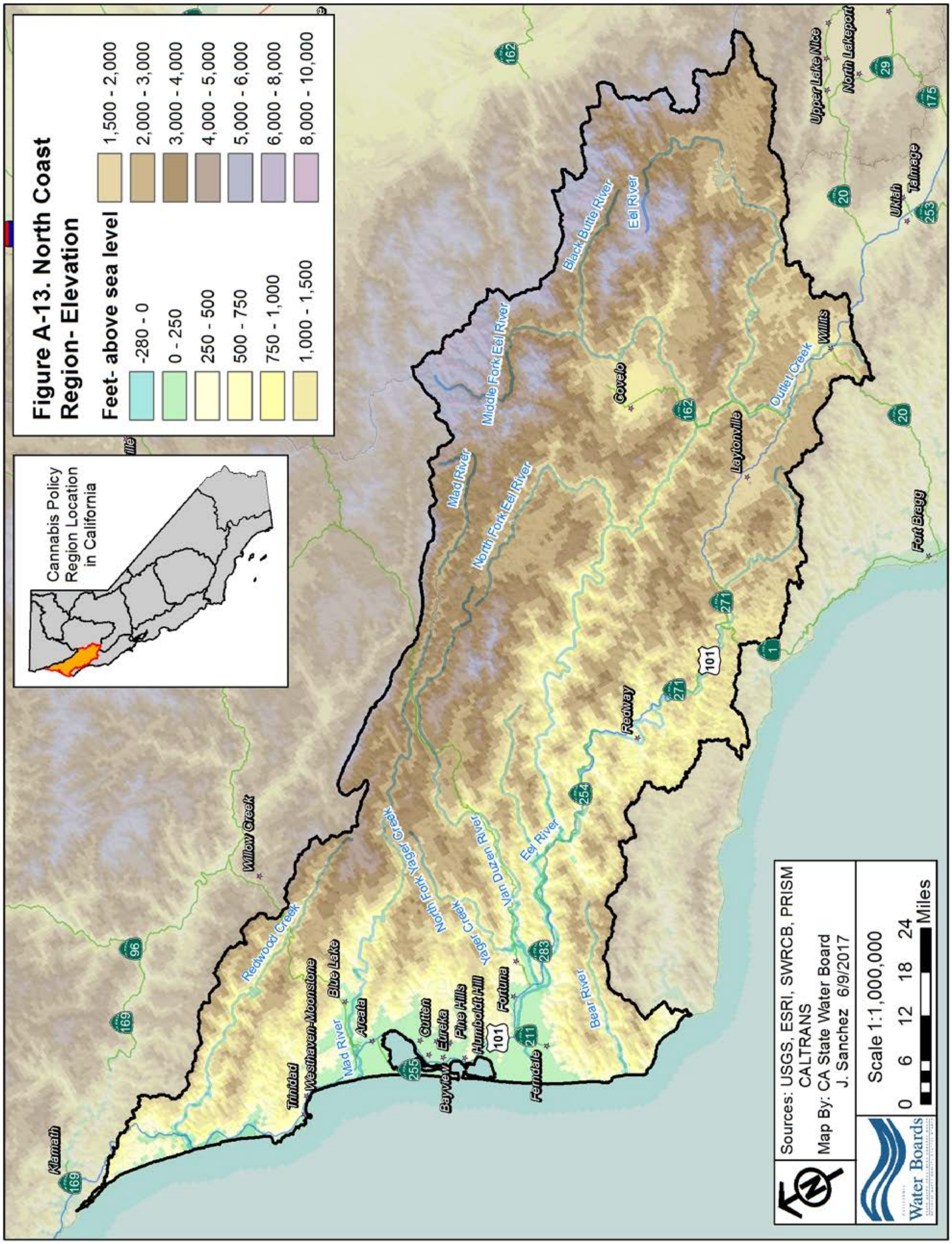


Figure A-13. North Coast Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,000,000
0 6 12 18 24 Miles
Water Boards
Klamath
Trinidad
Westhaven-Moonstone
Blue Lake
Arcata
Cutten
Eureka
Bayview
Pine Hills
Humboldt Hill
Fortuna
Ferndale
Willow Creek
Redway
Laytonville
Covelo
Willits
Fort Bragg
Ukiah
Talmage
Upper Lake Nice
North Lakeport
Redwood Creek
Mad River
North Fork Yager Creek
Yager Creek
Van Duzen River
Eel River
Bear River
North Fork Eel River
Middle Fork Eel River
Black Butte River
Outlet Creek

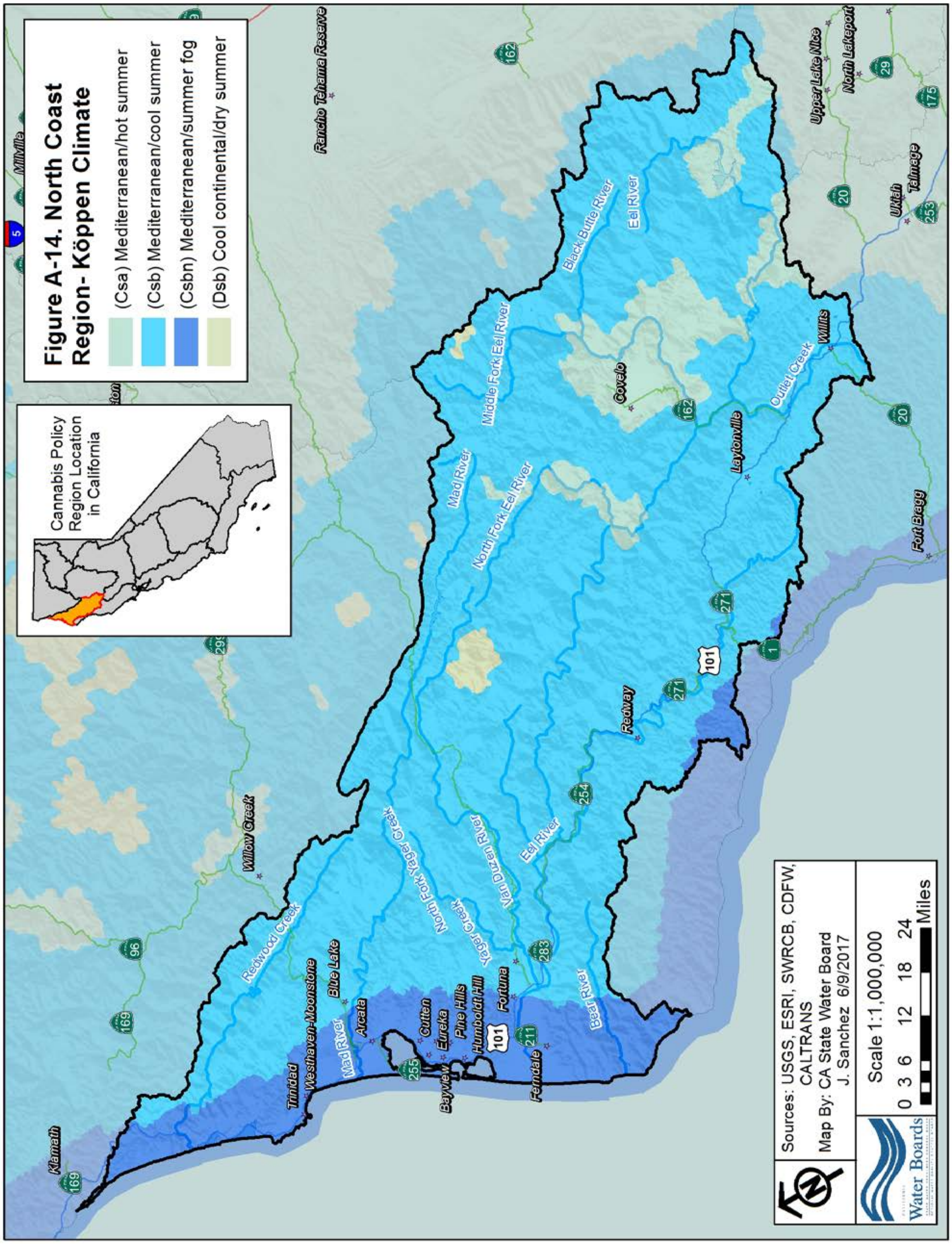


Figure A-14. North Coast Region- Köppen Climate
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Csbn) Mediterranean/summer fog
(Dsb) Cool continental/dry summer
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, CDFW, CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,000,000
0 3 6 12 18 24 Miles
Water Boards
Klamath
Trinidad
Westhaven-Moonstone
Blue Lake
Arcata
Mad River
Bayview
Cutten
Eureka
Pine Hills
Humboldt Hill
Fortuna
Ferndale
Bear River
Redwood Creek
Willow Creek
North Fork Yager Creek
Yager Creek
Van Duzen River
Eel River
Redway
Mad River
North Fork Eel River
Middle Fork Eel River
Black Butte River
Covelo
Laytonville
Outlet Creek
Willits
Fort Bragg
Ukiah
Talmage
Upper Lake Nice
North Lakeport
Rancho Tehama Reserve
Millville

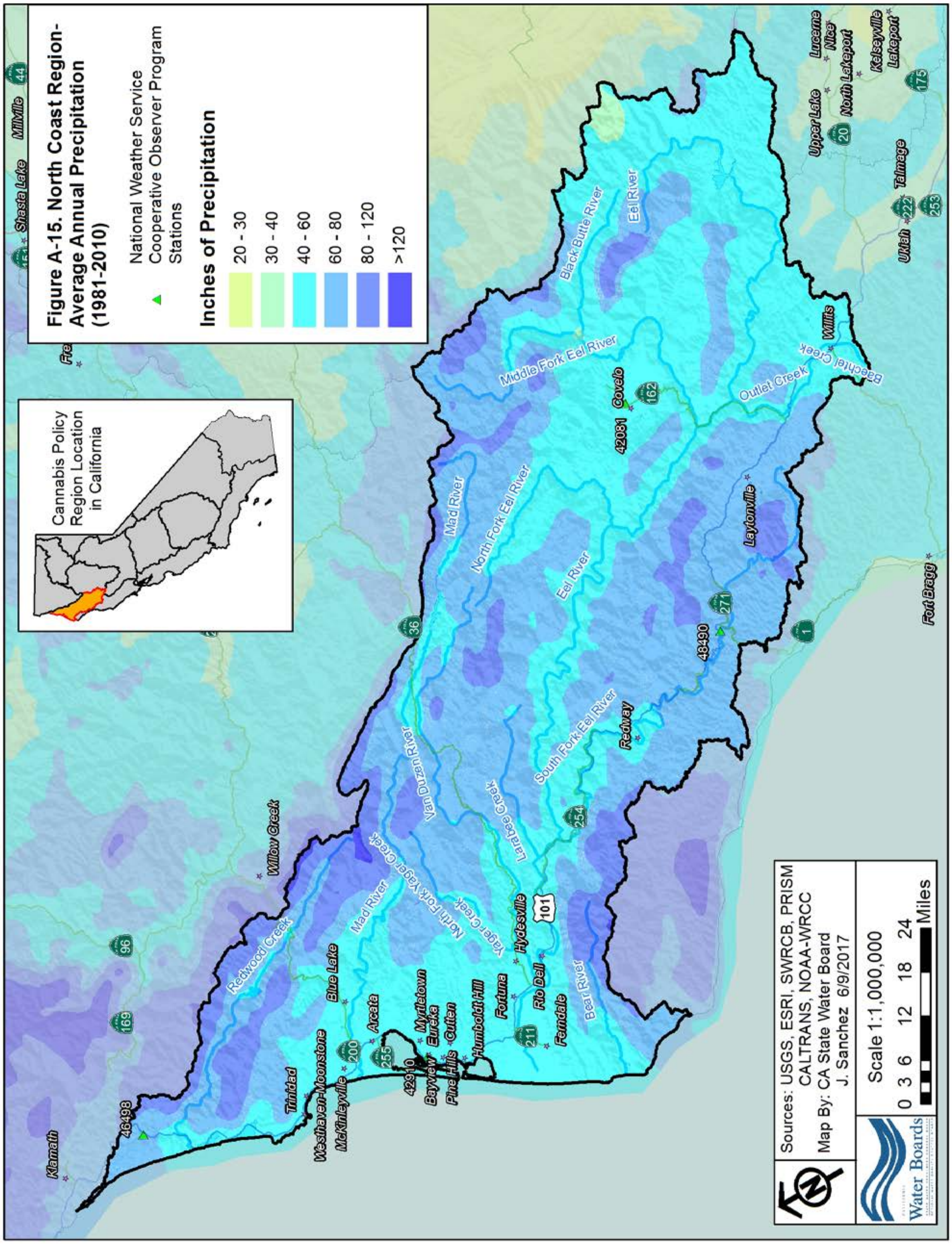


Figure A-15. North Coast Region-
Average Annual Precipitation
(1981-2010)
National Weather Service
Cooperative Observer Program
Stations
Inches of Precipitation
20 - 30
30 - 40
40 - 60
60 - 80
80 - 120
>120
Cannabis Policy
Region Location
in California
Sources: USGS, ESRI, SWRCB, PRISM
CALTRANS, NOAA-WRCC
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,000,000
0 3 6 12 18 24
Miles
Water Boards
Klamath
Trinidad
Westhaven-Moonstone
McKinleyville
Blue Lake
Arcata
Myrtletown
Eureka
Bayview
Cutten
Pine Hills
Humboldt Hill
Fortuna
Rio Dell
Ferndale
Hydesville
Willow Creek
Redway
Laytonville
Covelo
Willits
Fort Bragg
Ukiah
Talmage
Upper Lake
North Lakeport
Lucerne
Nice
Kelseyville
Lakeport
Shasta Lake
Millville
Redwood Creek
Mad River
North Fork Yager Creek
Yager Creek
Van Duzen River
Larabee Creek
Bear River
South Fork Eel River
Eel River
North Fork Eel River
Middle Fork Eel River
Black Butte River
Outlet Creek
Baechtel Creek
46498
42910
48490
42081
101
1
36
96
169
200
211
254
255
271
162
20
175
222
253
44

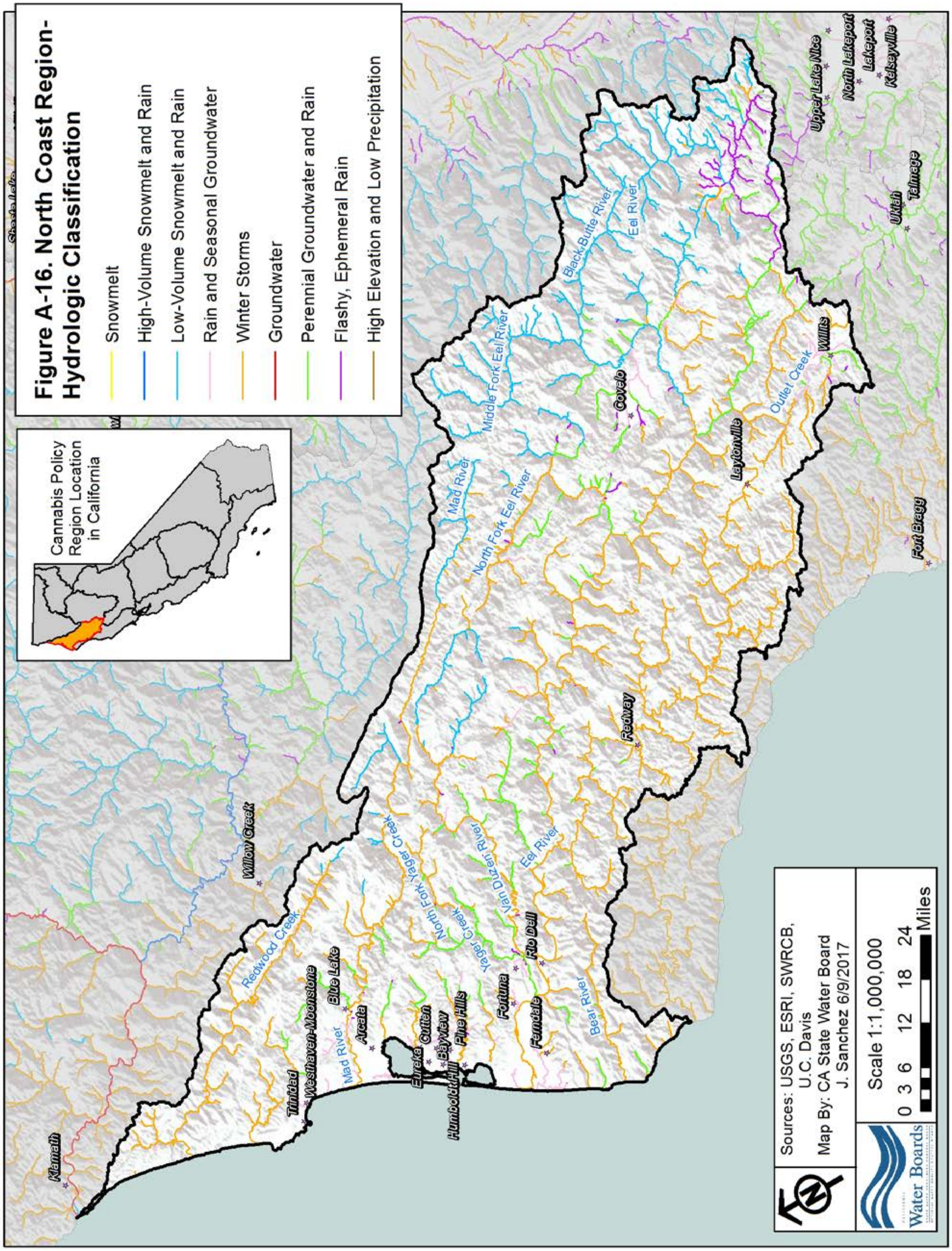


Figure A-16. North Coast Region-
Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
High Elevation and Low Precipitation
Cannabis Policy
Region Location
in California
Sources: USGS, ESRI, SWRCB,
U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,000,000
0 3 6 12 18 24
Miles
Water Boards
Klamath
Trinidad
Westhaven-Moonstone
Blue Lake
Arcata
Mad River
Eureka
Cutten
Bayview
Humboldt Hill
Pine Hills
Fortuna
Ferndale
Rio Dell
Bear River
Eel River
Van Duzen River
Yager Creek
North Fork Yager Creek
Redwood Creek
Willow Creek
Redway
Mad River
North Fork Eel River
Middle Fork Eel River
Black Butte River
Eel River
Covelo
Laytonville
Outlet Creek
Willits
Fort Bragg
Ukiah
Talmage
Upper Lake Nice
North Lakeport
Lakeport
Kelseyville

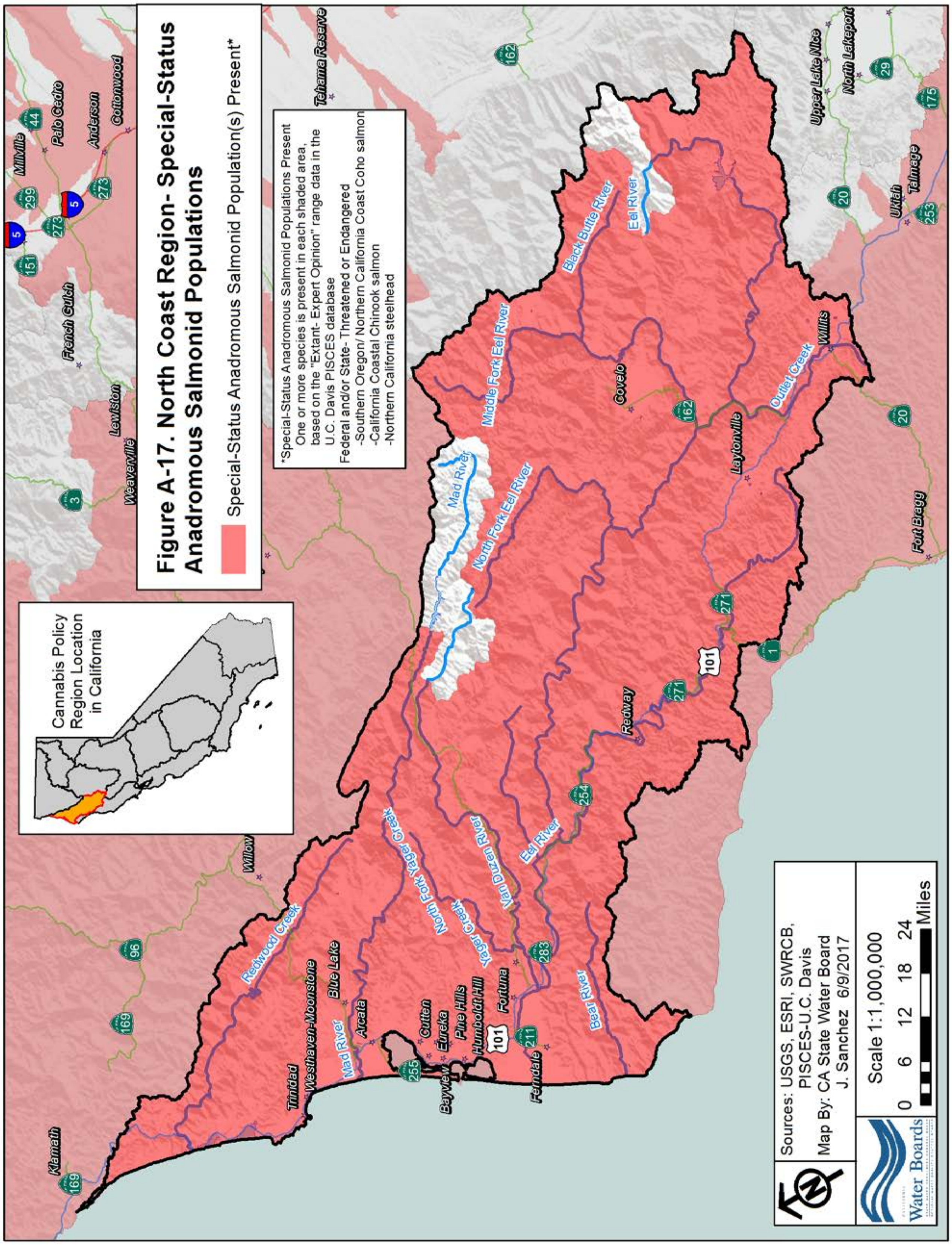


Figure A-17. North Coast Region- Special-Status Anadromous Salmonid Populations
Special-Status Anadromous Salmonid Population(s) Present*
*Special-Status Anadromous Salmonid Populations Present
One or more species is present in each shaded area,
based on the "Extant- Expert Opinion" range data in the
U.C. Davis PISCES database
Federal and/or State- Threatened or Endangered
-Southern Oregon/ Northern California Coast Coho salmon
-California Coastal Chinook salmon
-Northern California steelhead
Cannabis Policy
Region Location
in California
Sources: USGS, ESRI, SWRCB,
PISCES-U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,000,000
0 6 12 18 24
Miles
Water Boards
Klamath
Trinidad
Westhaven-Moonstone
Blue Lake
Arcata
Cutten
Eureka
Pine Hills
Humboldt Hill
Bayview
Fortuna
Ferndale
Redway
Laytonville
Covelo
Willits
Fort Bragg
Ukiah
Talmage
Upper Lake Nice
North Lakeport
Tehama Reserve
Willow
Weaverville
Lewiston
French Gulch
Millville
Palo Cedro
Anderson
Cottonwood
Redwood Creek
Mad River
North Fork Yager Creek
Yager Creek
Van Duzen River
Eel River
Bear River
North Fork Eel River
Middle Fork Eel River
Black Butte River
Outlet Creek

1.4 Middle Sacramento Region

The Middle Sacramento Region covers approximately 8,562 square miles in northern and central California, as shown in attached (Figure A-18). Elevations in this region range from 40 feet near Knights Landing and the confluence of the Sacramento and Feather Rivers, to over 10,400 feet at the peak of Mount Lassen; please refer to (Figure A-19) for an elevation map of the Middle Sacramento Region. The Middle Sacramento Region contains the Coast Ranges in the western portion of the region, the Central Valley in the center of the region, and the Cascade Range in the eastern portion of the region. The Middle Sacramento Region also contains the Sutter Buttes. A portion of the Sacramento River watershed is located in this region, including several significant Sacramento River tributaries. Clear Creek, Cottonwood Creek, Thomes Creek, and Stony Creek drain the east side of the Coast Ranges and Klamath Mountains, and enter the Sacramento River from the west. Battle Creek, Antelope Creek, Mill Creek, Deer Creek, Big Chico Creek, and Butte Creek drain the west side of the Sierra Nevada and Cascade Range, and enter the Sacramento River from the east.

1.4.1 Climate and Precipitation

The Middle Sacramento Region is characterized by a Mediterranean climate, with hot summers and moist to wet winters. Please refer to Figure A-20 for a climatic map of the Middle Sacramento Region. In general, lower elevation areas in the Middle Sacramento Region exhibit higher average annual maximum and higher average annual minimum temperatures compared to higher elevation areas. At lower elevations and in the northern portion of this region, average annual maximum temperatures exceed 75 degrees Fahrenheit, while average annual maximum temperatures exceed 50 degrees Fahrenheit at high elevation areas in this region. Average annual minimum temperatures tend to drop below 50 degrees Fahrenheit in the Central Valley portion of the Middle Sacramento Region, while average annual minimum temperatures at higher elevation areas in the Middle Sacramento Region drop below freezing.

In the Middle Sacramento Region, precipitation tends to fall from October through April. The majority of precipitation in this region falls as rain, and significant snowfall tends to fall only at the high elevation margins of the region. Average annual precipitation amounts vary significantly within the Middle Sacramento Region, and the northern portion of the Middle Sacramento Region tends to receive a larger amount of precipitation compared to the southern portion of the region. Over 120 inches of annual precipitation tends to fall near Mount Lassen in the northern portion of the region, while under 20 inches of annual precipitation tends to fall in the southern portion of the region, south of the Sutter Buttes.

Please refer to Figure A-21 for a precipitation map of the Middle Sacramento Region. Please refer to Chart A-6 and A-7, below, for illustrations of typical precipitation patterns in the northern and southern portions of the Middle Sacramento Region.

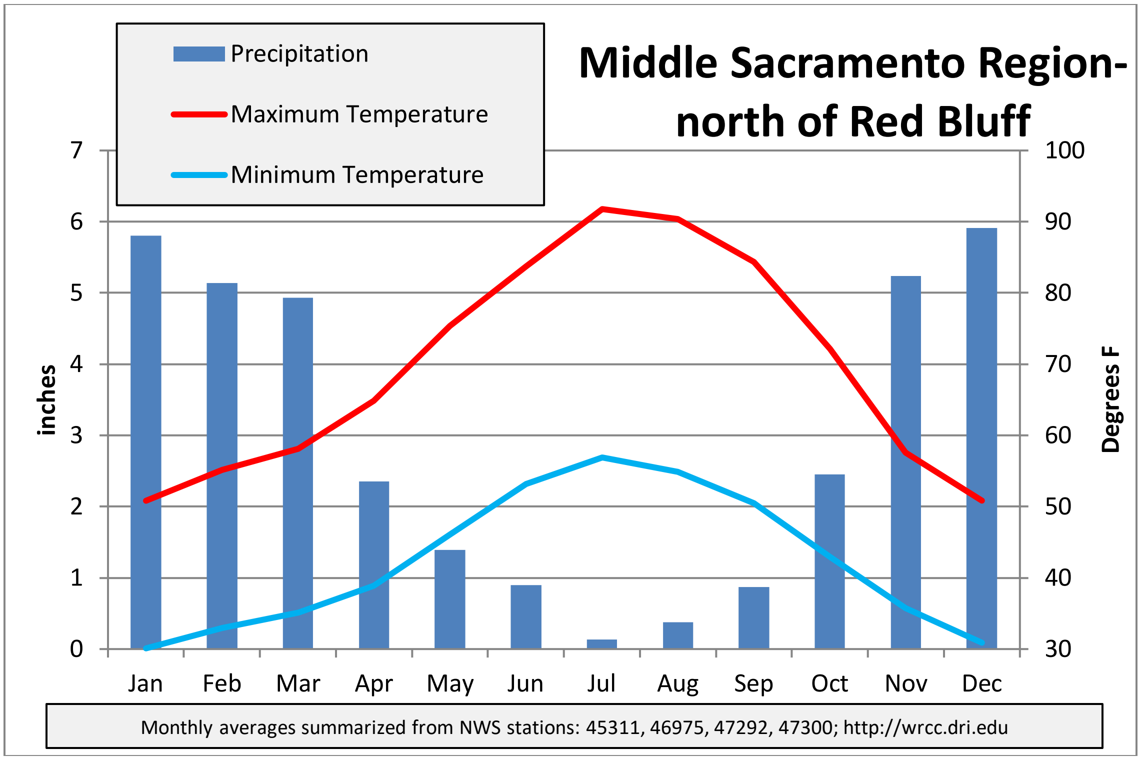


Chart A-6. Average annual patterns of temperature and precipitation in the Middle Sacramento Region, north of Red Bluff.

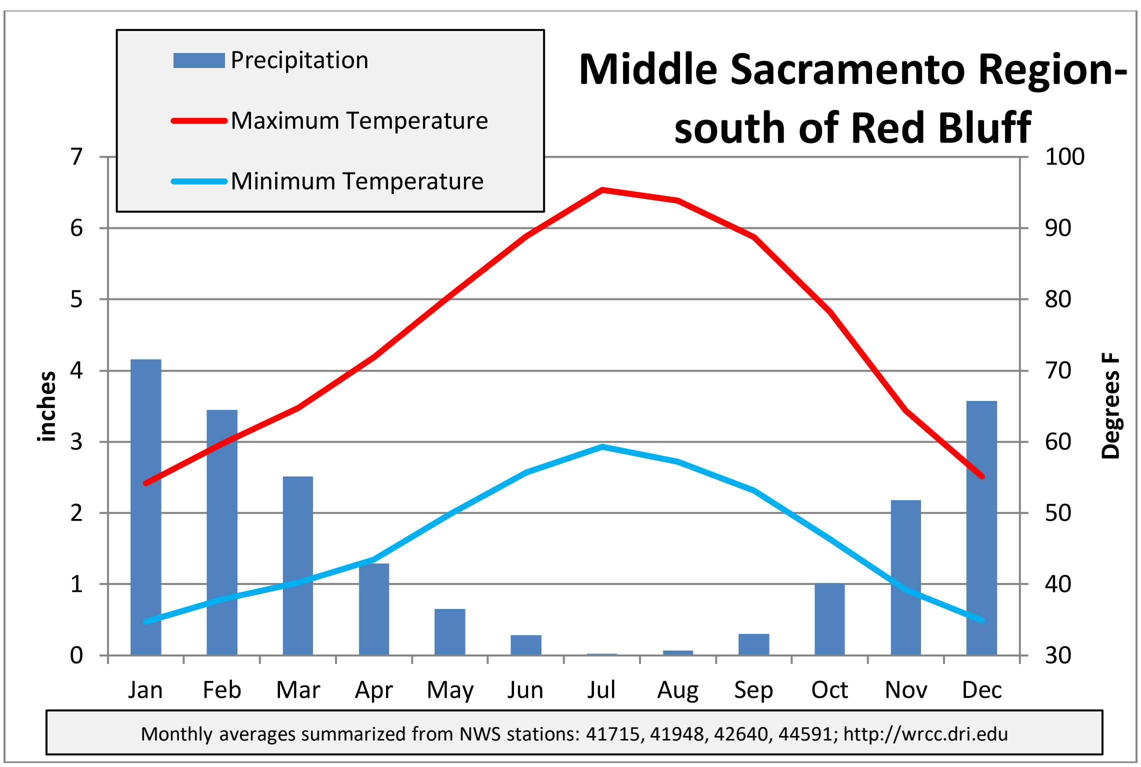


Chart A-7. Average annual patterns of temperature and precipitation in the Middle Sacramento Region, south of Red Bluff.

1.4.2 Hydrology

The hydrology of Middle Sacramento Region streams varies greatly from west to east, and several UC Davis hydrologic classifications exist for stream reaches in this region. The eastern and western margins of the Middle Sacramento Region, which correspond to high elevation mountains, are dominated by Low-Volume Snowmelt and Rain (LSR) stream reaches. The central portion of the region, which corresponds to the Sacramento Valley, contains many Winter Storms (WS) stream reaches. Additionally, Perennial Groundwater and Rain (PGR) stream reaches are located primarily in the northwestern portion of the Middle Sacramento Region, and correspond with mid-elevation areas in the Coast Ranges. Finally, Rain and Seasonal Groundwater (RSG) stream reaches are located at mid-elevation areas in the northern Cascade Range. Other UC Davis hydrologic classifications also exist in the Middle Sacramento Region in smaller numbers. (Lane et al 2016)

Please refer to Figure A-22 for a stream classification map of the Middle Sacramento Region.

1.4.3 Geology

The Middle Sacramento Region is located in the Coast Ranges, Great Valley, and Cascade Range geomorphic provinces. The Cascade Range geomorphic province, located in the northeastern portion of the Middle Sacramento Region, is characterized by extrusive volcanic activity, and the active volcano Mount Lassen is located on the edge of the Middle Sacramento Region. The Cascade Range is generally underlain by igneous rock, including lava flows, pyroclastic flows, and alluvium eroded from volcanic features. The Great Valley geomorphic province, located in the Central Valley and in the middle portion of the Middle Sacramento Region, contains a large alluvial plain and unconsolidated sedimentary deposits. The Coast Ranges, located in the western portion of the Middle Sacramento Region, contain irregular, knobby, landslide topography. The Coast Ranges are primarily comprised of sedimentary and metamorphic rock, and alluvial deposits in valley areas. (CGS 2002)

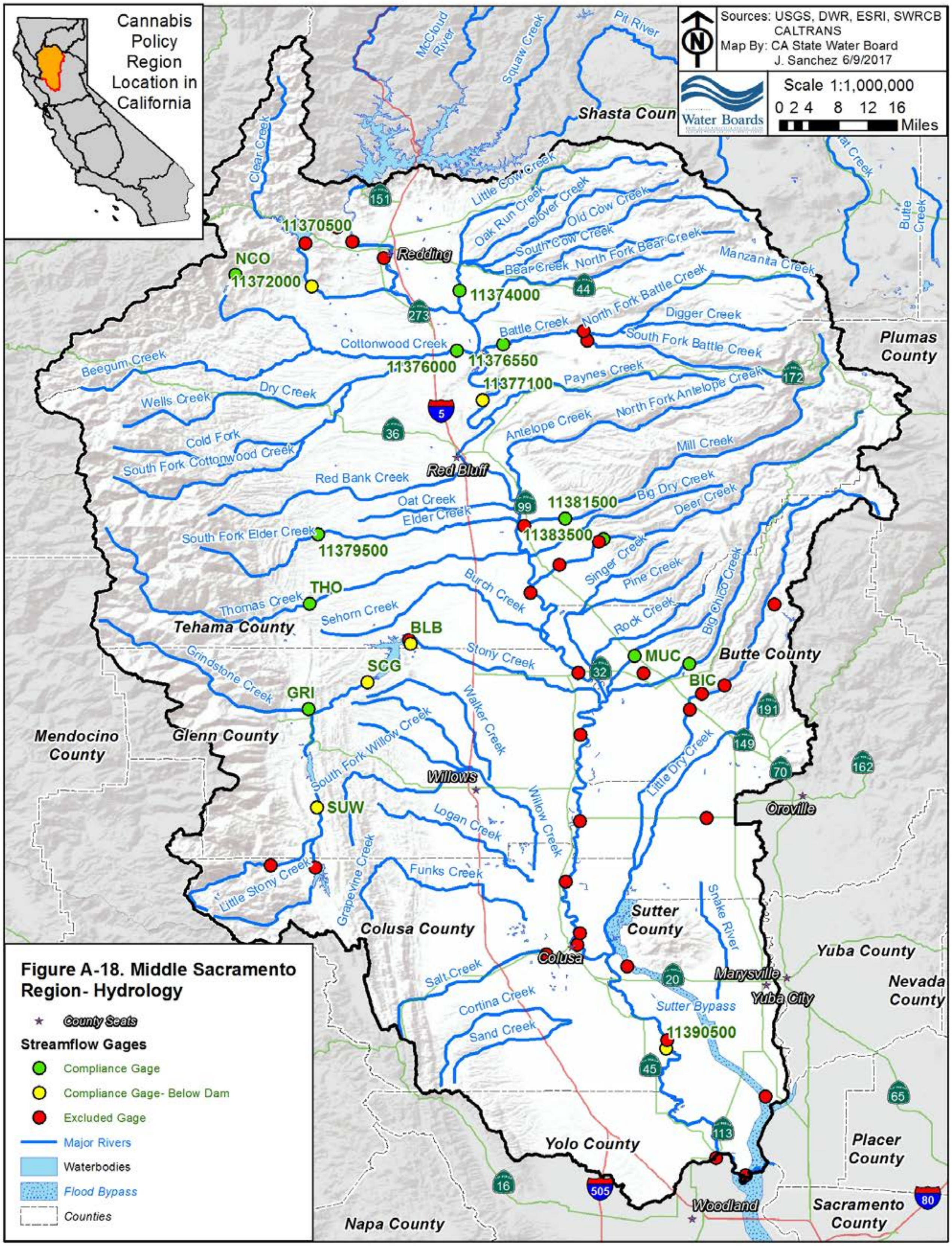
1.4.4 Anadromous Salmonid Population

Five special-status ESUs, DPSes, or DTEs are currently extant within the Middle Sacramento Region (Figure A-23):

- the Sacramento River winter-run (SRWR) Chinook salmon ESU,
- the Central Valley spring-run (CV SR) Chinook salmon ESU,
- the Central Valley fall-run (CV FR) Chinook salmon DTE[4],
- the Central Valley late fall-run (CV LFR) Chinook salmon DTE, and
- the California Central Valley (CCV) steelhead DPS.

The SRWR Chinook salmon ESU is currently listed as endangered under the ESA and the CESA (CDFW 2017b). The CV SR Chinook salmon ESU and the CCV steelhead DPS are currently listed as threatened under the ESA (CDFW 2017b). The CV SR Chinook salmon ESU is also listed as threatened under the CESA (CDFW 2017b). The CV FR and CV LFR Chinook salmon populations are each listed as species of special concern by CDFW and, jointly, as a species of concern by NMFS (Moyle et al. 2015, NMFS 2017).

[4] CV FR and CV LFR Chinook salmon together constitute a single ESU; however, CDFW treats the two runs as distinct taxonomic entities based upon their distinct life-history strategies and in consideration of the unique management concerns of each run (Moyle et al. 2015).



Cannabis Policy Region Location in California
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Water Boards
Scale 1:1,000,000
0 2 4 8 12 16 Miles
Figure A-18. Middle Sacramento Region- Hydrology
County Seats
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Major Rivers
Waterbodies
Flood Bypass
Counties
Shasta Coun
Plumas County
Tehama County
Butte County
Glenn County
Mendocino County
Colusa County
Sutter County
Yuba County
Nevada County
Placer County
Yolo County
Sacramento County
Napa County
Redding
Red Bluff
Willows
Oroville
Colusa
Marysville
Yuba City
Woodland
11370500
NCO
11372000
11374000
11376000
11376550
11377100
11381500
11383500
11379500
THO
BLB
SCG
GRI
MUC
BIC
SUW
11390500
Pit River
McCloud River
Squaw Creek
Clear Creek
Little Cow Creek
Oak Run Creek
Clover Creek
Old Cow Creek
South Cow Creek
Bear Creek
North Fork Bear Creek
Manzanita Creek
North Fork Battle Creek
Digger Creek
Battle Creek
South Fork Battle Creek
Cottonwood Creek
Beegum Creek
Paynes Creek
Dry Creek
Wells Creek
North Fork Antelope Creek
Antelope Creek
Cold Fork
South Fork Cottonwood Creek
Mill Creek
Red Bank Creek
Big Dry Creek
Oat Creek
Elder Creek
Deer Creek
South Fork Elder Creek
Singer Creek
Pine Creek
Burch Creek
Big Chico Creek
Thomas Creek
Sehorn Creek
Rock Creek
Stony Creek
Grindstone Creek
Walker Creek
South Fork Willow Creek
Little Dry Creek
Logan Creek
Willow Creek
Grapevine Creek
Little Stony Creek
Funks Creek
Snake River
Salt Creek
Cortina Creek
Sand Creek
Sutter Bypass
Butte Creek

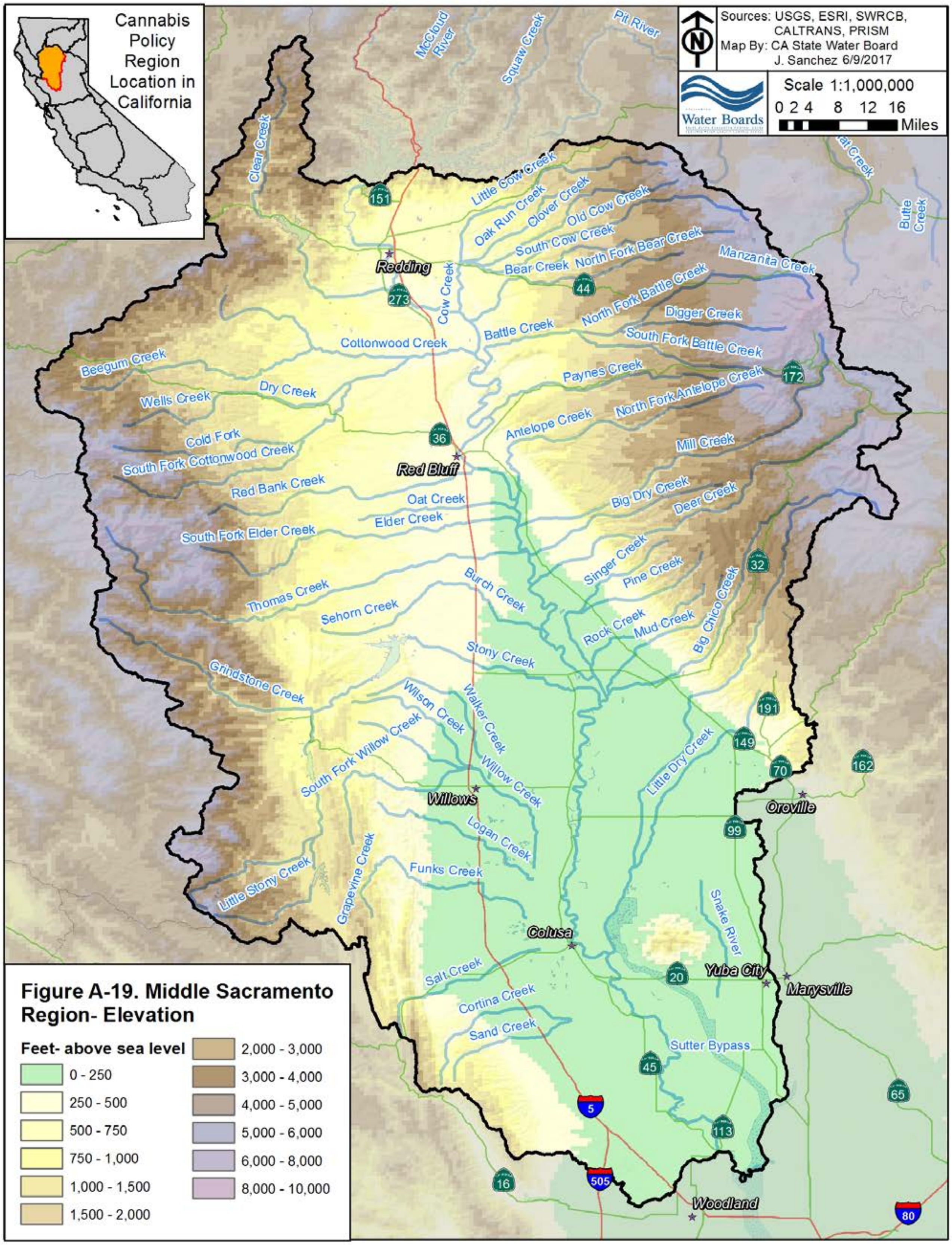
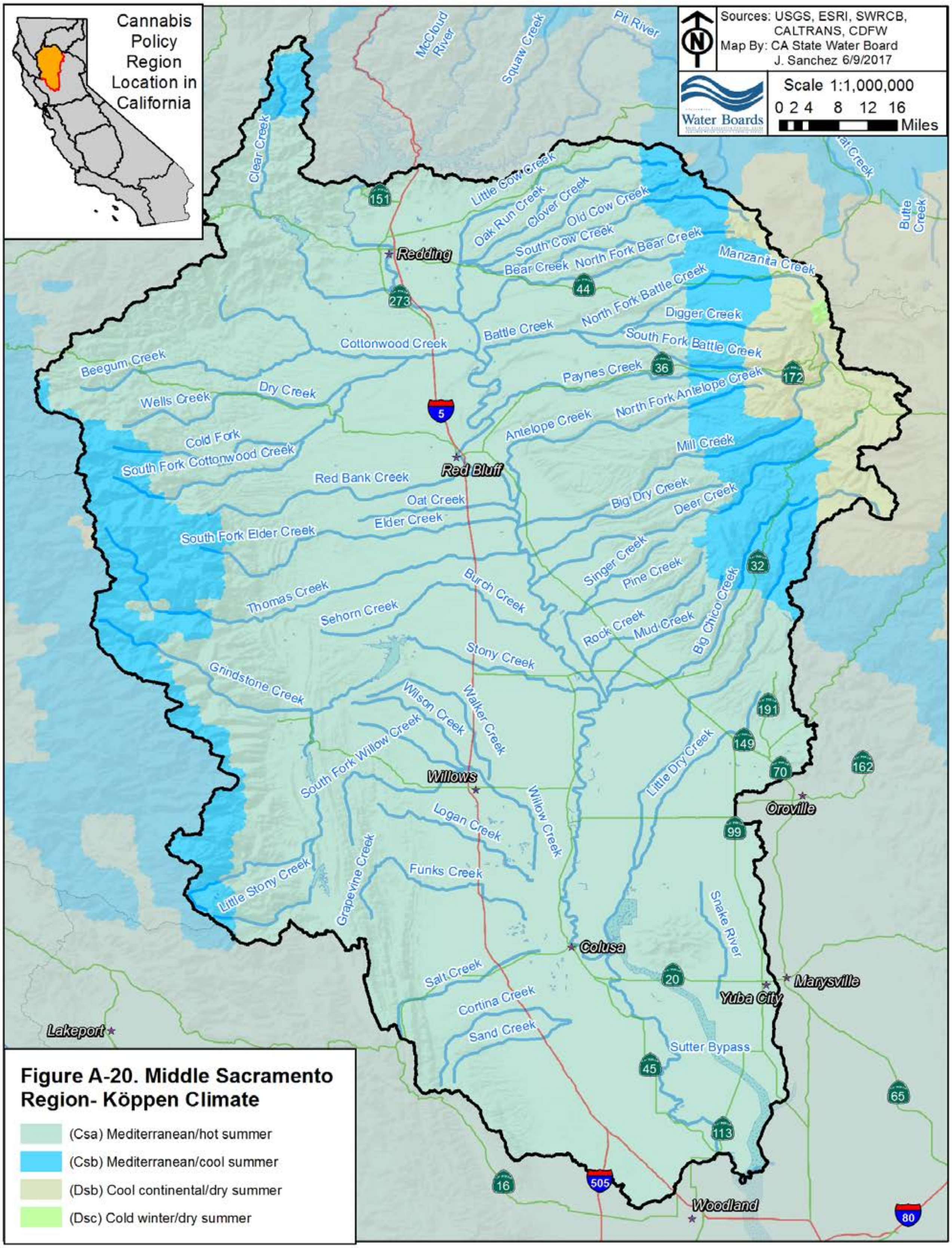


Figure A-19. Middle Sacramento Region- Elevation


Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, CALTRANS, CDFW
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,000,000
0 2 4 8 12 16
Miles
Water Boards
Figure A-20. Middle Sacramento Region- Köppen Climate
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Dsb) Cool continental/dry summer
(Dsc) Cold winter/dry summer
Redding
Red Bluff
Willows
Oroville
Colusa
Marysville
Yuba City
Woodland
Lakeport
Clear Creek
McCloud River
Squaw Creek
Pit River
Little Cow Creek
Oak Run Creek
Clover Creek
Old Cow Creek
South Cow Creek
Bear Creek
North Fork Bear Creek
Manzanita Creek
North Fork Battle Creek
Digger Creek
Battle Creek
South Fork Battle Creek
Cottonwood Creek
Beegum Creek
Dry Creek
Wells Creek
Paynes Creek
North Fork Antelope Creek
Antelope Creek
Cold Fork
South Fork Cottonwood Creek
Mill Creek
Red Bank Creek
Oat Creek
Elder Creek
Big Dry Creek
Deer Creek
South Fork Elder Creek
Singer Creek
Pine Creek
Burch Creek
Thomas Creek
Sehorn Creek
Rock Creek
Mud Creek
Big Chico Creek
Stony Creek
Grindstone Creek
Wilson Creek
Walker Creek
South Fork Willow Creek
Little Dry Creek
Logan Creek
Willow Creek
Little Stony Creek
Grapevine Creek
Funks Creek
Snake River
Salt Creek
Cortina Creek
Sand Creek
Sutter Bypass
Butte Creek
151
44
273
36
172
5
32
191
149
70
162
99
20
45
113
65
16
505
80

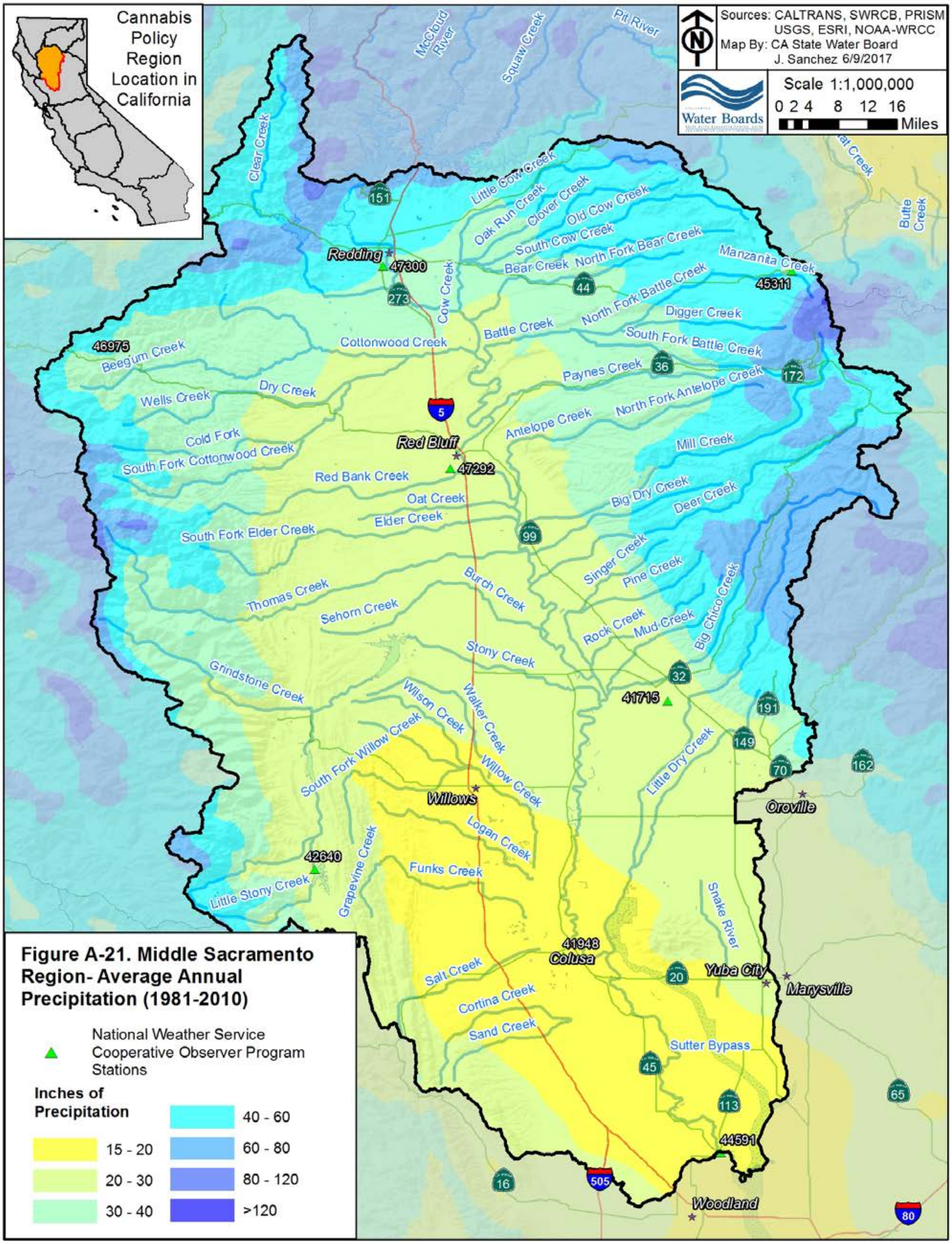


Figure A-21. Middle Sacramento Region- Average Annual Precipitation (1981-2010)

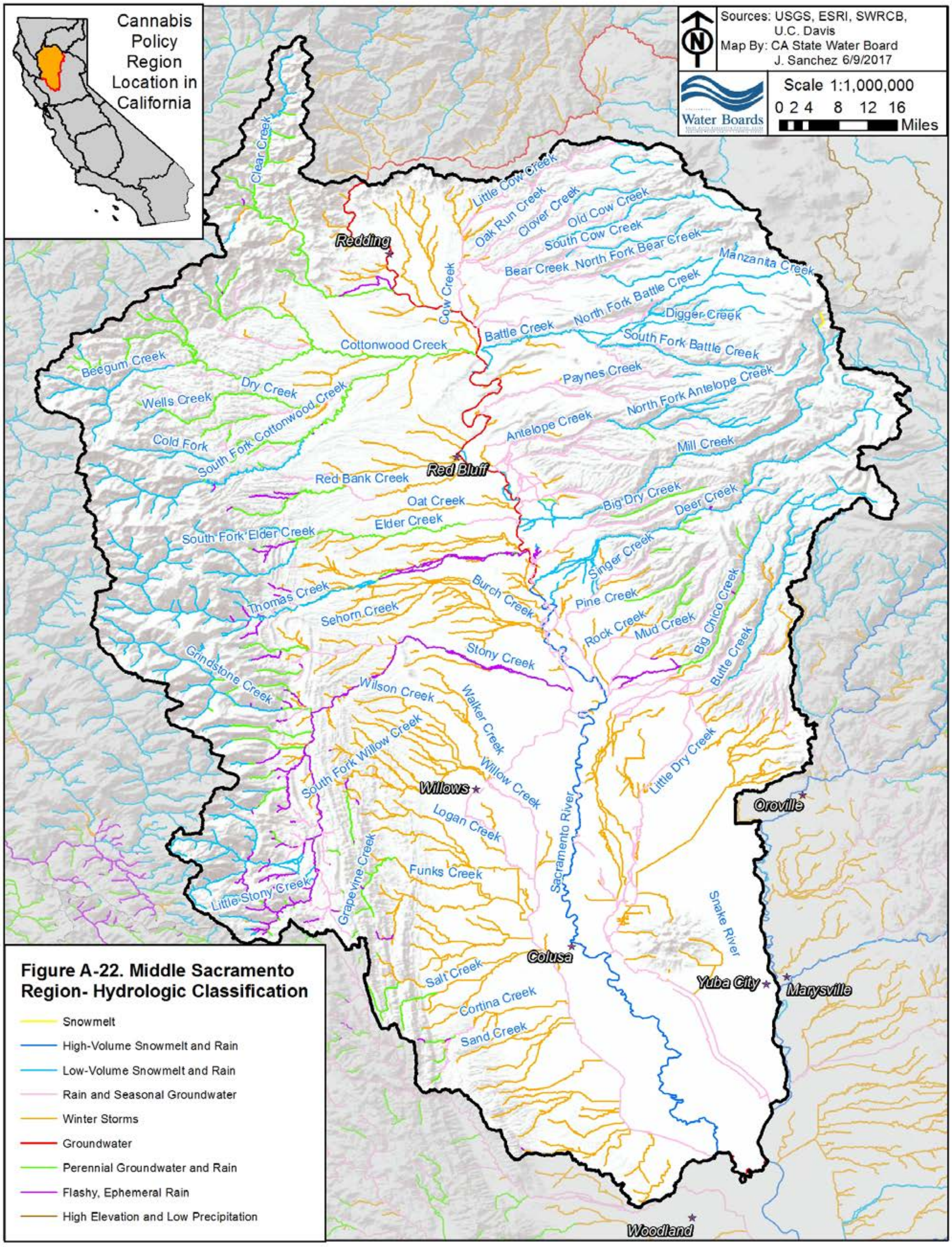


Figure A-22. Middle Sacramento Region- Hydrologic Classification

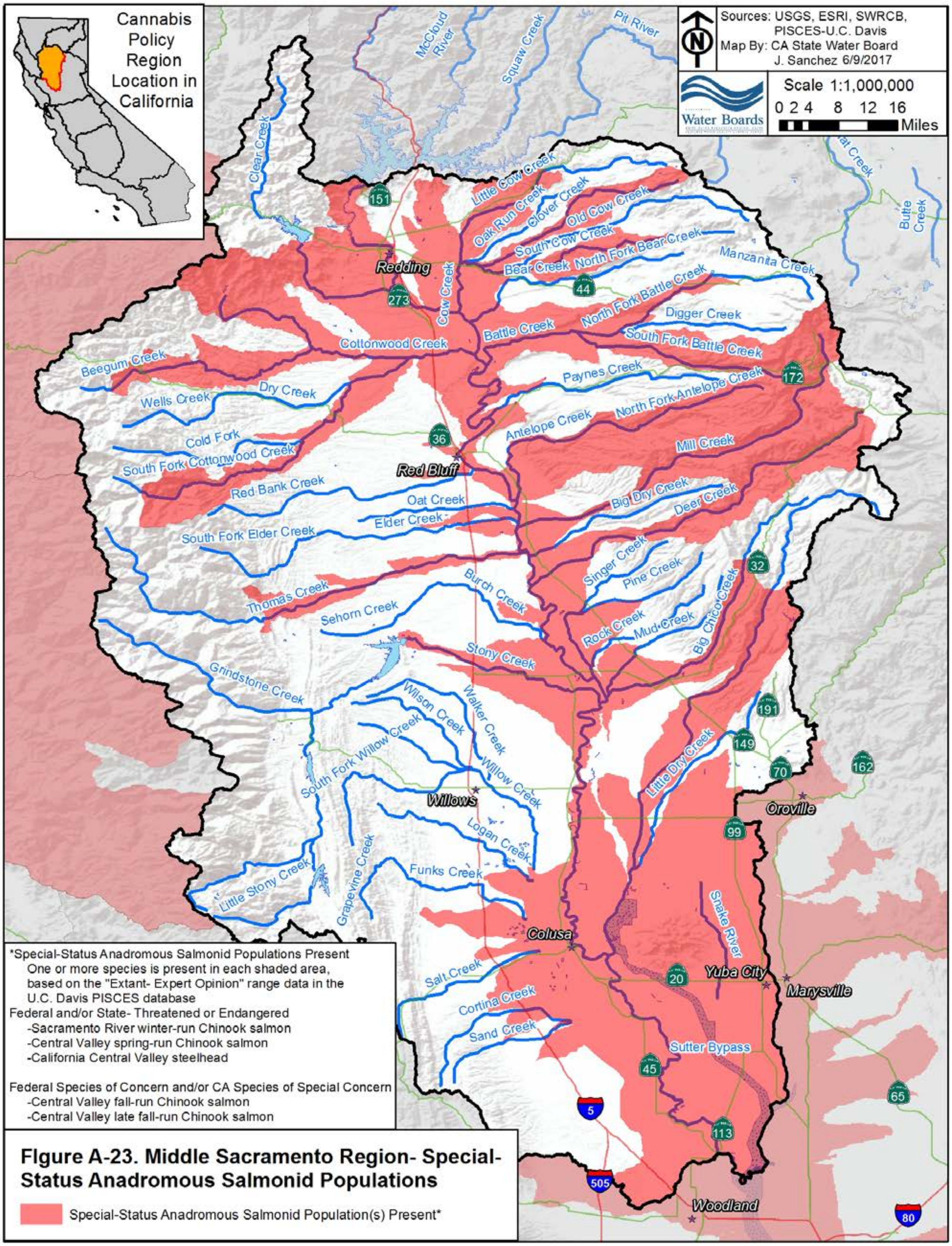


Figure A-23. Middle Sacramento Region- Special-Status Anadromous Salmonid Populations

1.5 South Sacramento Region

The South Sacramento Region covers approximately 14,195 square miles in central California, as shown in attached (Figure A-24). Elevations in this region range from below sea level in the Sacramento-San Joaquin River Delta, to over 8,000 feet along the crest of the Sierra Nevada mountains. Please refer to Figure A-25 for an elevation map of the region. The Middle Sacramento region includes the lower Sacramento River watershed, from its confluence with the Feather River to confluence of the Sacramento-San Joaquin River Delta and the San Francisco Bay. Several major tributaries to the Sacramento River are located in this region, including Putah Creek and Cache Creek, which drain the eastern side of the Coast Ranges and enter the Sacramento River from the west, and the Feather, Yuba, and American Rivers, which drain the western side of the Sierra Nevada and enter the Sacramento River from the east.

1.5.1 Climate and Precipitation

The climate of the South Sacramento Region varies with elevation, and generally grades from west to east. There are significant climatic, temperature, and precipitation differences between the Coast Ranges, Central Valley, western side of the Sierra Nevada mountains, and eastern side of the Sierra Nevada mountains. The Coast Ranges and Central Valley, located in the western and central portion of the South Sacramento Region, are characterized by a Mediterranean climate with hot summers. The Sierra Nevada foothills, located to the east of the Central Valley, are characterized by a Mediterranean climate with cool summers. The northern and eastern margins of the Sierra Nevada mountains are characterized as cool continental with dry summers. Please refer to Figure A-26 for a climatic map of the South Sacramento Region.

In general, the western portion of the South Sacramento Region, which includes the Coast Ranges and Central Valley, exhibit higher average annual maximum and higher average annual minimum temperatures compared to the eastern portion of the region, which includes the Sierra Nevada. The western portion of the Sierra Nevada mountains also exhibits higher average annual maximum and higher average annual minimum temperatures compared to the eastern portion of the Sierra Nevada mountains. Average annual maximum temperatures in the Central Valley and Coast Ranges portions of the South Sacramento Region tend to exceed 75 degrees Fahrenheit, while average annual maximum temperatures at higher elevations in the Sierra Nevada mountains tend to exceed 50 degrees Fahrenheit. Average annual minimum temperatures tend to remain above 45 degrees Fahrenheit throughout the Central Valley and Sierra Nevada foothills, while average annual minimum temperatures tend to remain below freezing at high elevation areas in the Sierra Nevada.

In the South Sacramento Region, precipitation generally falls from November through April. Average annual precipitation amounts in the South Sacramento Region vary greatly between the Coast Ranges, Central Valley, and Sierra Nevada mountains. Up to 60 inches of precipitation tends to fall annually in the Coast Ranges, less than 15 inches of precipitation tends to fall annually in the southern portion of the South Sacramento Region, and over 80 inches of precipitation tends to fall annually along the Sierra Nevada crest. East of the Sierra Nevada crest, less than 15 inches of precipitation tends to fall annually, which is a result of the rain shadow effect. Significant amounts of precipitation tend to fall as snow in the Sierra Nevada mountains, and snowfall depths are typically higher in the northern Sierra Nevada mountains compared to the southern Sierra Nevada mountains. Average snowfall totals in the Sierra Nevada mountain portion of the Southern Sacramento Region vary from nearly 190 inches at Mount Lassen, located at the northern boundary of the region, to nearly 400 inches at Echo Summit south of Lake Tahoe. (WRCC 2016)

Please refer to Figure A-27 for a precipitation map of the Southern Sacramento Region. Please refer to Charts A-8, A-9 and A-10, below, for illustrations of the typical precipitation and temperature patterns across the region.

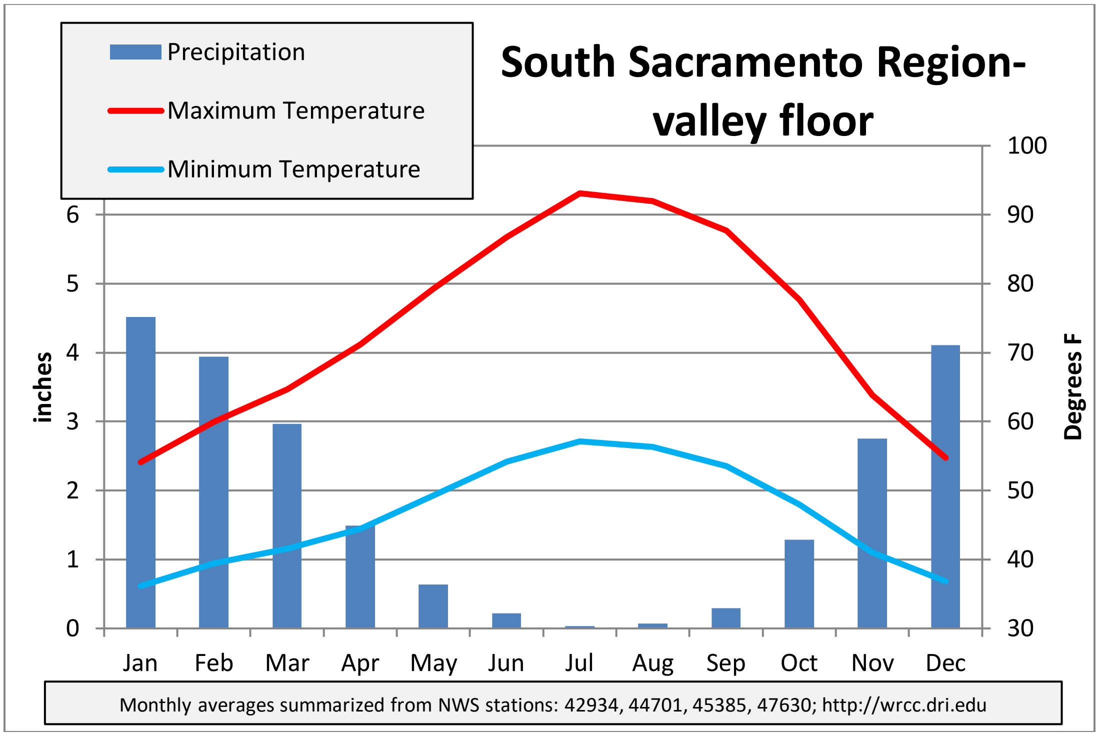


Chart A-8. Average annual patterns of temperature and precipitation in the South Sacramento Region, valley floor.

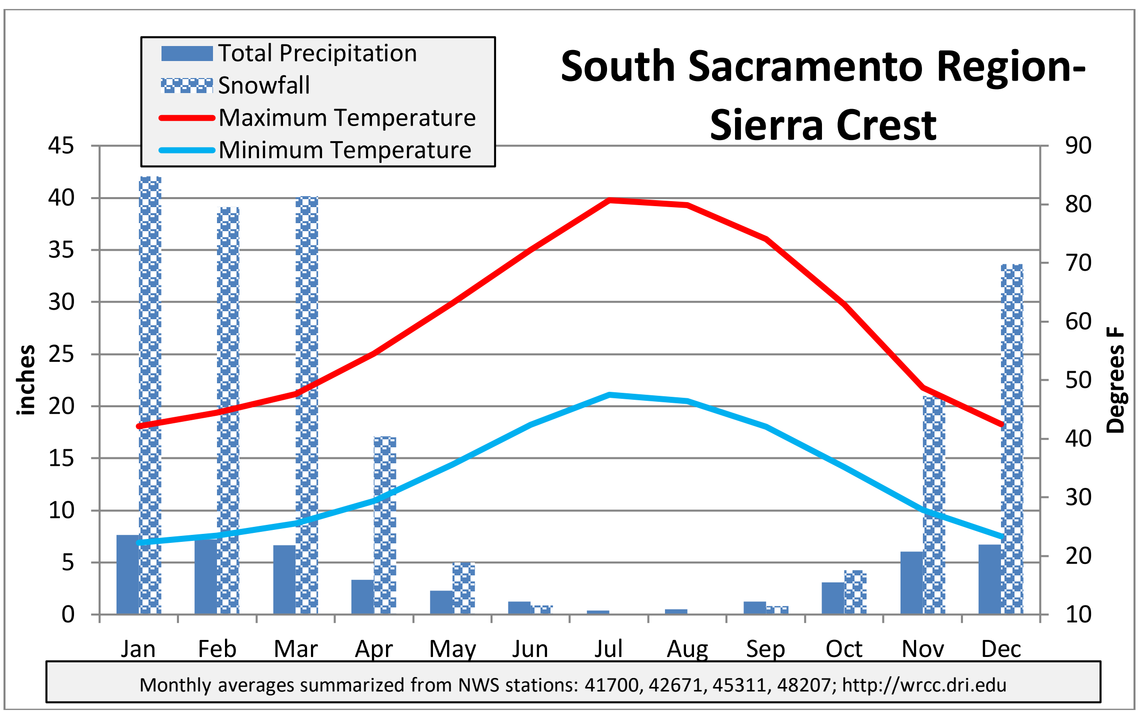


Chart A-9. Average annual patterns of temperature and precipitation in the South Sacramento Region, Sierra Crest.

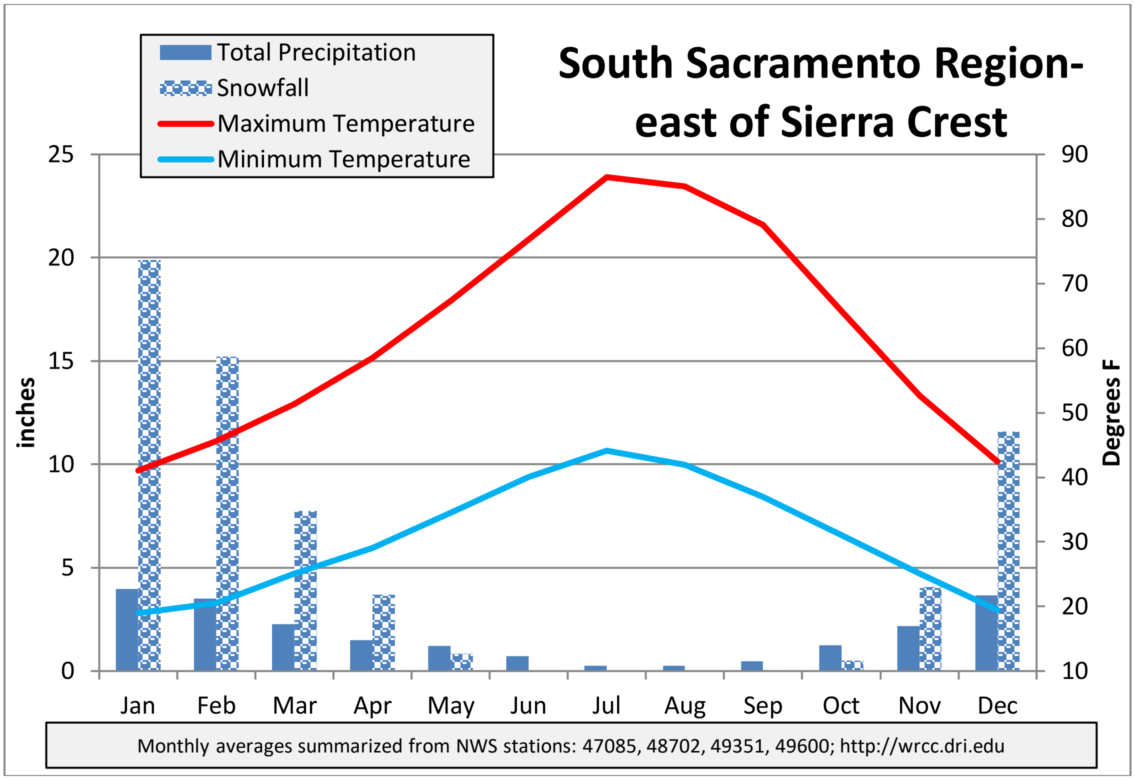


Chart A-10. Average annual patterns of temperature and precipitation in the South Sacramento Region, east of Sierra Crest.

1.5.2 Hydrology

The hydrology of South Sacramento Region stream reaches varies greatly from west to east, and several UC Davis hydrologic classifications exist for stream reaches in this region. Streams in the northwestern portion of the South Sacramento Region, which includes the Coast Ranges, are primarily classified as Rain and Seasonal Groundwater (RSG) or Perennial Groundwater and Rain (PGR) systems. The central portion of the South Sacramento Region, which includes the Central Valley and Sierra Nevada foothills, are dominated by Winter Storms (WS) and Rain and Seasonal Groundwater (RSG) systems. The eastern portion of the South Sacramento Region, which includes the Sierra Nevada, is dominated by Low-Volume Snowmelt and Rain (LSR) systems. Several main rivers, including the Sacramento River on the valley floor, are characterized as High-Volume Snowmelt and Rain (HSR) systems. (Lane et al 2016)

Please refer to Figure A-28 for a depiction of the stream classifications within the Southern Sacramento Region.

1.5.3 Geology

The South Sacramento Region is primarily located in the Coast Ranges, Great Valley, and Sierra Nevada geomorphic provinces. The Coast Ranges, located in the western portion of the South Sacramento Region, contain irregular, knobby, landslide topography. The Coast Ranges contain sedimentary and metamorphic rock, and alluvial deposits in valley areas. The Great Valley geomorphic province, located in the center of this region and corresponding to the Sacramento Valley, consists of a large alluvial plain. The Sierra Nevada geomorphic province, located in the eastern portion of this region, contains steep mountains underlain by a granitic batholith. The foothill region of the Sierra Nevada geomorphic province are comprised of metamorphic rocks. Small portions of the northeastern portion of the South Sacramento Region are also located in the Cascade Range and the Basin and Range geomorphic provinces. (CGS, 2002)

1.5.4 Anadromous Salmonid Population

Six special-status ESUs, DPSes, or DTEs are currently extant within the South Sacramento Region (Figure A-29):

- the SRWR Chinook salmon ESU,
- the CV SR Chinook salmon ESU,
- the CV FR of Chinook salmon DTE[5],
- the CV LFR of Chinook salmon DTE,
- the CCV steelhead DPS, and
- the Central California Coast (CCC) steelhead DPS.

The SRWR Chinook salmon ESU is currently listed as endangered under the ESA and the CESA (CDFW 2017b). The CV SR Chinook salmon ESU, CCV steelhead DPS, and the CCC steelhead DPS are currently listed as threatened under the ESA (CDFW 2017b). In addition, the CV SR Chinook salmon ESU is listed as threatened under the CESA (CDFW 2017b). The CV FR and CV LFR Chinook salmon populations are each listed as species of special concern by CDFW and, jointly, as a species of concern by NMFS (Moyle et al. 2015, NMFS 2017).

[5] CV FR and CV LFR Chinook salmon together constitute a single ESU; however, CDFW treats the two runs as distinct taxonomic entities based upon their distinct life-history strategies and in consideration of the unique management concerns of each run (Moyle et al. 2015).

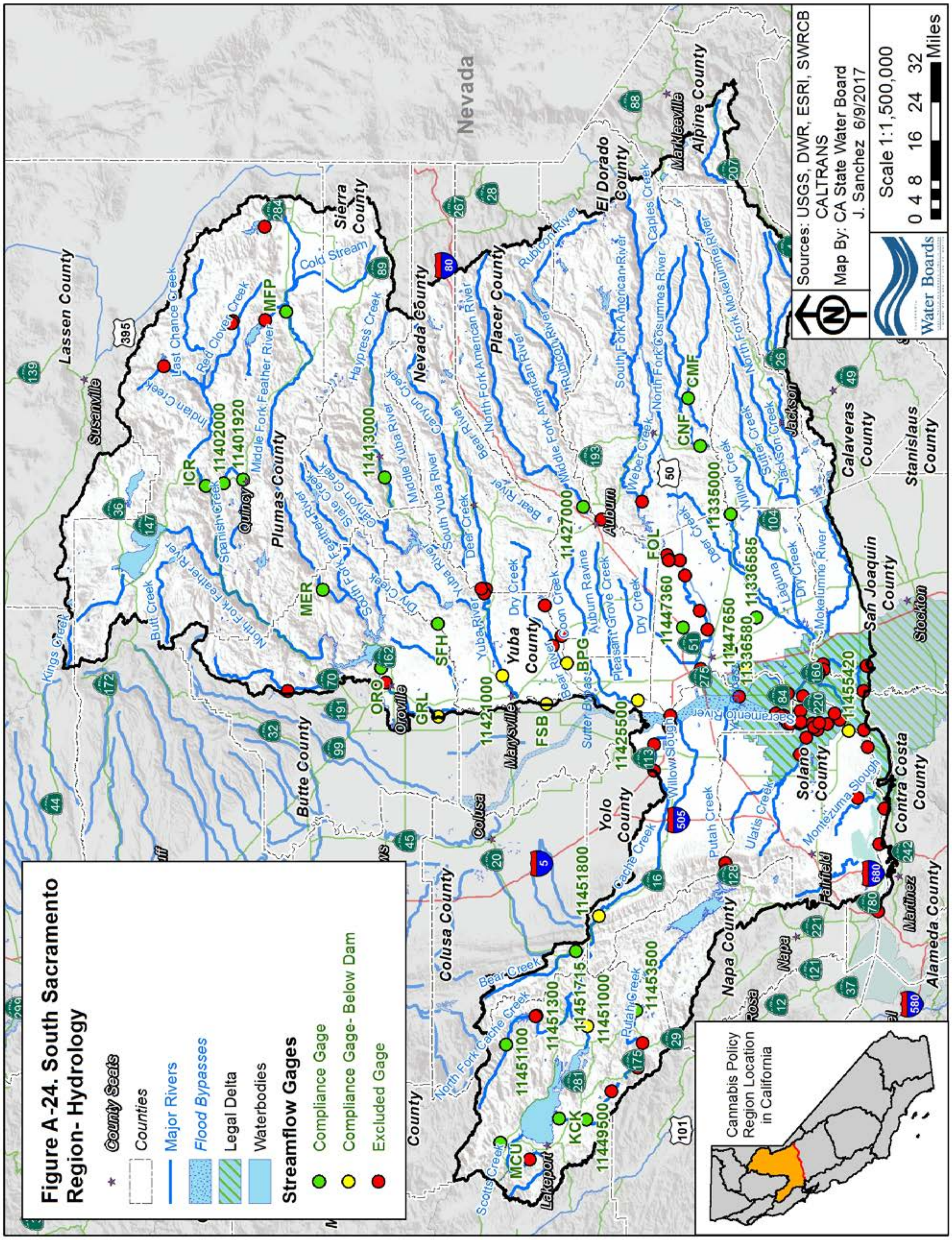


Figure A-24. South Sacramento Region- Hydrology
County Seats
Counties
Major Rivers
Flood Bypasses
Legal Delta
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Cannabis Policy Region Location in California
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,500,000
0 4 8 16 24 32 Miles
Nevada

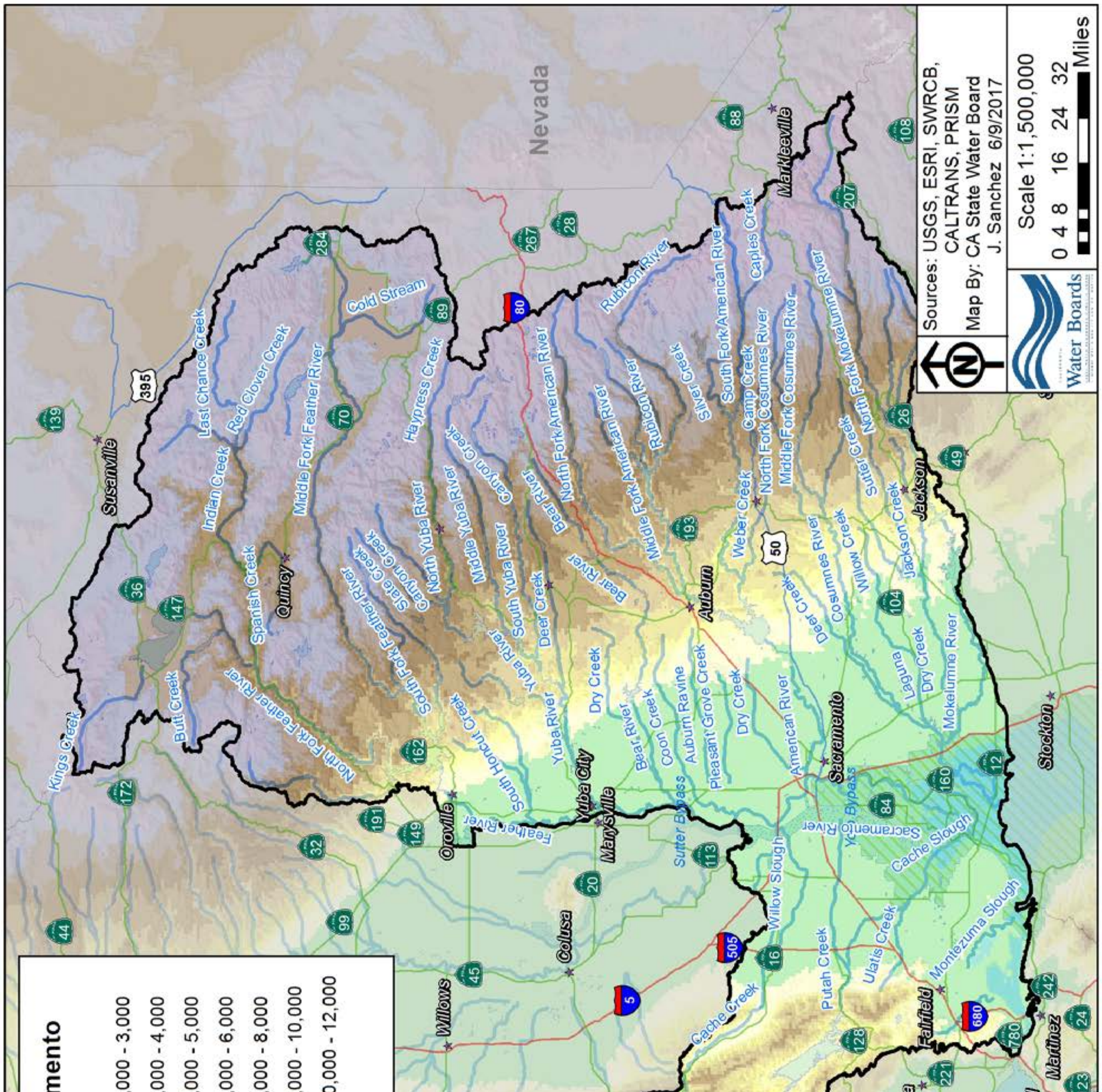


Figure A-25. South Sacramento Region- Elevation

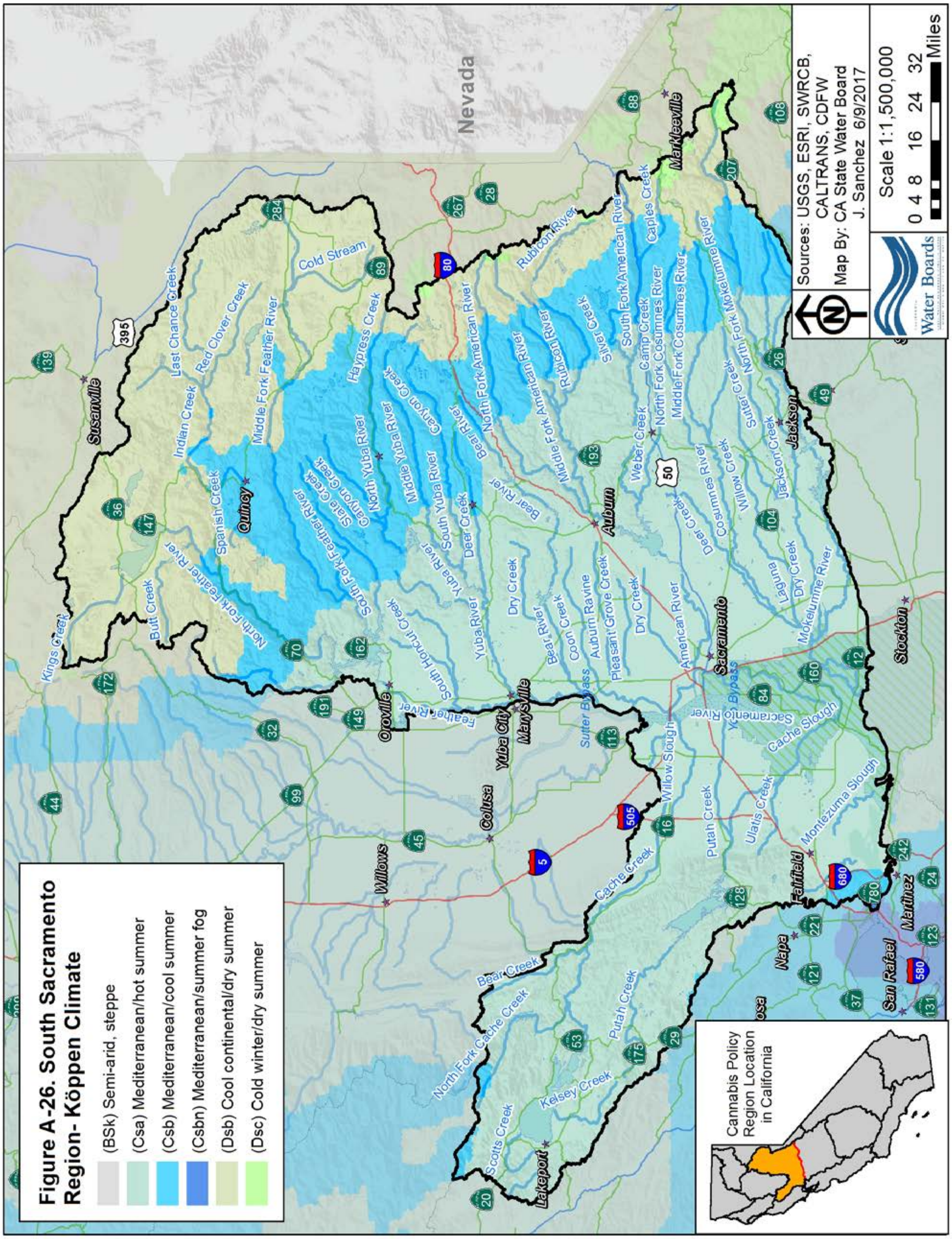


Figure A-26. South Sacramento Region- Köppen Climate
(BSk) Semi-arid, steppe
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Csbn) Mediterranean/summer fog
(Dsb) Cool continental/dry summer
(Dsc) Cold winter/dry summer
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, CALTRANS, CDFW
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,500,000
0 4 8 16 24 32 Miles
Water Boards
Nevada
Susanville
Quincy
Oroville
Yuba City
Marysville
Colusa
Willows
Auburn
Sacramento
Stockton
Jackson
Markleeville
Lakeport
Napa
Fairfield
Martinez
San Rafael

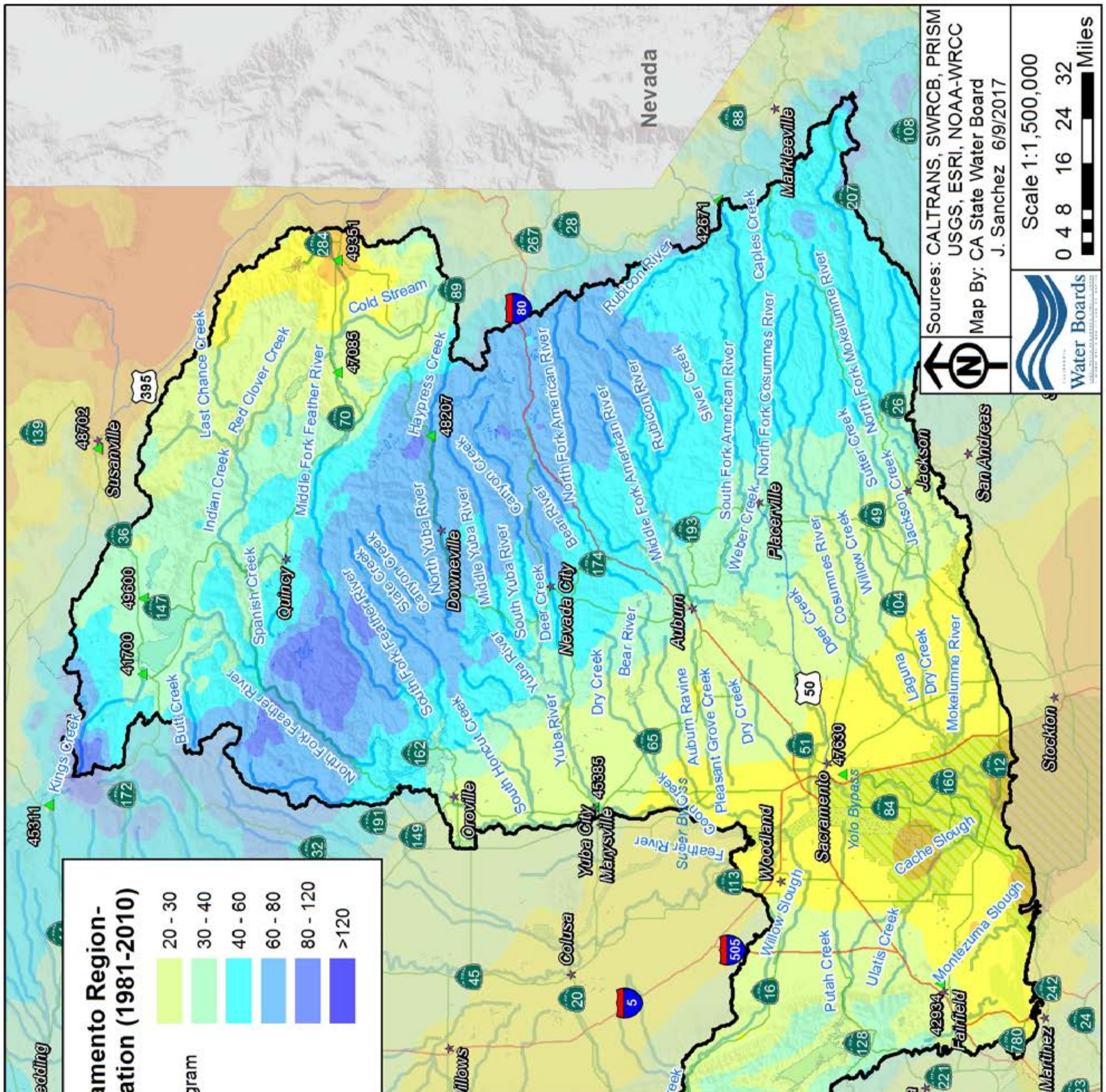


Figure A-27. South Sacramento Region-Average Annual Precipitation (1981-2010)

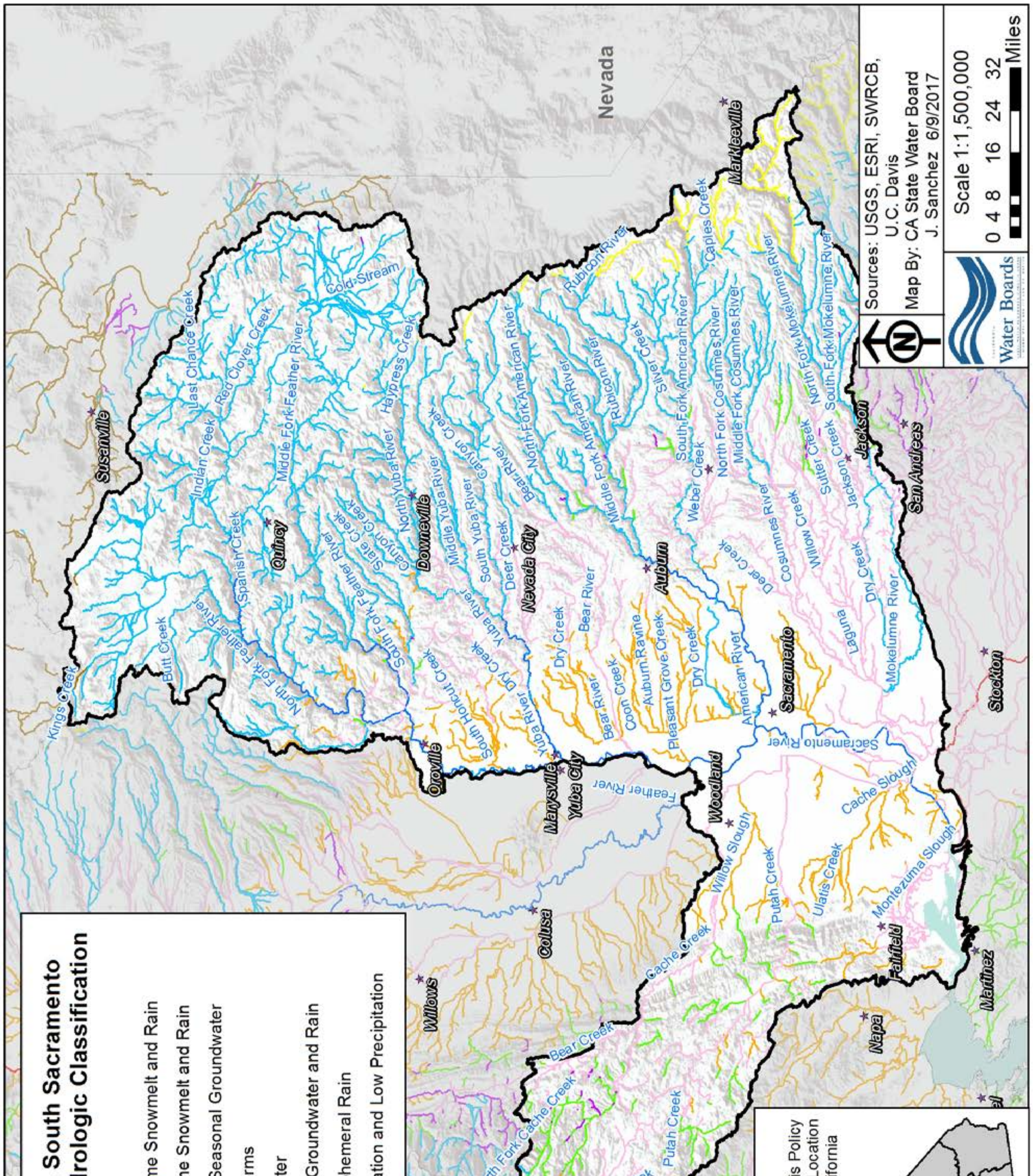
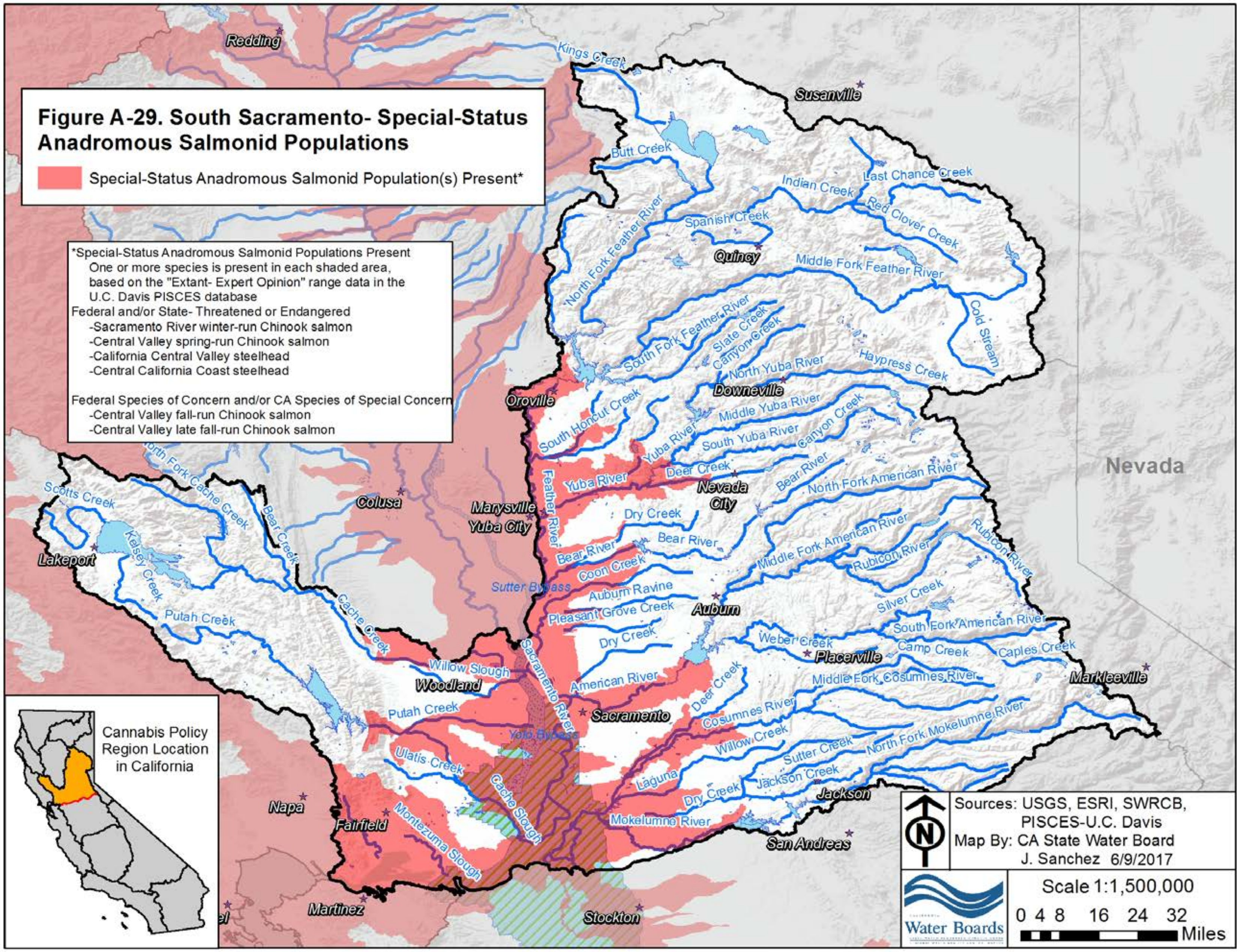


Figure A-28. South Sacramento Region- Hydrologic Classification

Figure A-29. South Sacramento- Special-Status Anadromous Salmonid Populations



1.6 North Central Coast Region

The North Central Coast Region covers approximately 4,785 square miles along the north-central coast of California, as shown in attached (Figure A-30). This region is bordered by the San Francisco Bay to the south and by the Eel River to the north. Elevations in the North Central Coast Region range from sea level along the coast and near the San Francisco Bay, to over 2,000 feet in the Coast Ranges along the northeastern boundary of the region. Please refer to Figure A-31 for an elevation map of the North Central Coast Region. Several watersheds are located in the North Central Coast Region, including the Russian, Mattole, Noyo, Big, Navarro, Garcia, and Gualala River watersheds which drain directly to the Pacific Ocean, and the Napa, and Petaluma River watersheds which drain into San Francisco Bay. The Russian River watershed is the largest watershed in the North Central Coast Region.

1.6.1 Climate and Precipitation

The climate of the North Central Coast Region is described as Mediterranean with hot summers in inland areas, and Mediterranean with cooler summers in the coastal portions of the region. Summer fog is common along the coast in this region. Please refer to Figure A-32 for a climate map of this region.

Temperature conditions tend to be more variable in the inland portion of the North Central Coast Region compared to areas near the coast. Average annual maximum temperatures in the North Central Coast Region exceed 70 degrees Fahrenheit in inland areas, and remain slightly cooler near the coast. Average annual minimum temperatures in the North Central Coast Region remain above 40-45 degrees Fahrenheit in both coastal and inland areas.

Precipitation in the North Central Coast Region tends to fall during October through April, and the greatest amounts of precipitation tend to fall in December and January. Average annual precipitation amounts in the North Central Coast Region vary from over 60 inches near the northern coast, to under 30 inches in the southeast portion of the region. Snow does not comprise a significant portion of precipitation to the region. (WRCC 2016)

Please refer to Figure A-33 for a precipitation map of the region. Please refer to Chart A-11, below, for an illustration of temperature and precipitation patterns for the North Central Coast Region.

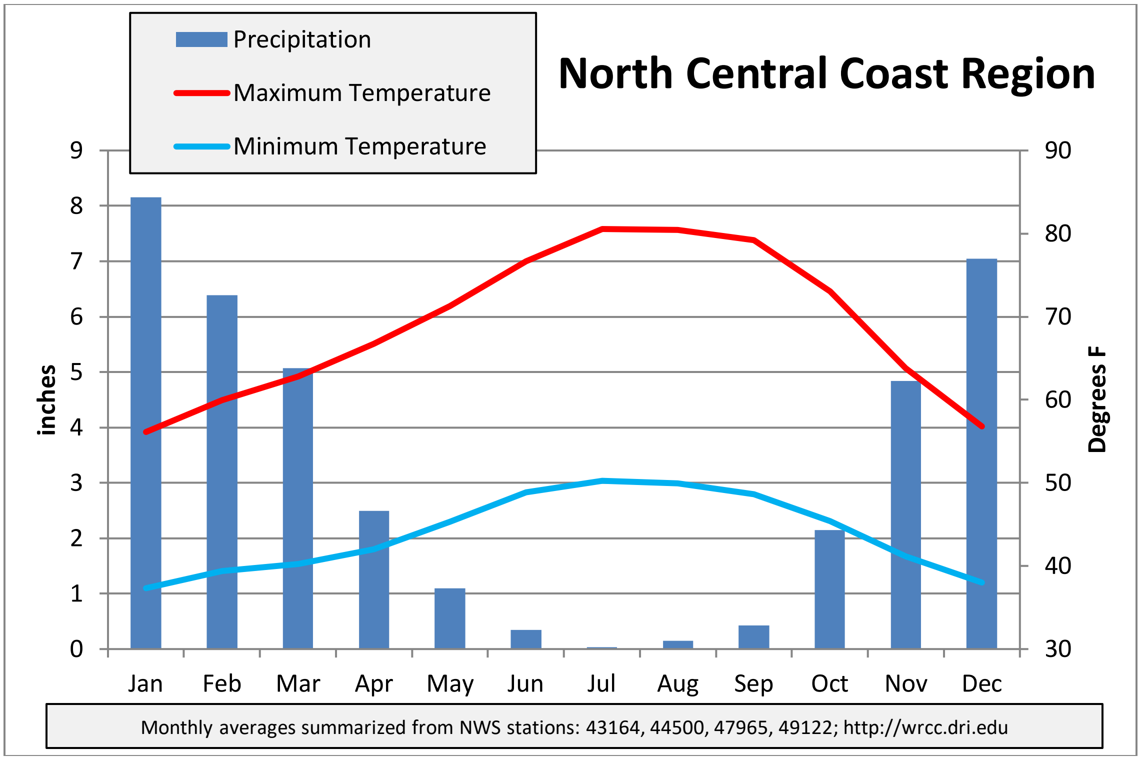


Chart A-11. Average annual patterns of temperature and precipitation in the North Central Coast Region.

1.6.2 Hydrology

Stream reaches in the North Central Coast Region are generally classified under UC Davis' hydrologic classification system as Winter Storms (WS), Perennial Groundwater and Rain (PGR), or Rain and Seasonal Groundwater (RSG) systems. Many North Central Coast Region stream reaches located near the coast, including tributaries to San Francisco Bay, are classified under the Winter Storm (WS) hydrologic regime. Many stream reaches located in the eastern, inland portion of the North Central Coast Region are classified under the PGR hydrologic regime, and a smaller amount of streams in this inland region are classified as RSG stream systems. (Lane et al 2016)

Please refer to (Figure A-34) for a stream classification map of the North Central Coast Region.

1.6.3 Geology

The North Central Coast Region is located in the Coast Ranges geomorphic province. The Coast Ranges in the North Coast Region are dominated by irregular, knobby, landslide topography. The Coast Ranges are underlain by sedimentary and metamorphic rock, with alluvial deposits in valley floors and along the coastline. The San Andreas Fault system is located near the western margin of the North Central Coast Region, and extends off of the California coast in the northern section of the region. (CGS 2002)

1.6.4 Anadromous Salmonid Population

Six special-status ESUs, DPSes, or DTEs are currently extant within the North Central Coast Region (Figure A-35):

- the CC Chinook salmon ESU,
- the CV SR Chinook salmon ESU,
- the NC steelhead DPS,
- the CCC steelhead DPS,
- the SONCC coho salmon ESU, and
- the Central California Coast (CCC) coho salmon ESU.

The CCC coho salmon ESU is currently listed as endangered under the ESA and the CESA (CDFW 2017b). The CC Chinook salmon ESU, CV SR Chinook salmon ESU, NC steelhead DPS, CCC steelhead DPS, and SONCC coho salmon ESU are all currently listed as threatened under the ESA (CDFW 2017b). In addition, the CV SR Chinook and SONCC coho salmon ESUs are currently listed as threatened under the CESA (CDFW 2017b).

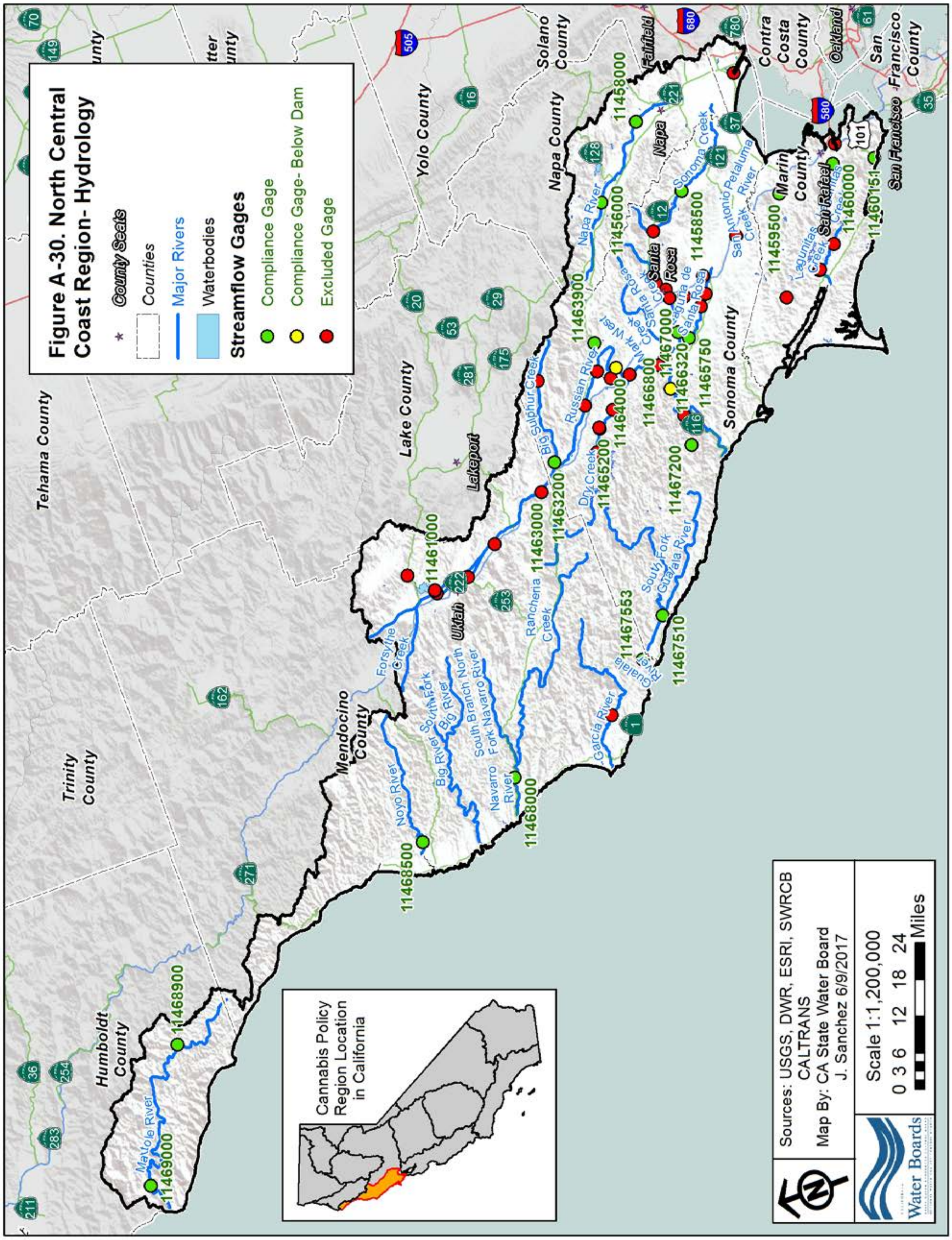


Figure A-30. North Central Coast Region- Hydrology
County Seats
Counties
Major Rivers
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Cannabis Policy Region Location in California
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,200,000
0 3 6 12 18 24 Miles
Water Boards
Humboldt County
Trinity County
Tehama County
Mendocino County
Lake County
Yolo County
Napa County
Solano County
Sonoma County
Marin County
Contra Costa County
San Francisco County
Ukiah
Lakeport
Santa Rosa
Napa
Fairfield
San Rafael
Oakland
San Francisco
11469000
11468900
11468500
11468000
11467510
11467553
11461000
11463000
11463200
11465200
11464000
11463900
11466800
11467000
11466320
11465750
11467200
11456000
11458500
11458000
11459500
11460000
11460151
Mattole River
Noyo River
Big River
South Fork Big River
South Branch North Fork Navarro River
Navarro River
Garcia River
Gualala River
South Fork Gualala River
Rancheria Creek
Forsythe Creek
Big Sulphur Creek
Dry Creek
Russian River
Mark West Creek
Santa Rosa Creek
Laguna de Santa Rosa
Napa River
Sonoma Creek
Petaluma River
San Antonio Creek
Lagunitas Creek

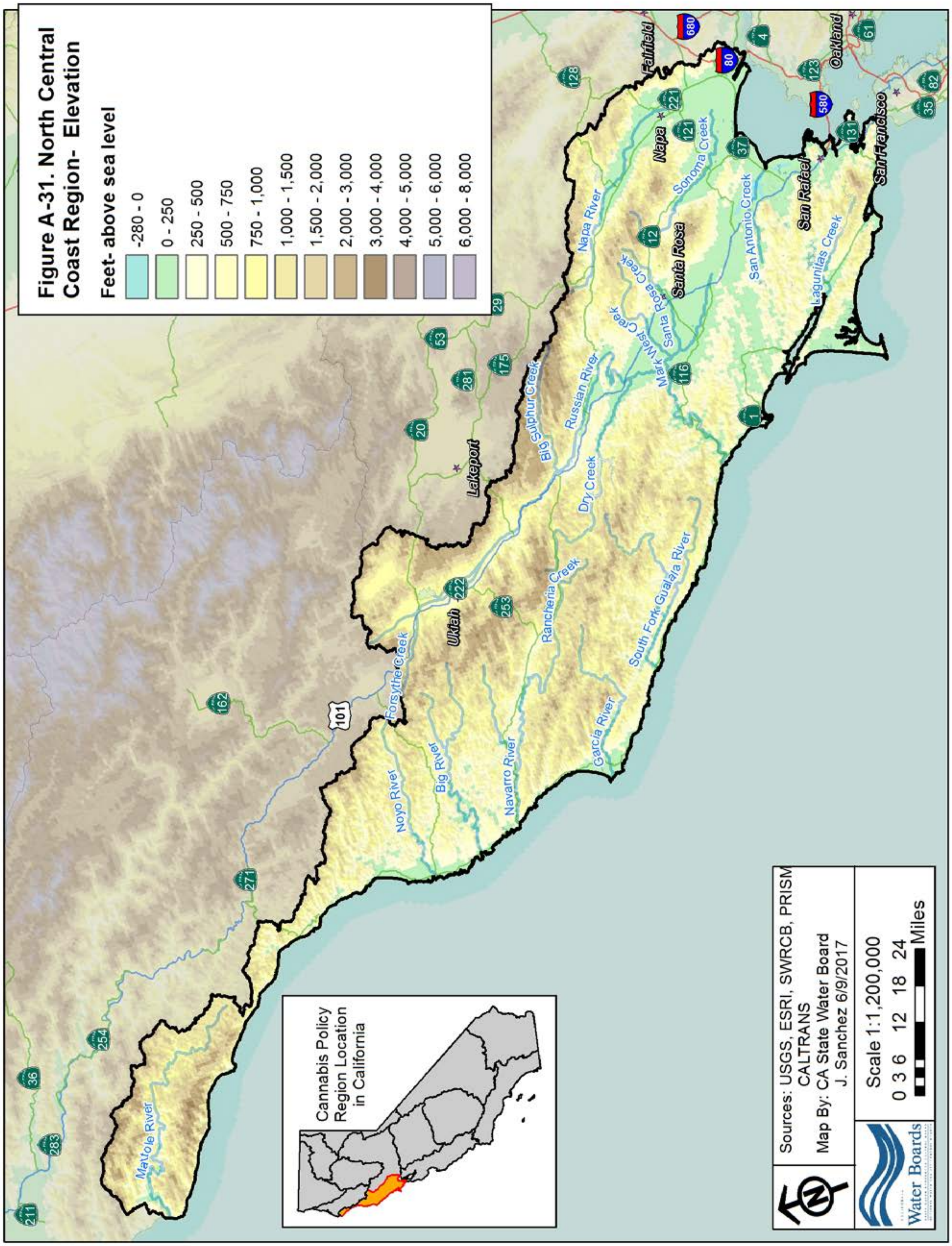


Figure A-31. North Central Coast Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,200,000
0 3 6 12 18 24 Miles
Water Boards
Mattole River
Noyo River
Big River
Navarro River
Garcia River
Forsythe Creek
Rancheria Creek
South Fork Gualala River
Dry Creek
Russian River
Big Sulphur Creek
Mark West Creek
Santa Rosa Creek
Napa River
Sonoma Creek
San Antonio Creek
Lagunitas Creek
Ukiah
Lakeport
Santa Rosa
Napa
Fairfield
San Rafael
San Francisco
Oakland
211
283
36
254
271
162
101
222
253
20
281
175
53
29
116
1
12
121
221
37
128
680
80
4
123
580
131
61
35
82

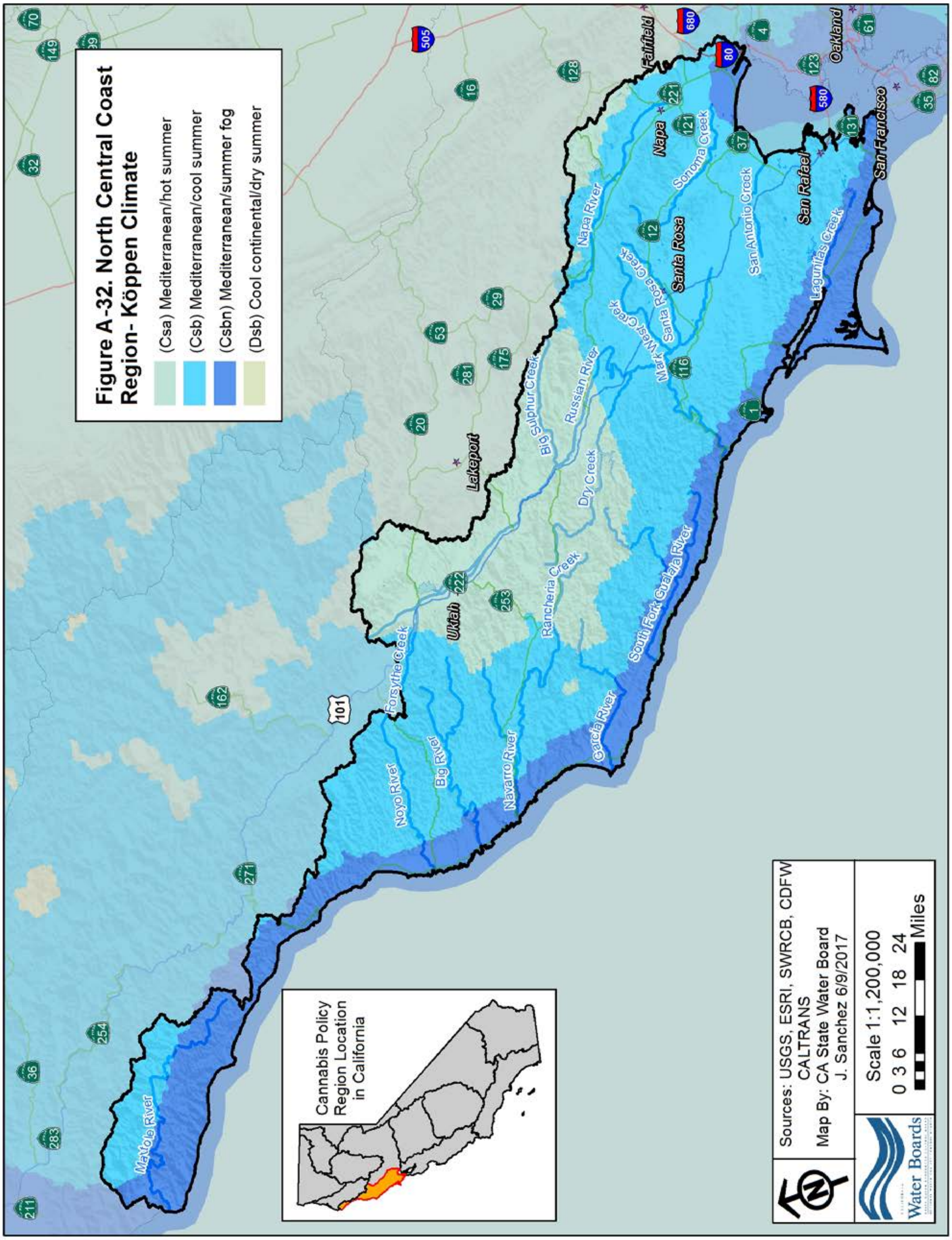


Figure A-32. North Central Coast Region- Köppen Climate
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Csbn) Mediterranean/summer fog
(Dsb) Cool continental/dry summer
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, CDFW CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,200,000
0 3 6 12 18 24 Miles
Water Boards
Fairfield
Oakland
Napa
San Francisco
San Rafael
Santa Rosa
Lakeport
Ukiah
Napa River
Sonoma Creek
San Antonio Creek
Lagunitas Creek
Santa Rosa Creek
Mark West Creek
Russian River
Big Sulphur Creek
Dry Creek
Rancheria Creek
South Fork Gualala River
Garcia River
Navarro River
Big River
Noyo River
Forsythe Creek
Mattole River

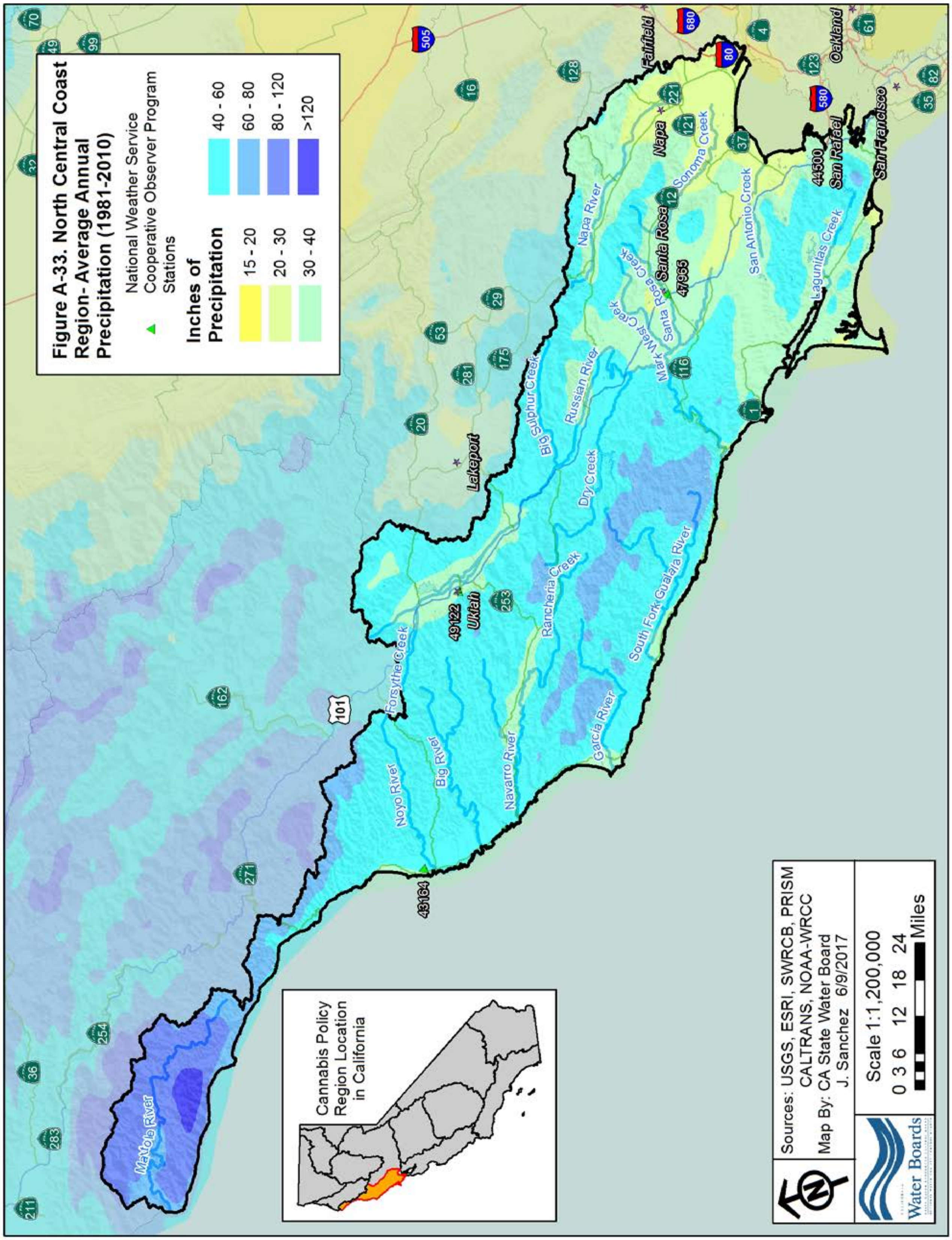


Figure A-33. North Central Coast Region- Average Annual Precipitation (1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
80 - 120
>120
Mattole River
Noyo River
Big River
Navarro River
Garcia River
Forsythe Creek
Rancheria Creek
South Fork Gualala River
Dry Creek
Big Sulphur Creek
Russian River
Mark West Creek
Santa Rosa Creek
Napa River
Sonoma Creek
San Antonio Creek
Lagunitas Creek
Ukiah
Lakeport
Santa Rosa
Napa
Fairfield
San Rafael
San Francisco
Oakland
43164
49122
47965
44500
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM CALTRANS, NOAA-WRCC
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,200,000
0 3 6 12 18 24 Miles
Water Boards

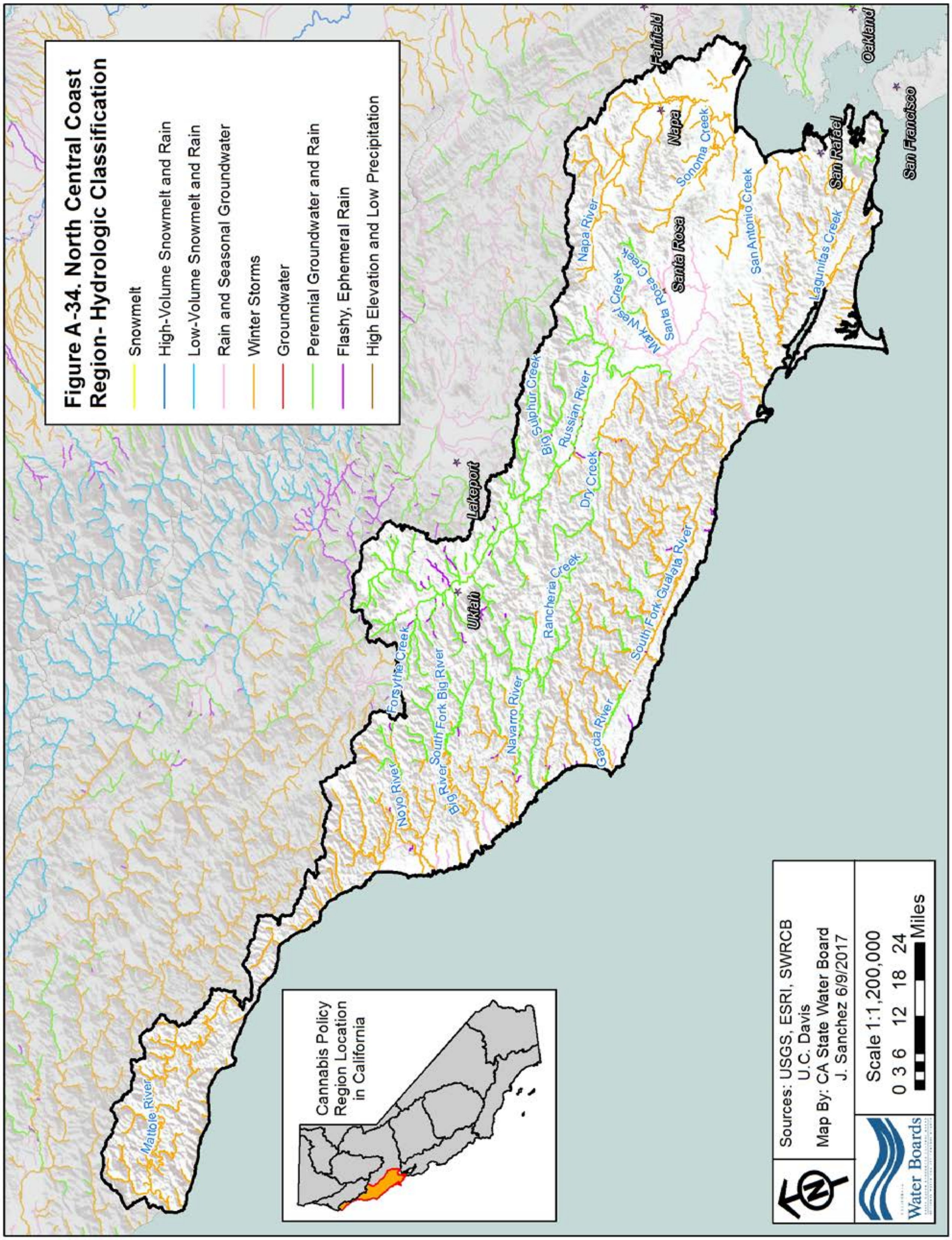


Figure A-34. North Central Coast Region- Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
High Elevation and Low Precipitation
Fairfield
Oakland
Napa
Sonoma Creek
San Rafael
San Francisco
Napa River
Santa Rosa
San Antonio Creek
Lagunitas Creek
Mark West Creek
Santa Rosa Creek
Big Sulphur Creek
Russian River
Lakeport
Dry Creek
Ukiah
Rancheria Creek
South Fork Gualala River
Forsythe Creek
South Fork Big River
Navarro River
Garcia River
Noyo River
Big River
Mattole River
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB
U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,200,000
0 3 6 12 18 24 Miles
Water Boards

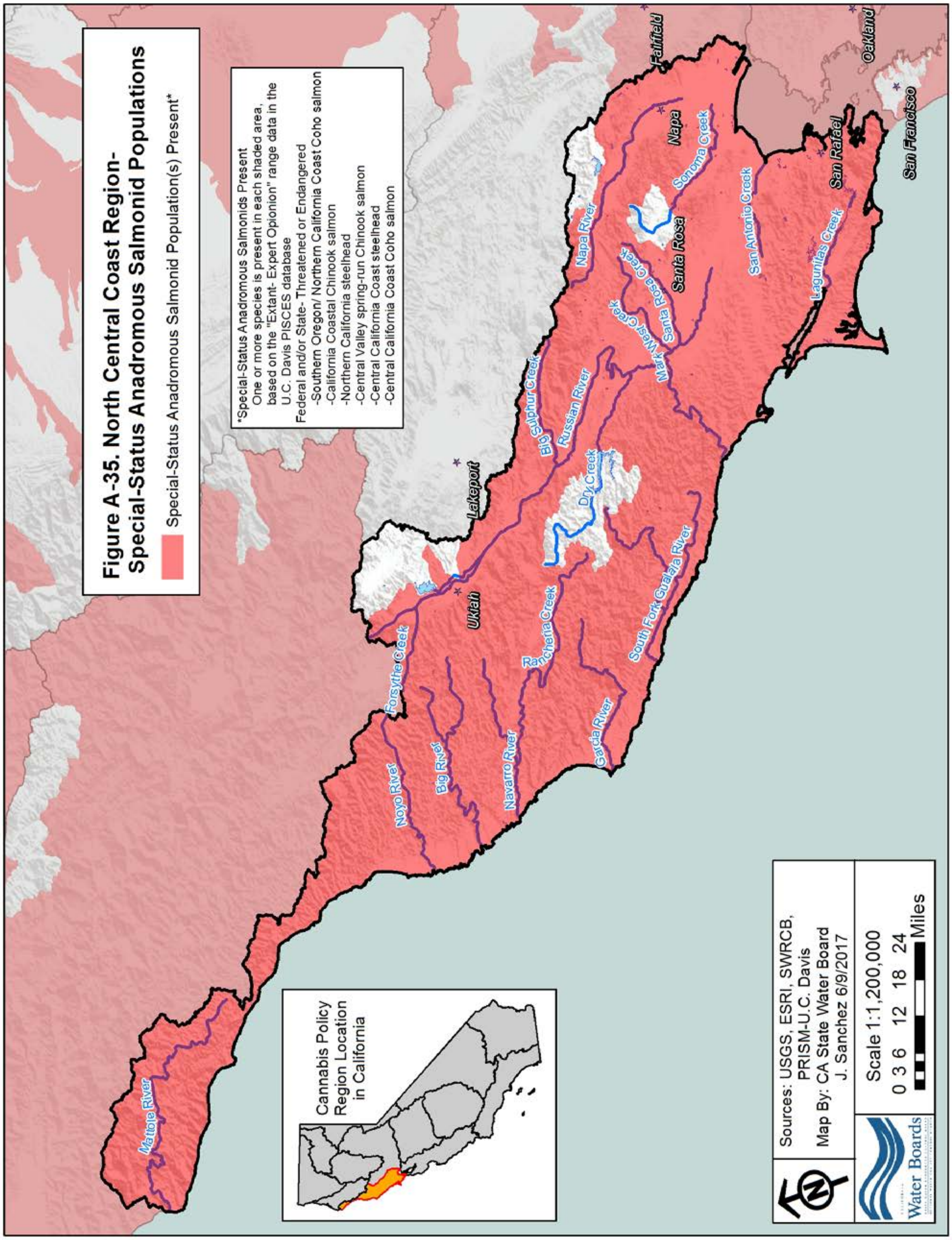


Figure A-35. North Central Coast Region-
Special-Status Anadromous Salmonid Populations
Special-Status Anadromous Salmonid Population(s) Present*
*Special-Status Anadromous Salmonids Present
One or more species is present in each shaded area,
based on the "Extant- Expert Opionion" range data in the
U.C. Davis PISCES database
Federal and/or State- Threatened or Endangered
-Southern Oregon/ Northern California Coast Coho salmon
-California Coastal Chinook salmon
-Northern California steelhead
-Central Valley spring-run Chinook salmon
-Central California Coast steelhead
-Central California Coast Coho salmon
Mattole River
Noyo River
Big River
Navarro River
Garcia River
Forsythe Creek
Rancheria Creek
South Fork Gualala River
Ukiah
Lakeport
Dry Creek
Big Sulphur Creek
Russian River
Mark West Creek
Santa Rosa Creek
Santa Rosa
Napa River
Napa
Sonoma Creek
San Antonio Creek
Lagunitas Creek
San Rafael
San Francisco
Oakland
Fairfield
Cannabis Policy
Region Location
in California
Sources: USGS, ESRI, SWRCB,
PRISM-U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,200,000
0 3 6 12 18 24
Miles
Water Boards

1.7 South Central Coast Region

The South Central Coast Region covers approximately 10,050 square miles along the south-central coast of California, as shown in attached (Figure A-36). The South Central Coast Region is bordered by the Santa Maria River to the south and by San Francisco Bay to the north. Elevations in the South Central Coast Region range from sea level along the coast and near the San Francisco Bay, to 2,000-3,000 feet along the eastern regional boundary in the Coast Ranges; please refer to (Figure A-37) for an elevation map of the South Central Coast Region. The Salinas River is the largest watershed in the South Central Coast Region, and the region also contains numerous San Francisco Bay and Pacific Ocean tributaries.

1.7.1 Climate and Precipitation

The South Central Coast Region is characterized by a Mediterranean climate. The eastern portion of the South Central Coast Region, which is furthest from the Pacific Ocean, is characterized by a Mediterranean climate with hot summers. The central portion of the region is generally characterized by a Mediterranean climate with cooler summers. Coastal areas in the South Central Coast Region are characterized by a Mediterranean climate with summer fog. Please refer to (Figure A-38) for a climatic map of the South Central Coast Region.

Precipitation and temperature patterns tend to vary between coastal and inland areas in the South Central Region. Average annual maximum temperatures in the South Central Coast Region tend to exceed 75 degrees Fahrenheit in inland areas, while coastal areas tend to exhibit slightly cooler average annual maximum temperatures. Average annual minimum temperatures in the South Central Coast Region tend to remain above 40-45 degrees Fahrenheit in both coastal and inland areas. The South Central Coast Region tends to receive an average of over 40 inches of precipitation along the coast, and under 15 inches of precipitation in the inland and southeast portions of the region. Precipitation generally falls from November to April, and peaks in December and January. Snow does not contribute a significant proportion of precipitation to the region. (WRCC 2016)

Please refer to (Figure A-39) for a precipitation map of the South Central Coast Region. Please refer to Chart A-12 below, for a graphic illustration of general South Central Coast Region precipitation and temperature.

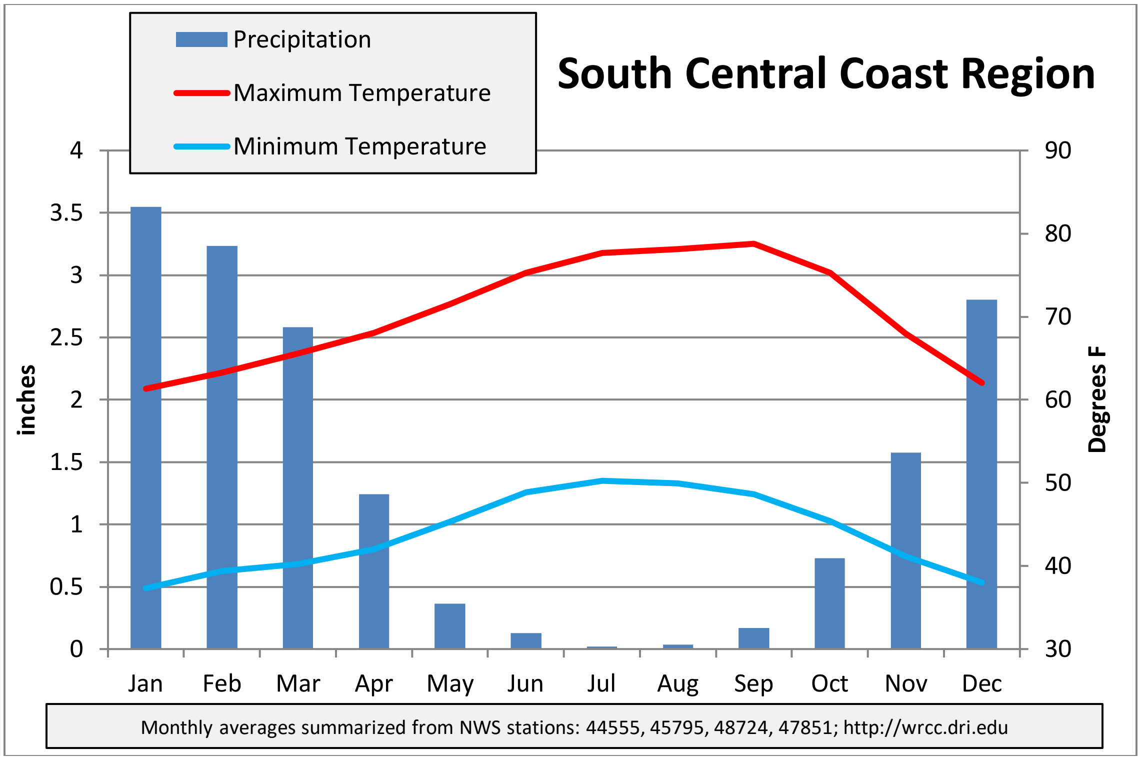


Chart A-12. Average annual patterns of temperature and precipitation in the South Central Coast Region.

1.7.2 Hydrology

The South Central Coast Region contains many streams that are classified as Perennial Groundwater and Rain (PGR) or as Rain and Seasonal Groundwater (RSG) streams under UC Davis' hydrologic classification system. Many coastal streams and tributaries to San Francisco Bay in this region are classified as PGR streams. Many streams in the southeastern portion of the South Central Coast Region and some tributaries to Monterey Bay are classified as RSG stream system. A small number of Winter Storm (WS) stream and Flashy, Ephemeral Rain streams are found in the South Central Coast Region. (Lane et al 2016)

Please refer to (Figure A-40) for a stream classification map of the South Central Coast Region.

1.7.3 Geology

The South Central Coast Region is located in the Coast Ranges geomorphic province, and is dissected by the San Andreas Fault system. The San Andreas Fault system runs through the South Central Coast Region, from the northwestern edge to the southeastern portion of the region. The San Andreas Fault is generally located in the mountain range between the Salinas and San Benito River valleys. The San Andreas Fault system separates oceanic crust from continental crust, and regional geology differs on the two sides of the San Andreas Fault. Granitic outcrops, marine sedimentary, and metamorphosed sedimentary rock underlay the South Central Coast Region west of the San Andreas Fault, whereas marine sedimentary rock underlays the South Central Coast Region east of the San Andreas Fault. Alluvial deposits are characteristic of the valleys throughout the South Central Coast Region. (CGS, 2002)

1.7.4 Anadromous Salmonid Population

Three special-status ESUs, DPSes, or DTEs are currently extant within the South Central Coast Region (Figure A-41):

- the CCC steelhead DPS,
- the South-Central California Coast (SCCC) steelhead DPS, and
- the CCC coho salmon ESU.

The CCC coho salmon ESU is currently listed as endangered under the ESA and the CESA (CDFW 2017b). The CCC and SCCC steelhead DPSes are currently listed as threatened under the ESA (CDFW 2017b).

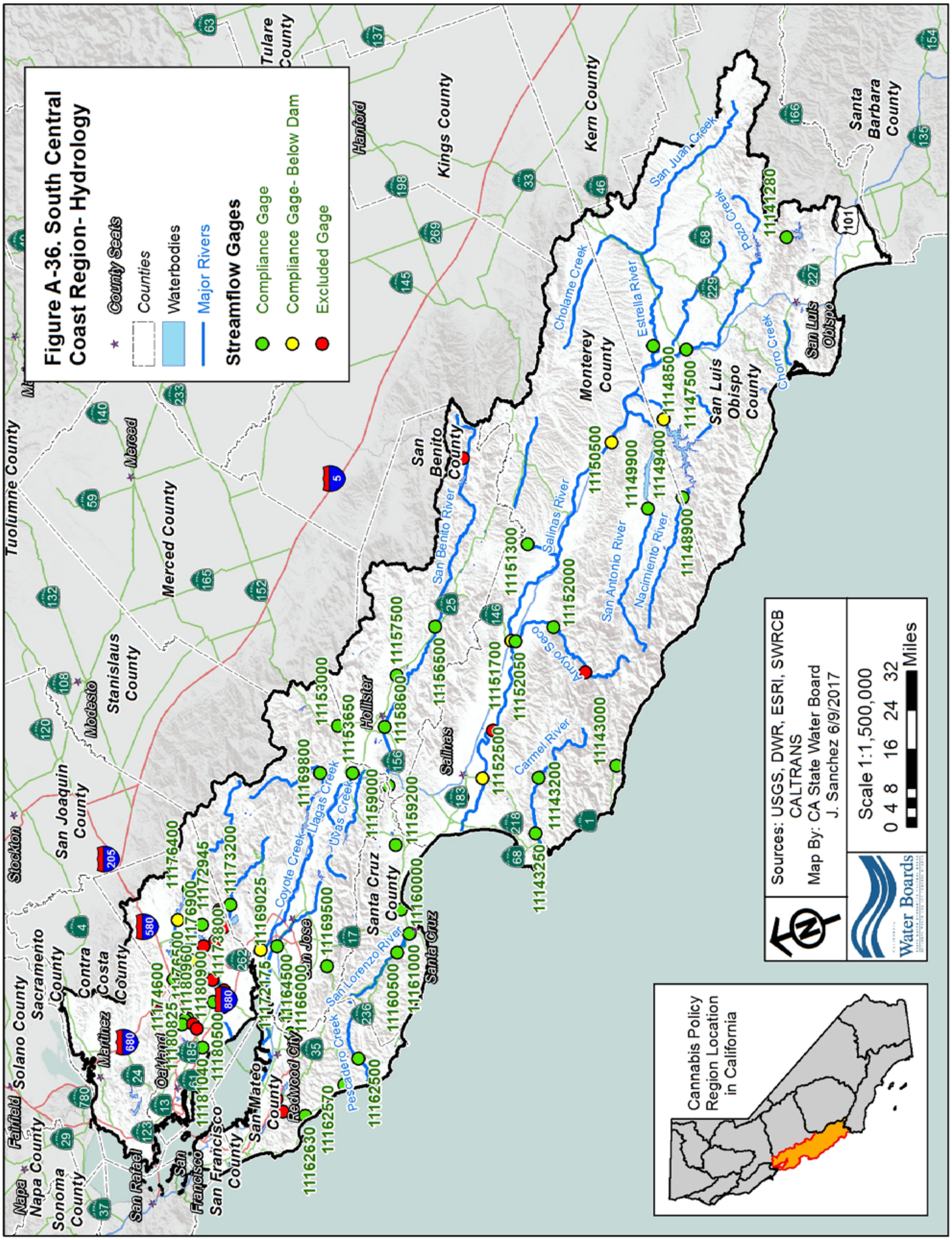


Figure A-36. South Central Coast Region- Hydrology
County Seats
Counties
Waterbodies
Major Rivers
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,500,000
0 4 8 16 24 32 Miles
Water Boards
Cannabis Policy Region Location in California
Tuolumne County
Stanislaus County
San Joaquin County
Merced County
Kings County
Kern County
Tulare County
Santa Barbara County
San Luis Obispo County
Monterey County
San Benito County
Santa Cruz County
San Mateo County
San Francisco County
Contra Costa County
Sacramento County
Solano County
Napa County
Sonoma County
Stockton
Modesto
Merced
Hanford
Salinas
Hollister
San Jose
Santa Cruz
Redwood City
Oakland
Martinez
San Francisco
San Rafael
Fairfield
Napa
San Luis Obispo
San Juan Creek
Pozo Creek
Estrella River
Cholame Creek
Chorro Creek
Salinas River
San Antonio River
Nacimiento River
San Benito River
Arroyo Seco
Carmel River
Uvas Creek
Llagas Creek
Coyote Creek
San Lorenzo River
Pescadero Creek
11141280
11147500
11148500
11149400
11149900
11148900
11150500
11151300
11152000
11151700
11152050
11152500
11143000
11143200
11143250
11156500
11157500
11158600
11153000
11153650
11159000
11159200
11160000
11160500
11161000
11169800
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11169025
11173200
11172945
11176400
11174600
11162500
11162570
11162630

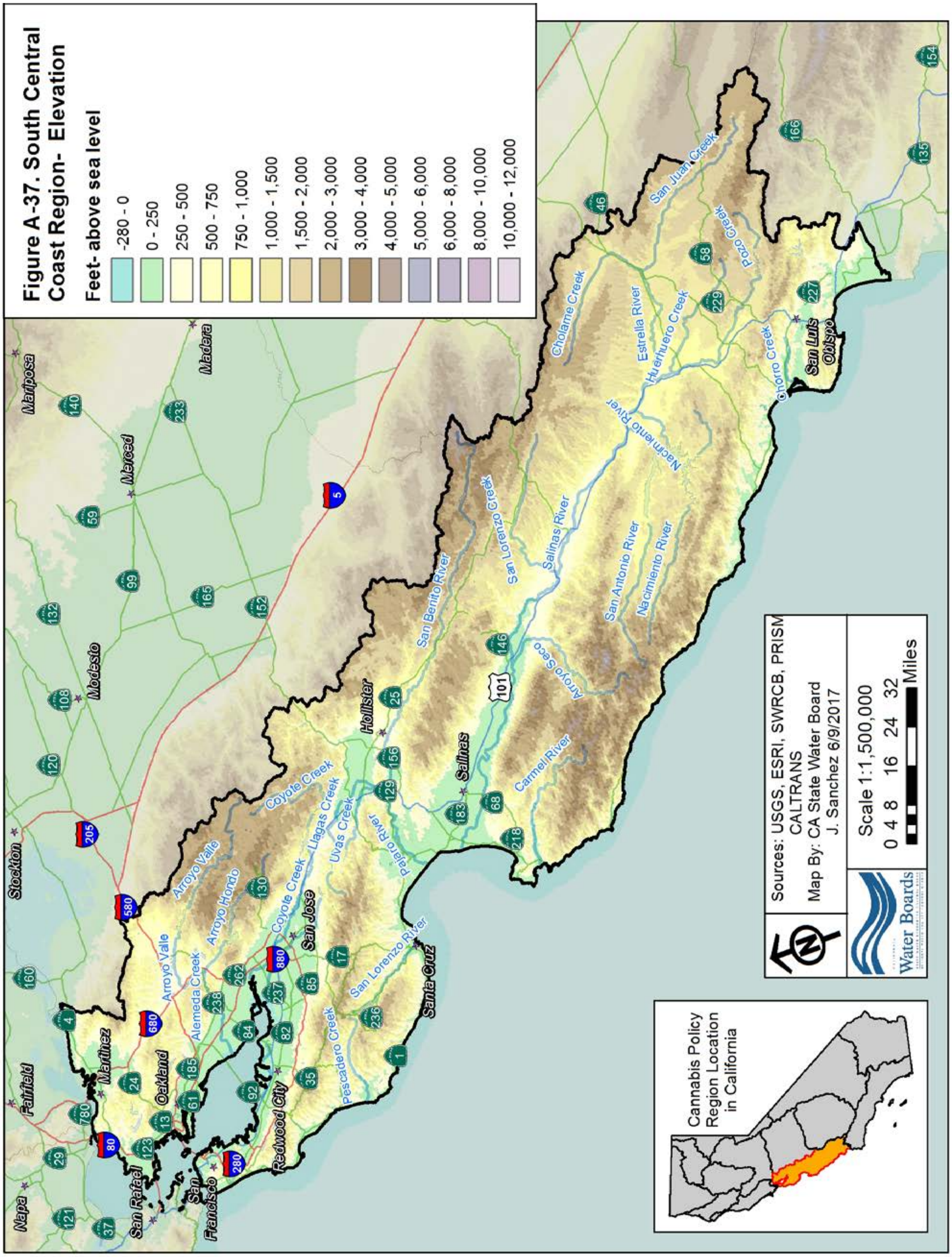
Figure A-37. South Central Coast Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
10,000 - 12,000
Sources: USGS, ESRI, SWRCB, PRISM CALTRANS
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,500,000
0 4 8 16 24 32 Miles
Water Boards
Cannabis Policy Region Location in California
Napa
Fairfield
Martinez
Oakland
San Rafael
San Francisco
Redwood City
San Jose
Santa Cruz
Stockton
Modesto
Merced
Mariposa
Madera
Hollister
Salinas
San Luis Obispo
Coyote Creek
Llagas Creek
Uvas Creek
Arroyo Valle
Arroyo Hondo
Alemeda Creek
Pescadero Creek
San Lorenzo River
Pajaro River
Carmel River
Arroyo Seco
San Benito River
San Lorenzo Creek
Salinas River
San Antonio River
Nacimiento River
Cholame Creek
Estrella River
Huerhuero Creek
San Juan Creek
Pozo Creek
Chorro Creek

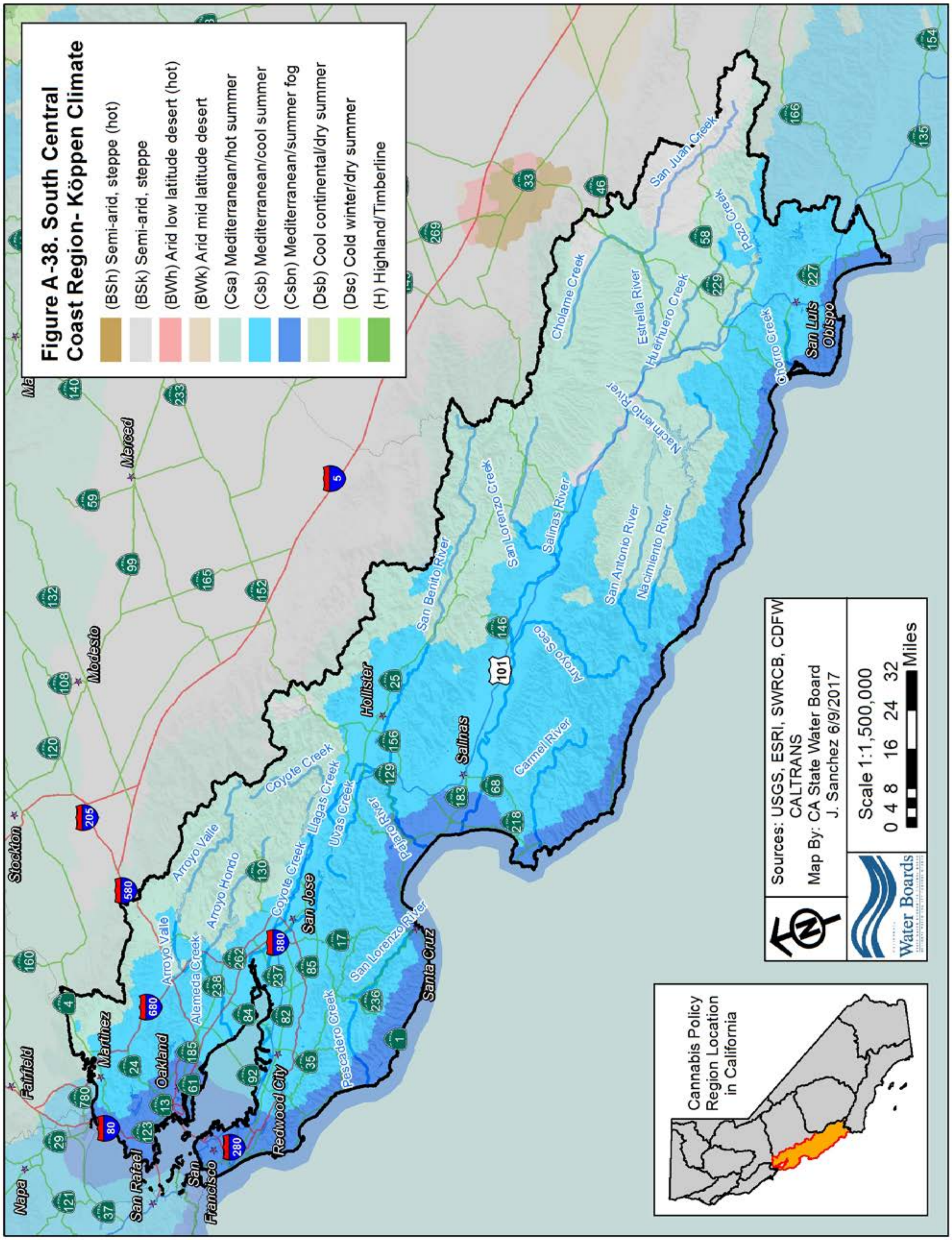

Figure A-38. South Central Coast Region- Köppen Climate

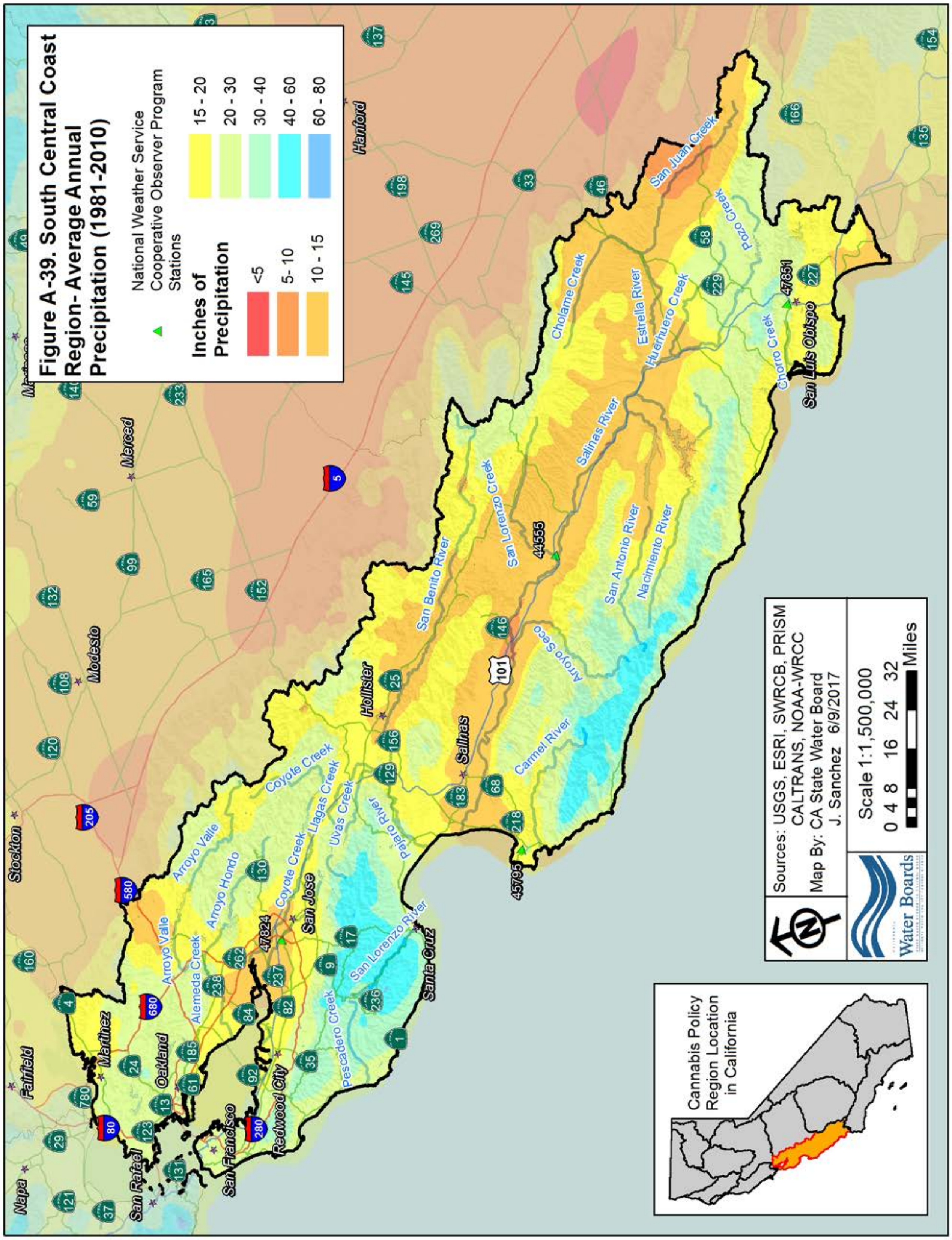
Figure A-39. South Central Coast Region- Average Annual Precipitation (1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
<5
5-10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
Sources: USGS, ESRI, SWRCB, PRISM CALTRANS, NOAA-WRCC
Map By: CA State Water Board J. Sanchez 6/9/2017
Scale 1:1,500,000
0 4 8 16 24 32 Miles
Cannabis Policy Region Location in California
Napa
Fairfield
Martinez
Stockton
Modesto
Merced
Hanford
San Rafael
Oakland
San Francisco
Redwood City
San Jose
Santa Cruz
Hollister
Salinas
San Luis Obispo
Coyote Creek
Llagas Creek
Uvas Creek
Pajaro River
Arroyo Valle
Arroyo Hondo
Alameda Creek
Pescadero Creek
San Lorenzo River
San Benito River
San Lorenzo Creek
Carmel River
Arroyo Seco
Salinas River
San Antonio River
Nacimiento River
Cholame Creek
Estrella River
Huerhuero Creek
Pozo Creek
Chorro Creek
San Juan Creek
47824
45795
44555
47851

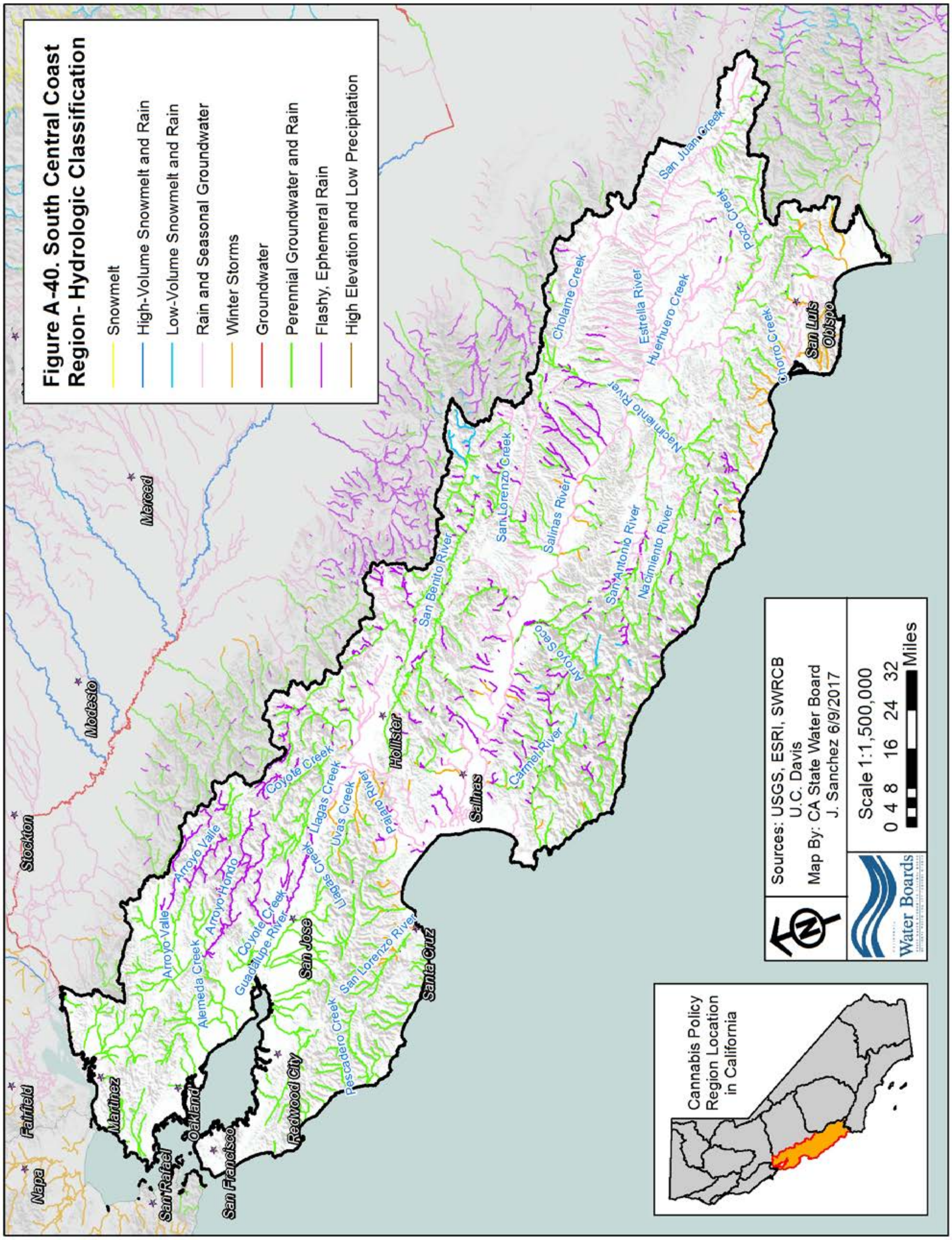
Figure A-40. South Central Coast Region- Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
High Elevation and Low Precipitation
Sources: USGS, ESRI, SWRCB
U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,500,000
0 4 8 16 24 32
Miles
Water Boards
Cannabis Policy
Region Location
in California
Napa
Fairfield
Stockton
Modesto
Merced
San Rafael
San Francisco
Oakland
Martinez
Redwood City
San Jose
Santa Cruz
Hollister
Salinas
San Luis Obispo
Arroyo Valle
Alemeda Creek
Arroyo Hondo
Coyote Creek
Guadalupe River
Llagas Creek
Uvas Creek
Pajaro River
Pescadero Creek
San Lorenzo River
Carmel River
Arroyo Seco
San Benito River
San Antonio River
Nacimiento River
Salinas River
San Lorenzo Creek
Cholame Creek
Estrella River
Huerhuero Creek
Chorro Creek
Pozo Creek
San Juan Creek

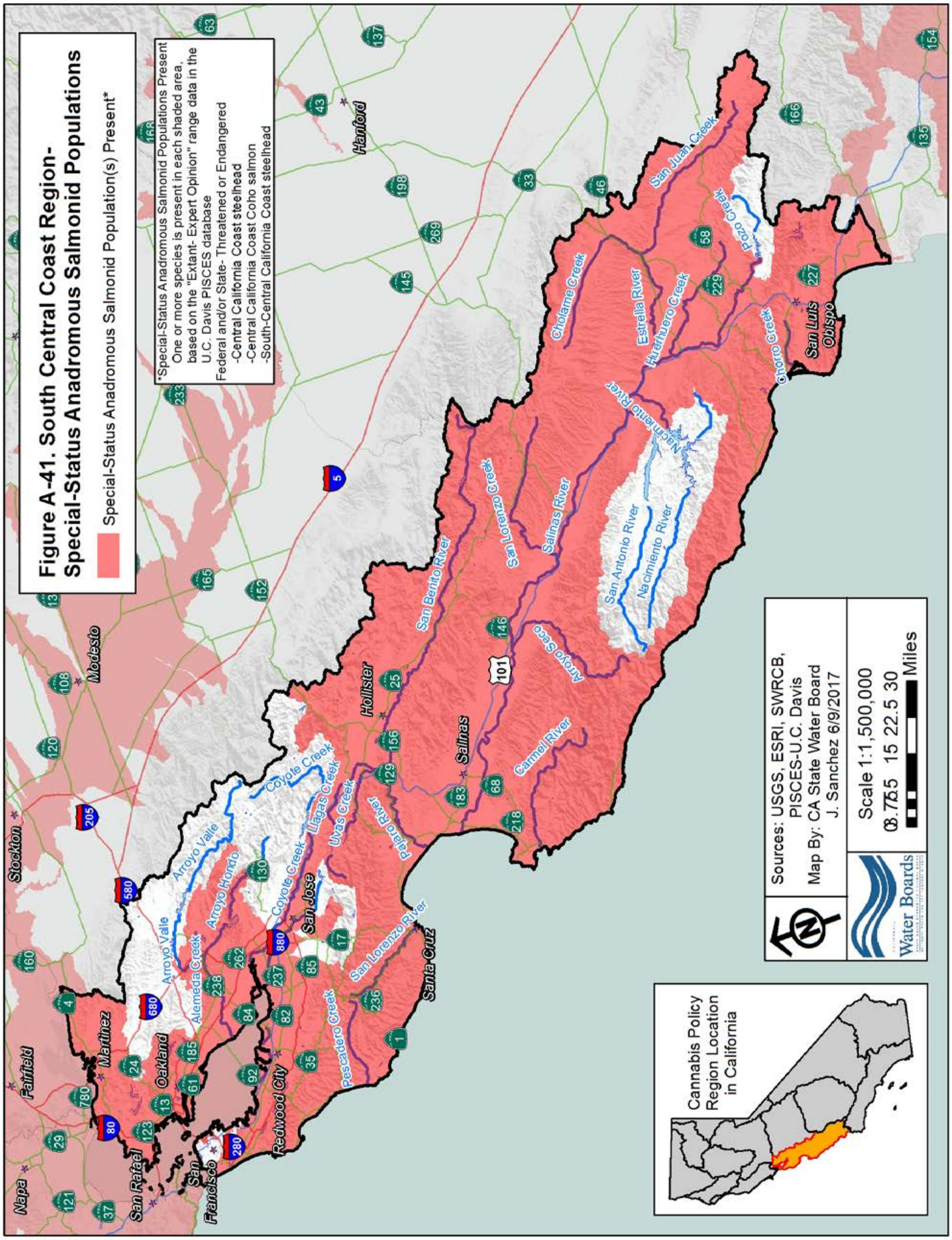
Figure A-41. South Central Coast Region-
Special-Status Anadromous Salmonid Populations
Special-Status Anadromous Salmonid Population(s) Present*
*Special-Status Anadromous Salmonid Populations Present
One or more species is present in each shaded area, based on the "Extant- Expert Opinion" range data in the U.C. Davis PISCES database
Federal and/or State- Threatened or Endangered
-Central California Coast steelhead
-Central California Coast Coho salmon
-South-Central California Coast steelhead
Sources: USGS, ESRI, SWRCB, PISCES-U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,500,000
0 3.75 7.5 15 22.5 30 Miles
Water Boards
Cannabis Policy Region Location in California
Napa
Fairfield
San Rafael
Martinez
Oakland
San Francisco
Redwood City
San Jose
Santa Cruz
Stockton
Modesto
Hollister
Salinas
Hanford
San Luis Obispo
Arroyo Valle
Alameda Creek
Arroyo Hondo
Coyote Creek
Llagas Creek
Uvas Creek
Pajaro River
San Lorenzo River
Pescadero Creek
Carmel River
San Benito River
San Lorenzo Creek
Salinas River
Arroyo Seco
San Antonio River
Nacimiento River
Cholame Creek
Estrella River
Huerhuero Creek
Chorro Creek
Pozo Creek
San Juan Creek

1.8 San Joaquin Region

The San Joaquin Region covers approximately 13,609 square miles in central California, as shown in attached (Figure A-42). Elevations in this region range from below sea level in the Sacramento-San Joaquin River Delta, to over 9,000 feet at the crest of the Sierra Nevada mountains at the northern end of the region, and to over 12,000 feet at the crest of the Sierra Nevada mountains at the southern end of the region (Figure A-43). The region includes the San Joaquin River watershed, including the San Joaquin River and its major tributaries: the Calaveras River, Stanislaus River, Tuolumne River, and Merced River.

1.8.1 Climate and Precipitation

The climate of the San Joaquin Region varies by elevation. The southwestern valley floor portion of the San Joaquin Region exhibits a Steppe (semi-arid, steppe) climate. Much of the center of the San Joaquin Region is characterized by a Mediterranean climate with hot summers. The northeastern margin of the San Joaquin Region is characterized by a Mediterranean climate with cool summers at lower elevations, by a cool continental climate with dry summers at mid- elevations, by cold winters and dry summers at the norther Sierra Nevada crest, and by a Highland/Timberline climate along the southern Sierra Nevada crest. Please refer to Figure A-44 for a climatic map of the San Joaquin Region.

In general, the Central Valley portion of the San Joaquin Region tends to exhibit higher average annual maximum and average annual minimum temperatures compared to the Sierra Nevada mountain portion of the region. Average annual maximum temperatures in the San Joaquin Region exceed 70-75 degrees Fahrenheit on the valley floor, 60 degrees Fahrenheit at mid-elevations in the Sierra Nevada, and 35-40 degrees Fahrenheit at high elevations in the Sierra Nevada. Average annual minimum temperatures in the San Joaquin Region remain above 45 degrees Fahrenheit throughout the Central Valley and Sierra Nevada foothills, and are well below freezing at many high-elevation locations in the Sierra Nevada mountains.

Precipitation patterns vary spatially within the San Joaquin Region, and higher amounts of precipitation tend to fall at the northern end of the region and at higher elevations. In the San Joaquin Region, 15-20 inches of rain typically falls in the northern portion of the Central Valley, and 10 inches or less typically falls in the southern portion of the Central Valley. Precipitation typically exceeds 80 inches along the Sierra Nevada crest, in the eastern portion of the San Joaquin Region. Significant amounts of precipitation tend to fall as snow in the Sierra Nevada mountains, and snowfall depths exceed 200 inches annually in many high-elevation areas. In the San Joaquin Region, precipitation generally lasts from November to April. (WRCC 2016)

Please refer to Figure A-45 for a precipitation map of the San Joaquin Region. Please refer to Charts A-13 and A-14, below, for a comparison of precipitation and temperature conditions for the valley floor and Sierra Nevada crest portions of the San Joaquin Region.

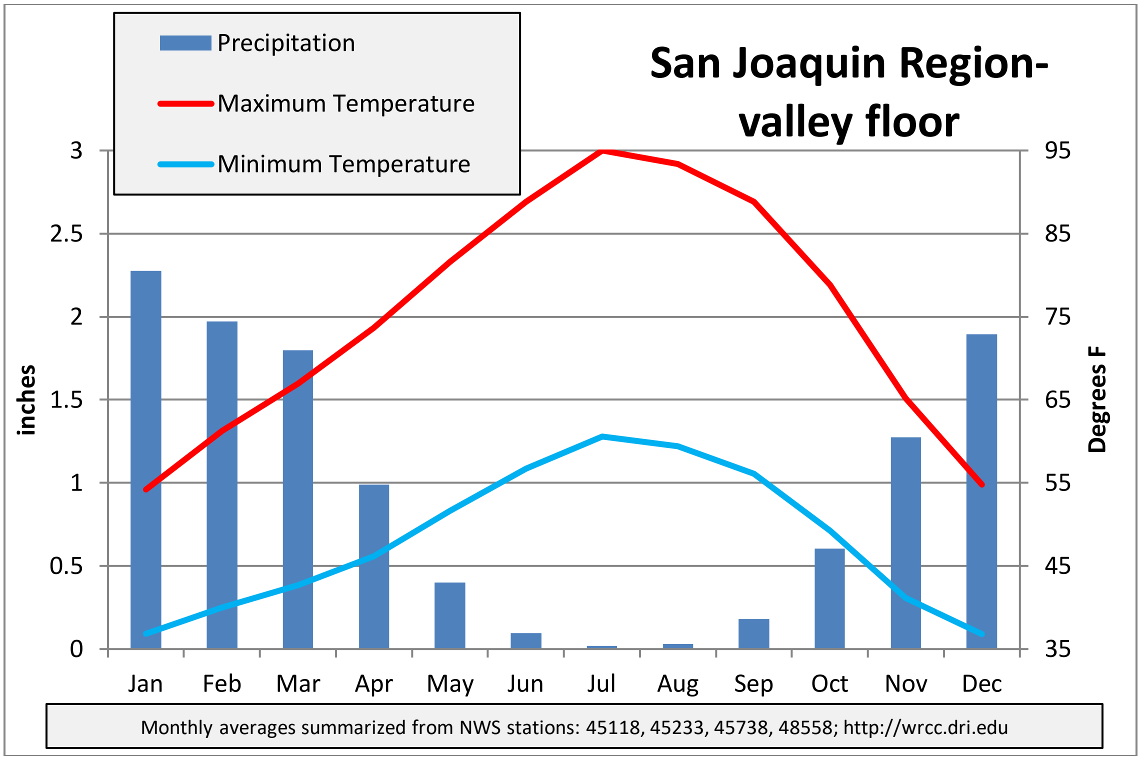

Chart A-13. Average annual patterns of temperature and precipitation, San Joaquin Region, valley floor.

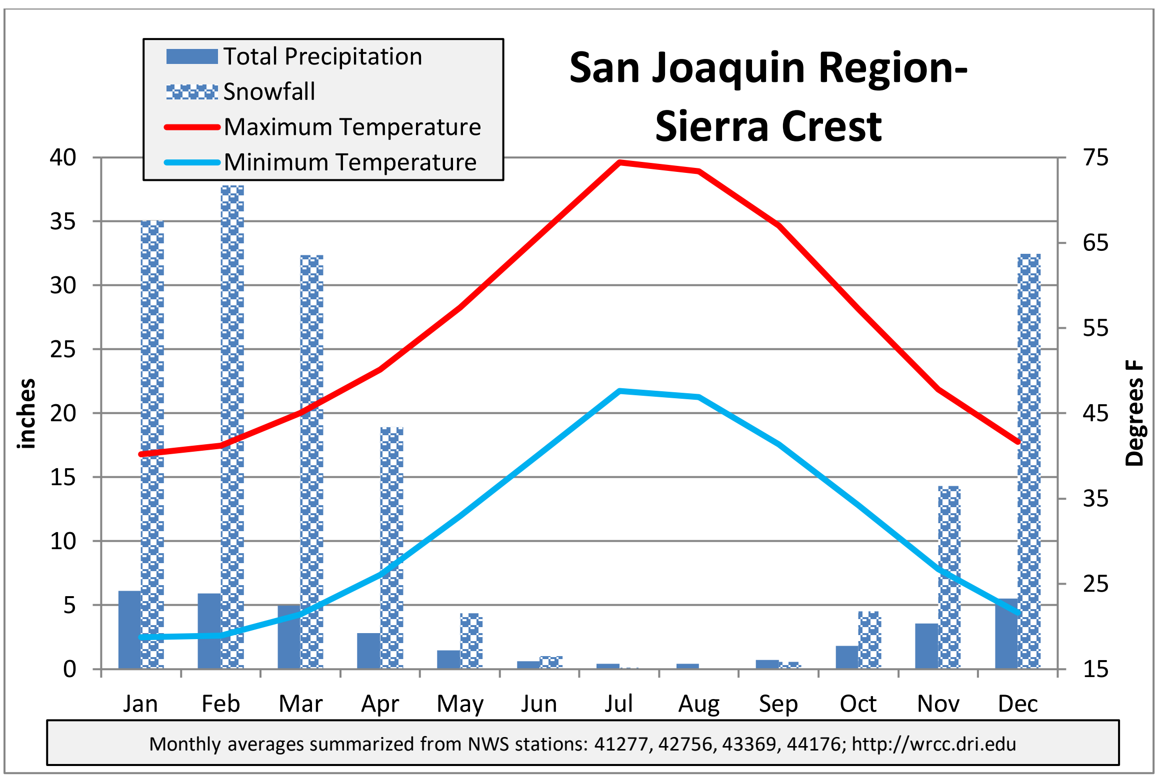

Chart A-14. Average annual patterns of temperature and precipitation, San Joaquin Region, Sierra Crest.

1.8.2 Hydrology

Stream reaches in the San Joaquin Region are generally classified under UC Davis' hydrologic classification system as Rain and Seasonal Groundwater (RSG), Low-Volume Snowmelt and Rain (LSR), and Snowmelt (SM) systems. The western and central portion of the region contains primarily RSG stream reaches. Mid-elevation areas in the Sierra Nevada mountains contain primarily LSR stream reaches. At high elevations in the Sierra Nevada mountains, many stream reaches are classified as SM systems.

Other streams in the San Joaquin Region are classified by Perennial Groundwater and Rain (PGR), Groundwater (GW), High-Volume Snowmelt and Rain (HSR), or the Flashy, Ephemeral Rain (FER) hydrologic classifications. For example, portions of the mainstem San Joaquin River and its major tributaries are classified as High-Volume Snowmelt and Rain (HSR) systems. The lower San Joaquin River is classified by a GW hydrologic regime. (Lane et al 2016)

Please refer to Figure A-46 for a depiction of the stream classifications within the San Joaquin Region.

1.8.3 Geology

The San Joaquin Region is underlain by the Coast Ranges on the western margin of the region, the Great Valley geomorphic provinces in the center of the region, and the Sierra Nevada geomorphic province in the eastern half of the region. The Coast Ranges geomorphic province is comprised of sedimentary and metamorphic rock and alluvial deposits in valleys and along the coastline. The Great Valley geomorphic province, which consists of a large alluvial plain, underlays the Central Valley. The Sierra Nevada geomorphic province, located in the eastern portion of this region, contains steep mountains underlain by a granitic batholith. Metamorphic rocks comprise the foothill region of the Sierra Nevada geomorphic province. (CGS, 2002)

1.8.4 Anadromous Salmonid Population

Three special-status ESUs, DPSes, or DTEs are currently extant within the San Joaquin Region (Figure A-47):

- the CV FR Chinook salmon DTE,
- the CV LFR Chinook salmon DTE, and
- the CCV steelhead DPS.

The CCV steelhead DPS is currently listed as threatened under the ESA (CDFW 2017b). The CV FR and CV LFR Chinook salmon populations are each listed as species of special concern by CDFW and, jointly, as a species of concern by NMFS (Moyle et al. 2015, NMFS 2017).

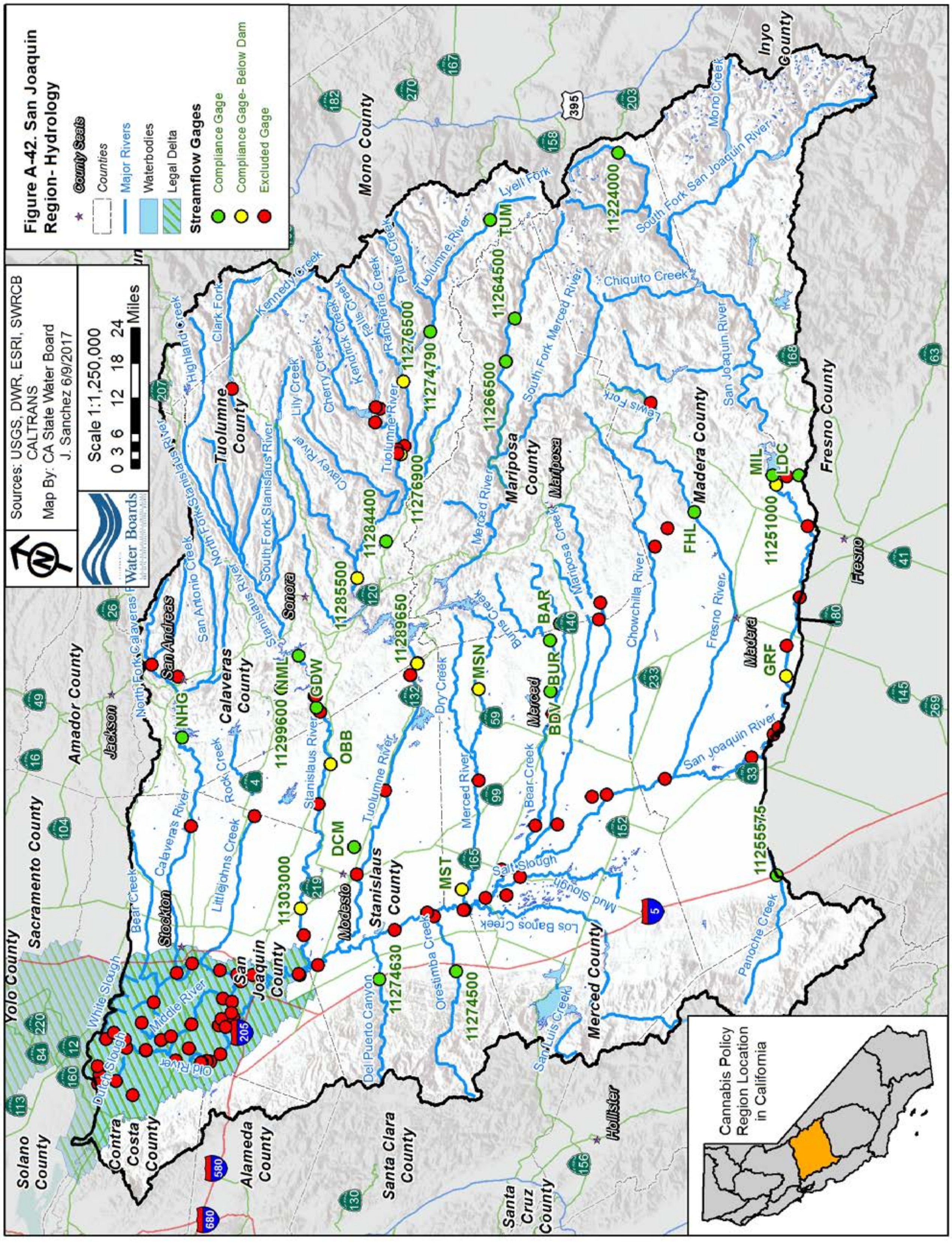

Figure A-42. San Joaquin Region- Hydrology
County Seats
Counties
Major Rivers
Waterbodies
Legal Delta
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,250,000
0 3 6 12 18 24 Miles
Water Boards
Cannabis Policy Region Location in California
Sacramento County
Amador County
Calaveras County
Tuolumne County
Mono County
Mariposa County
Madera County
Fresno County
Inyo County
Merced County
Stanislaus County
San Joaquin County
Contra Costa County
Alameda County
Santa Clara County
Santa Cruz County
Solano County
Yolo County
Stockton
Modesto
Sonora
San Andreas
Jackson
Merced
Mariposa
Madera
Fresno
Hollister
11303000
11274630
11274500
11299600
11285500
11284400
11289650
11276900
11276500
11274790
11266500
11264500
11224000
11251000
11255575
NHG
NML
GDW
OBB
DCM
MST
MSN
BDV
BUR
BAR
TUM
FHL
MIL
LDC
GRF

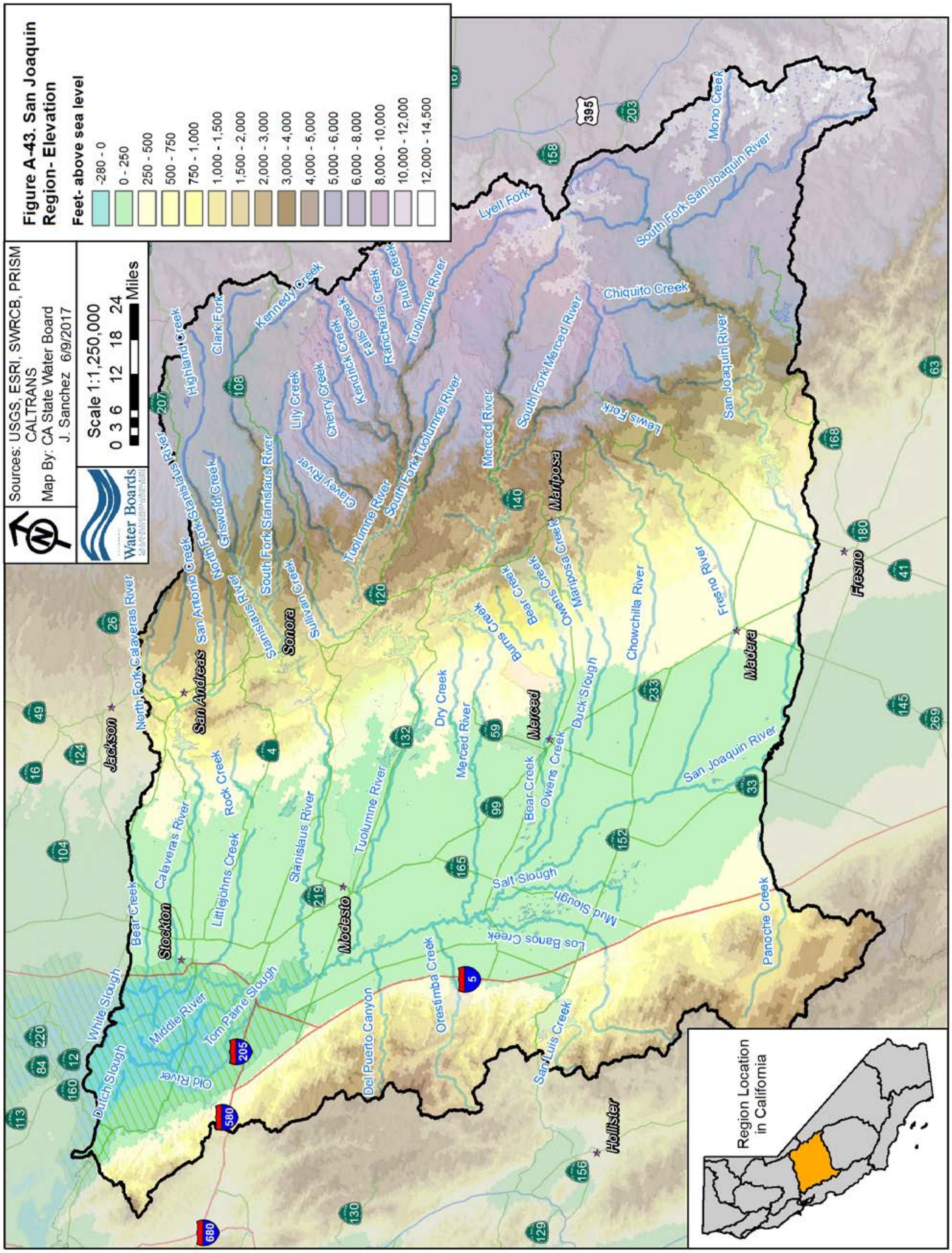
Figure A-43. San Joaquin Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
10,000 - 12,000
12,000 - 14,500
Sources: USGS, ESRI, SWRCB, PRISM
CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Water Boards
Scale 1:1,250,000
0 3 6 12 18 24
Miles
Region Location
in California
Stockton
Modesto
Merced
Madera
Fresno
Sonora
San Andreas
Jackson
Mariposa
Hollister
San Joaquin River
Stanislaus River
Tuolumne River
Merced River
Calaveras River
Chowchilla River
Fresno River
Mokelumne River
Old River
Middle River
Tom Paine Slough
Dutch Slough
White Slough
Bear Creek
Littlejohns Creek
Rock Creek
Dry Creek
Salt Slough
Mud Slough
Los Banos Creek
Orestimba Creek
Del Puerto Canyon
San Luis Creek
Panoche Creek
Duck Slough
Owens Creek
Mariposa Creek
Burns Creek
Chiquito Creek
South Fork San Joaquin River
Mono Creek
Lyell Fork
South Fork Merced River
Lewis Fork
Clavey River
Cherry Creek
Lily Creek
Kennedy Creek
Clark Fork
Highland Creek
Griswold Creek
North Fork Stanislaus River
South Fork Stanislaus River
South Fork Tuolumne River
North Fork Tuolumne River
Sullivan Creek
San Antonio Creek
North Fork Calaveras River
Kendrick Creek
Falls Creek
Rancheria Creek
Piute Creek

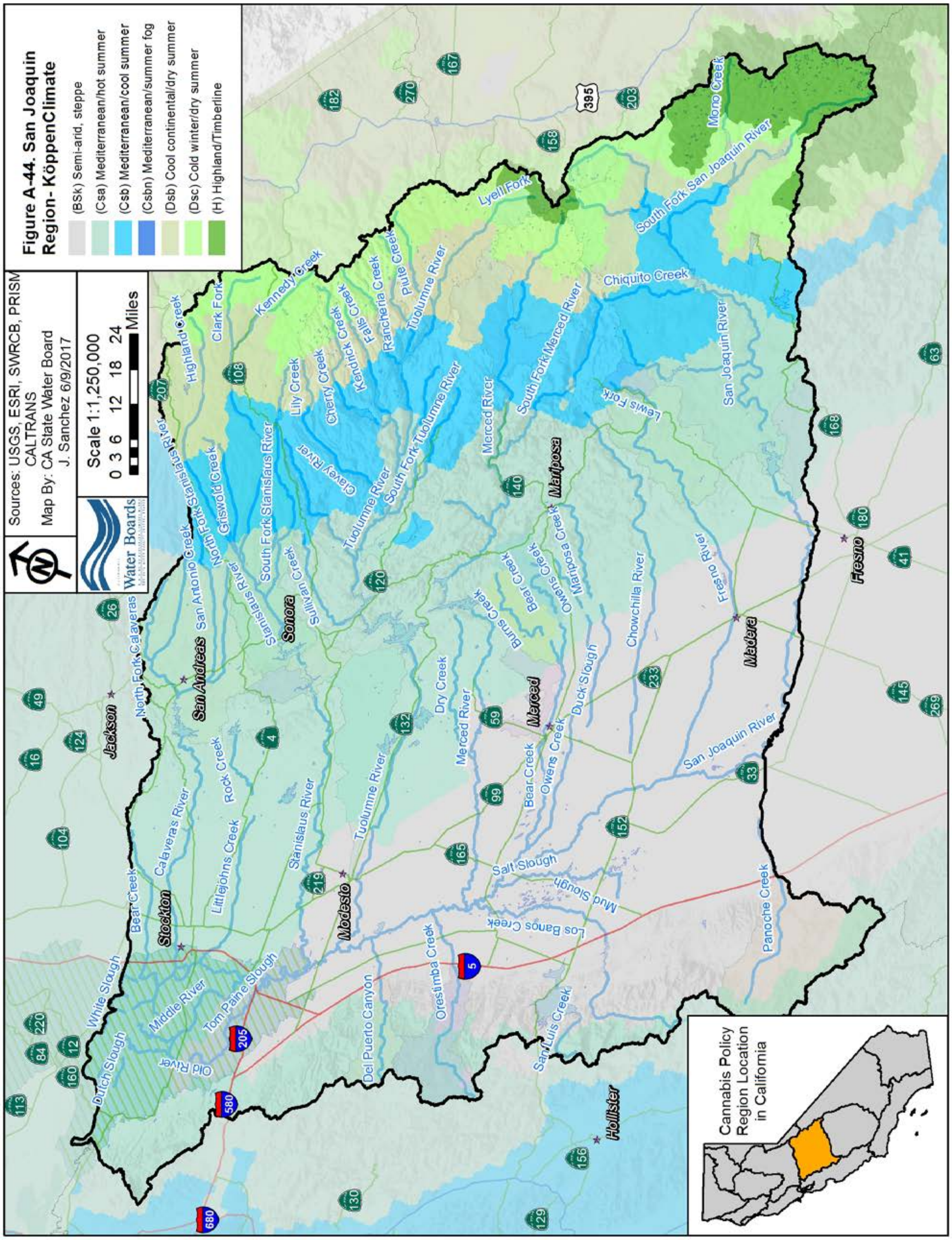
Figure A-44. San Joaquin Region- KöppenClimate
(BSk) Semi-arid, steppe
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Csbn) Mediterranean/summer fog
(Dsb) Cool continental/dry summer
(Dsc) Cold winter/dry summer
(H) Highland/Timberline
Sources: USGS, ESRI, SWRCB, PRISM
CALTRANS
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,250,000
0 3 6 12 18 24
Miles
Water Boards
Cannabis Policy
Region Location
in California
Stockton
Modesto
Merced
Madera
Fresno
Sonora
Mariposa
San Andreas
Jackson
Hollister
San Joaquin River
Tuolumne River
Merced River
Stanislaus River
Calaveras River
Chowchilla River
Fresno River
Mono Creek
Lyell Fork
Chiquito Creek
South Fork San Joaquin River

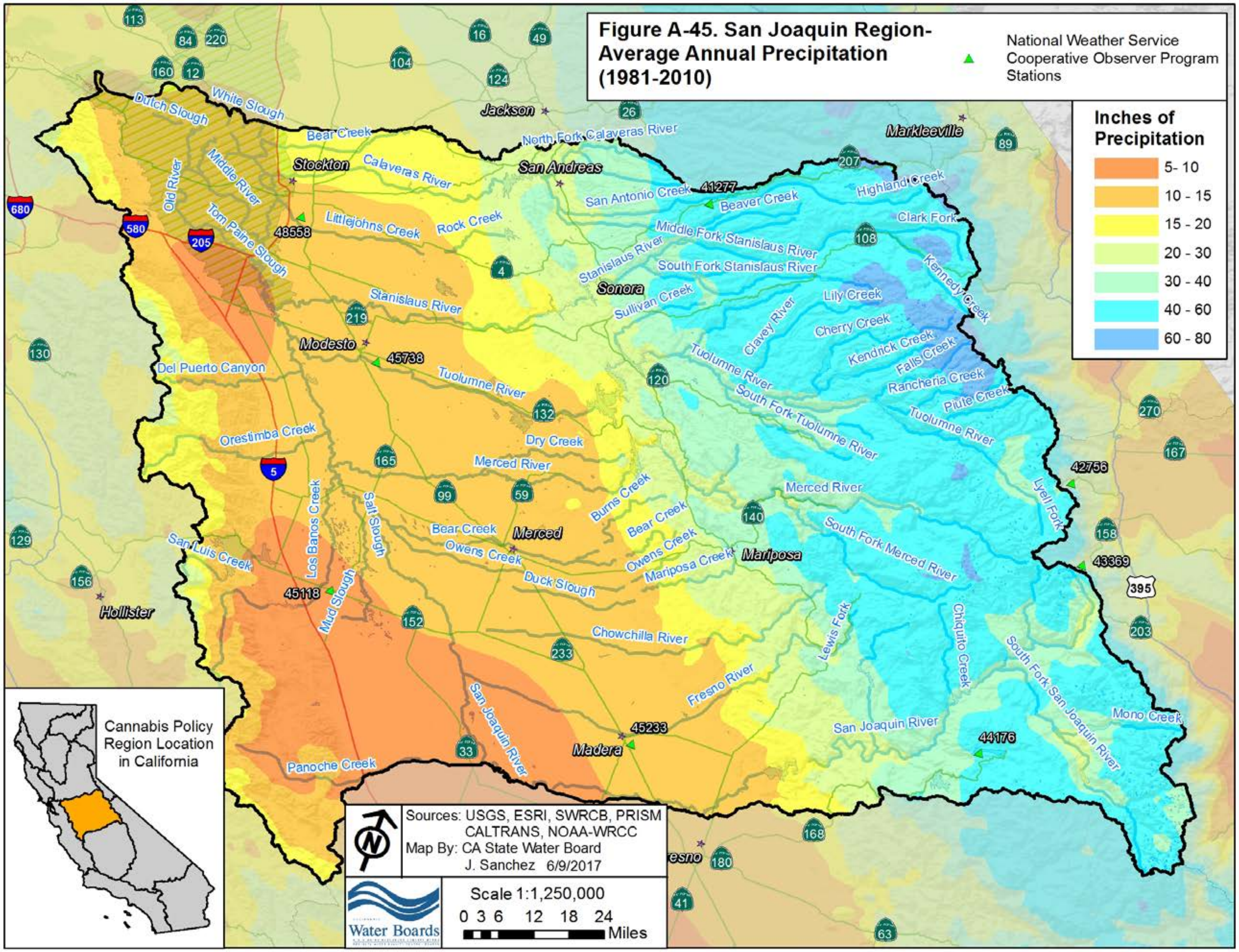

Figure A-45. San Joaquin Region-
Average Annual Precipitation
(1981-2010)
National Weather Service
Cooperative Observer Program
Stations
Inches of
Precipitation
5- 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
Cannabis Policy
Region Location
in California
Sources: USGS, ESRI, SWRCB, PRISM
CALTRANS, NOAA-WRCC
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,250,000
0 3 6 12 18 24
Miles
Water Boards
Stockton
San Andreas
Jackson
Markleeville
Sonora
Modesto
Merced
Mariposa
Madera
Hollister
Dutch Slough
White Slough
Bear Creek
Old River
Middle River
Tom Paine Slough
Calaveras River
North Fork Calaveras River
Littlejohns Creek
Rock Creek
San Antonio Creek
Beaver Creek
Highland Creek
Clark Fork
Middle Fork Stanislaus River
South Fork Stanislaus River
Stanislaus River
Sullivan Creek
Kennedy Creek
Lily Creek
Cherry Creek
Clavey River
Kendrick Creek
Falls Creek
Rancheria Creek
Piute Creek
Tuolumne River
South Fork Tuolumne River
Del Puerto Canyon
Orestimba Creek
Dry Creek
Merced River
Burns Creek
Bear Creek
Owens Creek
Mariposa Creek
Duck Slough
Los Banos Creek
Salt Slough
San Luis Creek
Mud Slough
Chowchilla River
Fresno River
Lewis Fork
Chiquito Creek
South Fork Merced River
Lyell Fork
South Fork San Joaquin River
Mono Creek
San Joaquin River
Panoche Creek
41277
48558
45738
45118
45233
44176
42756
43369

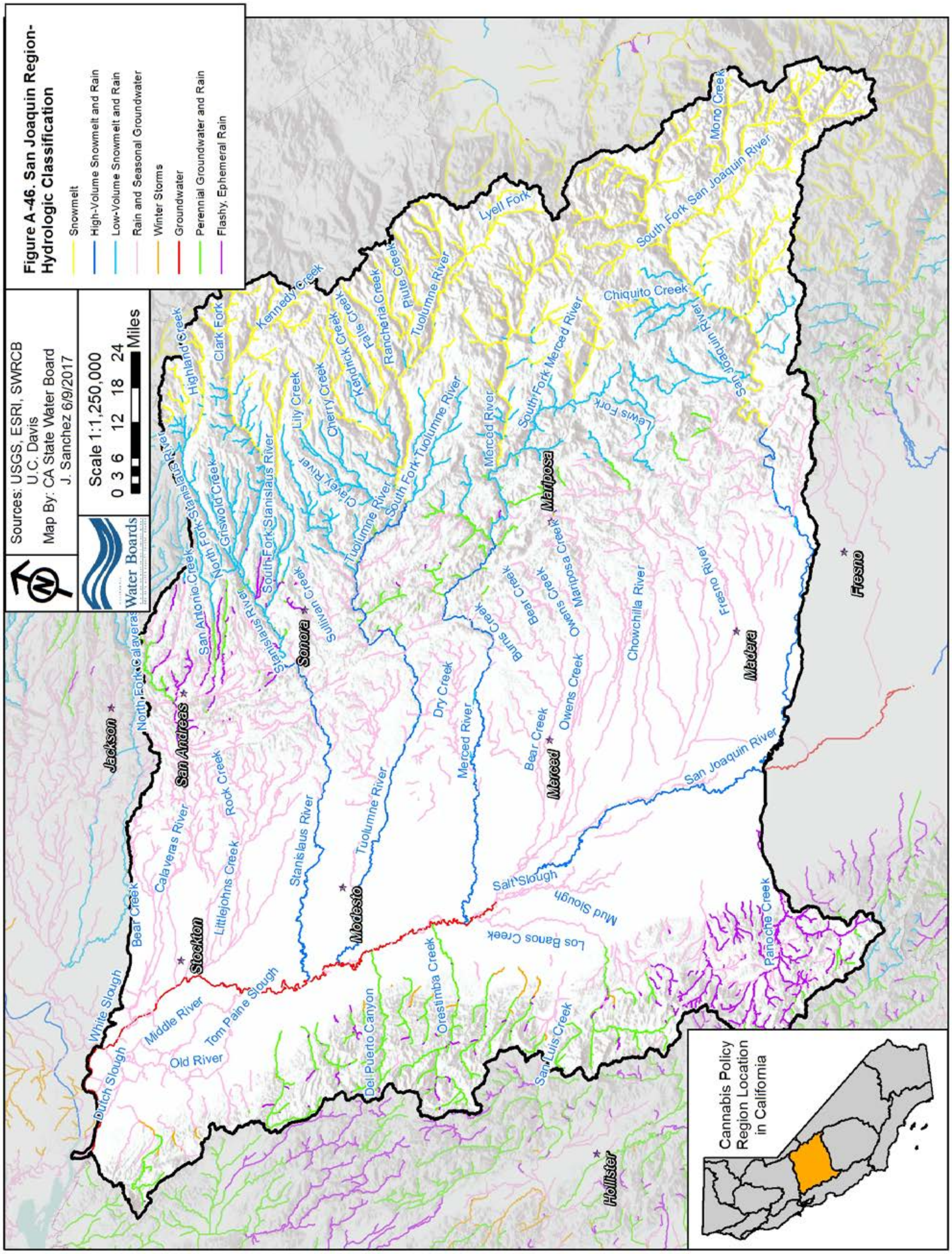
Figure A-46. San Joaquin Region-Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
Sources: USGS, ESRI, SWRCB
U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,250,000
0 3 6 12 18 24
Miles
Water Boards
Cannabis Policy
Region Location
in California
Jackson
San Andreas
Stockton
Modesto
Sonora
Mariposa
Merced
Madera
Fresno
Hollister
North Fork Calaveras
Calaveras River
Bear Creek
White Slough
Dutch Slough
Middle River
Old River
Tom Paine Slough
Littlejohns Creek
Rock Creek
Stanislaus River
Tuolumne River
Dry Creek
Merced River
Salt Slough
Mud Slough
Los Banos Creek
Orestimba Creek
Del Puerto Canyon
San Luis Creek
Panoche Creek
San Joaquin River
Owens Creek
Bear Creek
Burns Creek
Mariposa Creek
Chowchilla River
Fresno River
Lewis Fork
South Fork Merced River
South Fork Tuolumne River
Clavey River
Lily Creek
Cherry Creek
Kendrick Creek
Falls Creek
Rancheria Creek
Piute Creek
Kennedy Creek
Clark Fork
Highland Creek
North Fork Stanislaus River
Griswold Creek
North Fork
San Antonio Creek
South Fork Stanislaus River
Sullivan Creek
Lyell Fork
Chiquito Creek
South Fork San Joaquin River
Mono Creek

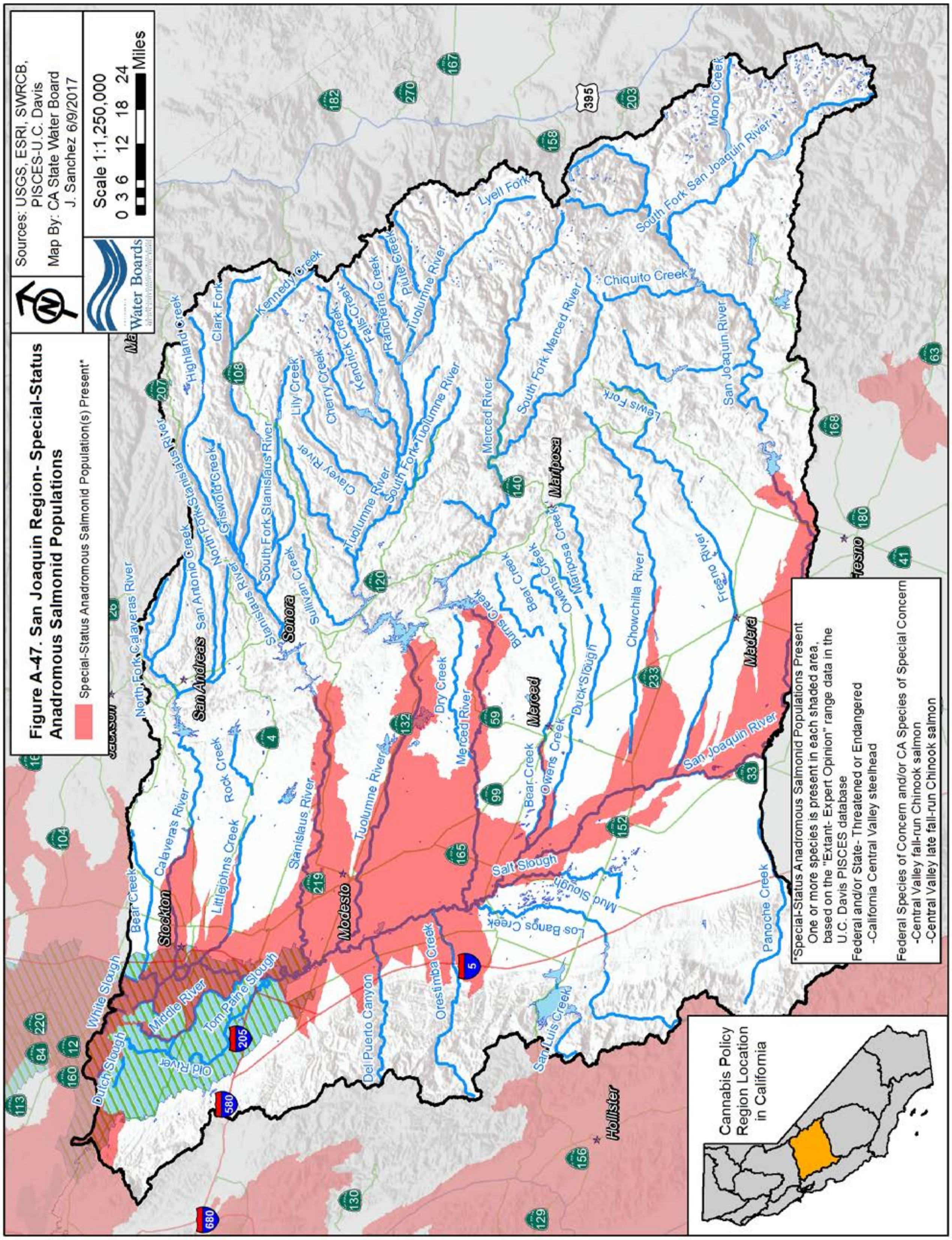
Figure A-47. San Joaquin Region- Special-Status Anadromous Salmonid Populations
Special-Status Anadromous Salmonid Population(s) Present*
Sources: USGS, ESRI, SWRCB, PISCES-U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:1,250,000
0 3 6 12 18 24 Miles
Water Boards
*Special-Status Anadromous Salmonid Populations Present
One or more species is present in each shaded area, based on the "Extant- Expert Opinion" range data in the U.C. Davis PISCES database
Federal and/or State- Threatened or Endangered
-California Central Valley steelhead
Federal Species of Concern and/or CA Species of Special Concern
-Central Valley fall-run Chinook salmon
-Central Valley late fall-run Chinook salmon
Cannabis Policy Region Location in California
Stockton
Modesto
Merced
Madera
Fresno
Sonora
San Andreas
Mariposa
Hollister
San Joaquin River
Tuolumne River
Stanislaus River
Merced River
Calaveras River

1.9 South Coast Region

The South Coast Region covers approximately 14,431 square miles along the southern coast of California, as shown in Figure A-48. Elevations in the South Coast Region range from sea level along the coast, to over 6,000 feet in the Los Padres and San Bernardino National Forests. Please refer to Figure A-49 for an elevation map of the region. Numerous watersheds of small and moderate size are located in the South Coast Region, including the Santa Maria River, Santa Ynez River, Ventura River, Santa Clara River, Los Angeles River, Santa Ana River, San Luis Rey River, and San Diego River. These coastal watersheds drain to the Pacific Ocean.

1.9.1 Climate and Precipitation

Much of the South Coast Region is described by Mediterranean and Steppe climates. The northern portion of the South Coast Region is generally characterized by a Mediterranean climate, with cool summers. Temperatures in the South Coast Region tend to be cooler near the coast, which is a result of the marine influence. Much of the central and southern portion of the South Coast Region is characterized by a Mediterranean climate with hot summers, or by a Semi-arid, steppe climate. Please refer to Figure A-50 for a climatic map of this region.

Temperature conditions and precipitation patterns in the South Coast Region tend to be mild. Average annual maximum temperatures in the South Coast Region tend to exceed 75 degrees Fahrenheit in inland areas, and coastal and high elevation areas tend to exhibit slightly cooler maximum temperatures. Average annual minimum temperatures in the South Central Coast Region tend to remain above 45 degrees Fahrenheit, although average annual minimum temperatures are cooler at the highest elevations. Average annual precipitation in the South Coast Region tends to range from 5 and 20 inches in most coastal and inland areas, but can exceed 40 inches at mountain peaks). Precipitation events tend to occur from November to April, with precipitation peaks in December and January. Nearly all precipitation in the South Coast Region falls as rain, and snow only contributes significant precipitation to the region in the vicinity of Big Bear Lake. (WRCC 2016)

Please refer to Figure A-51 for a precipitation map of the region. Please refer to Chart A-15, below, for an illustration of precipitation and temperature conditions in the South Coast Region.

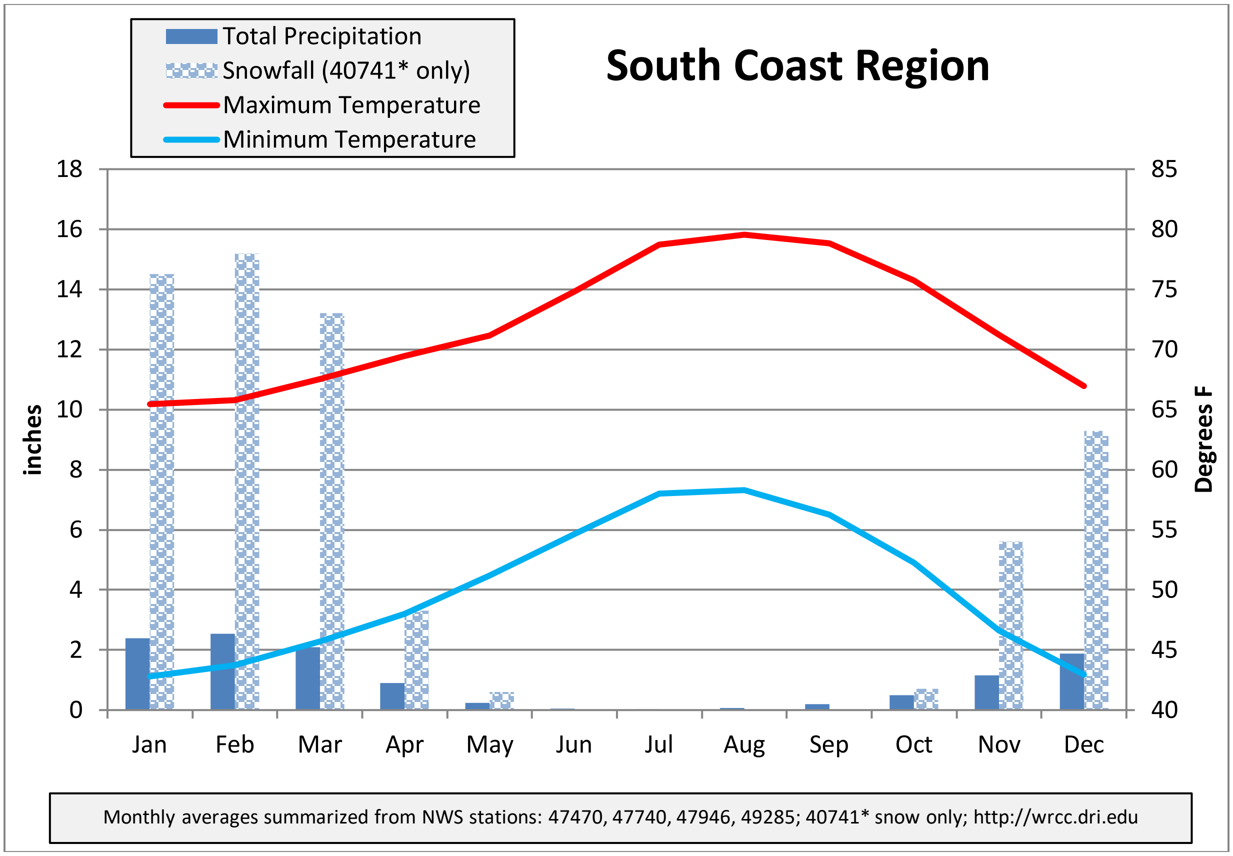

Chart A-15. Average annual patterns of temperature and precipitation in the South Coast Region.

1.9.2 Hydrology

Stream reaches in the South Coast Region are characterized by several classes described under UC Davis' hydrologic classification system. The majority of stream reaches located in the southern half of the South Coast Region are classified as Rain and Seasonal Groundwater (RSG) systems. Many streams located in the northern half of the South Coast Region and located along the eastern margin of the region are classified as Low-Volume Snowmelt and Rain (LSR) systems. The South Coast Region also contains several Perennial Groundwater and Rain (PGR), and Flashy, Ephemeral Rain (FER) stream systems. A small number of Winter Storm (WS) and Snowmelt (SM) stream reaches are also located in this region. (Lane et al 2016)

Please refer to Figure A-52 for a depiction of the stream classifications within the South Coast Region.

1.9.3 Geology

The South Coast Region is located in the Coast Ranges, Transverse Ranges, and Peninsular Ranges geomorphic provinces. The Coast Ranges, located in the northern portion of the region, are characterized by irregular, knobby, landslide topography, and contain sedimentary and metamorphic rock. The Transverse Ranges geomorphic province, located in the central portion of the region, contains steep mountain ranges and valleys oriented perpendicular to the other coastal mountain ranges. The Peninsular Ranges geomorphic province, located in the southern portion of the region, is characterized by topography similar to the Coast Ranges, but with rock types more similar to the Sierra Nevada mountains. Alluvial deposits are found in valleys throughout the South Coast Region. (CGS, 2002)

1.9.4 Anadromous Salmonid Population

One special-status ESU, DPS, or DTE is currently extant within the South Coast Region (Figure A-53):

- the Southern California Coast (SCC) steelhead DPS.

The SCC steelhead DPS is currently listed as endangered under the ESA (CDFW 2017b).

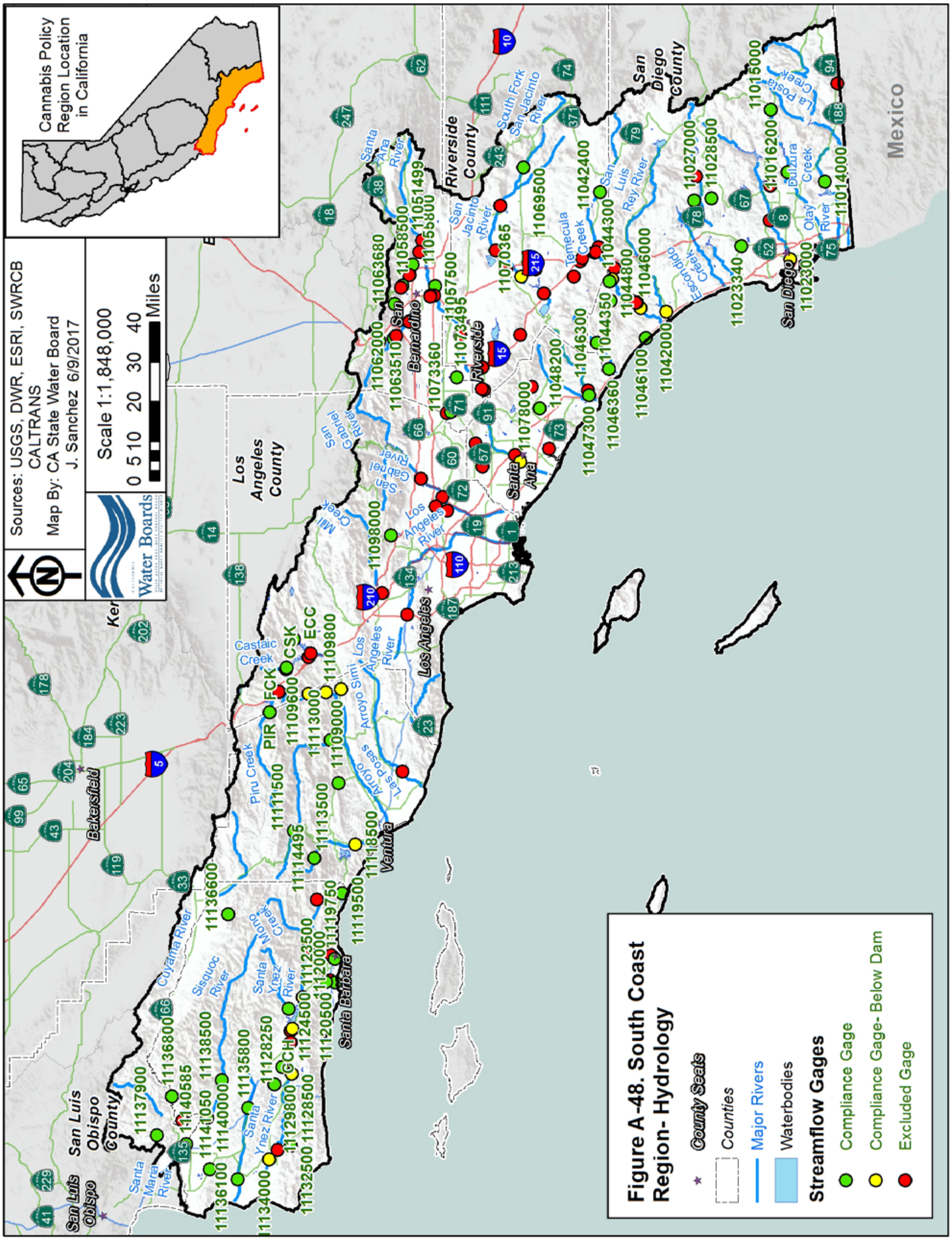

Figure A-48. South Coast Region- Hydrology

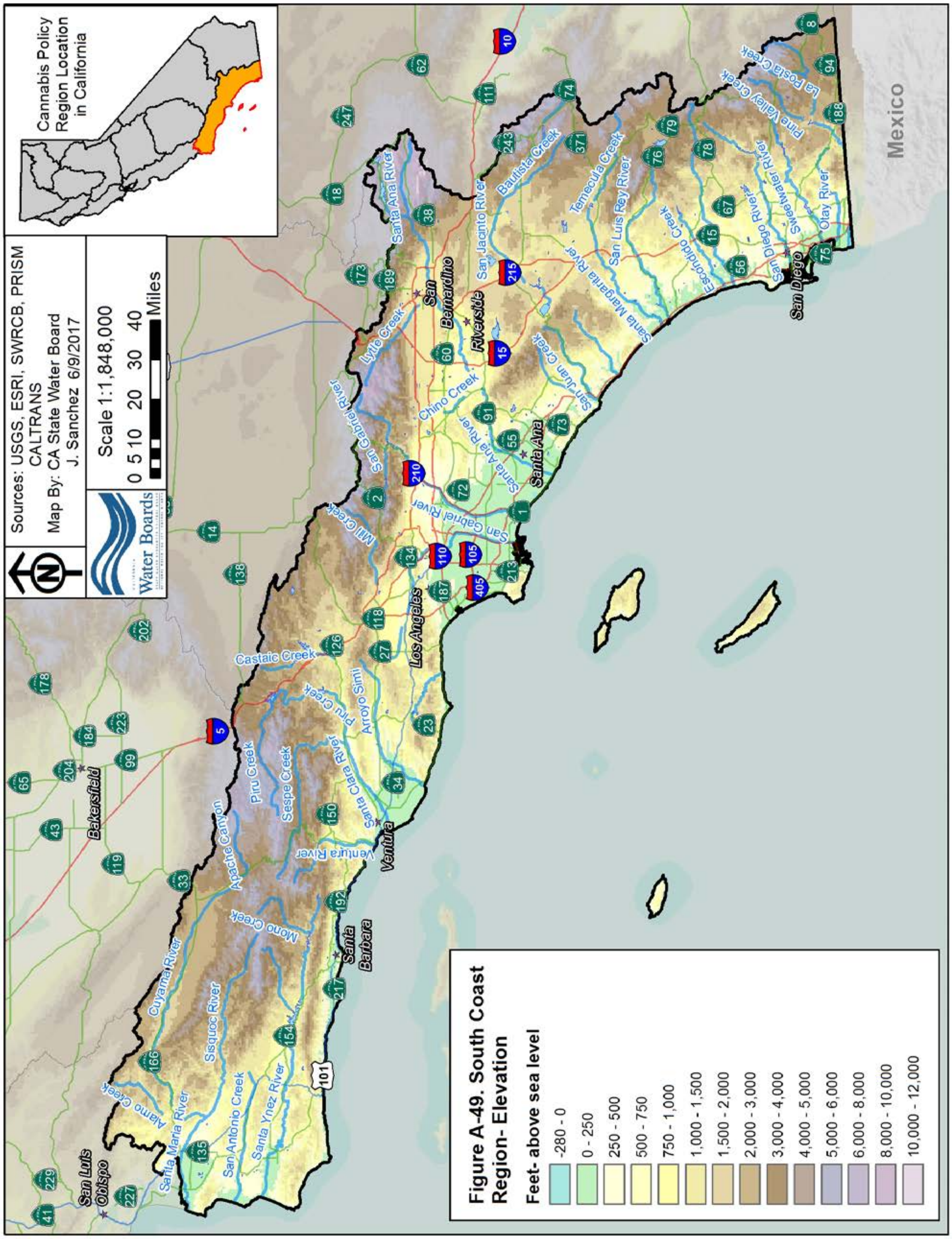

Figure A-49. South Coast Region- Elevation

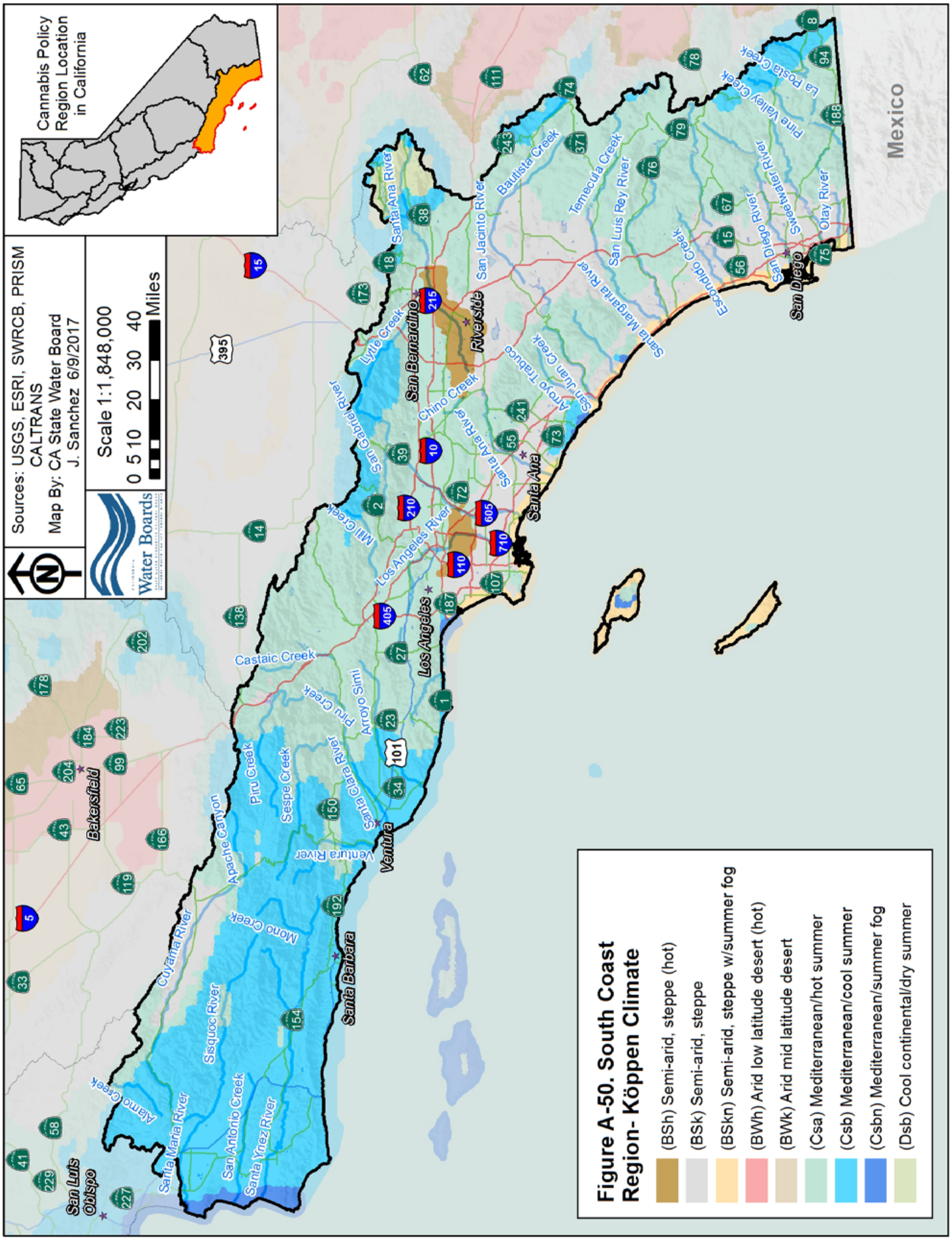

Figure A-50. South Coast Region- Köppen Climate

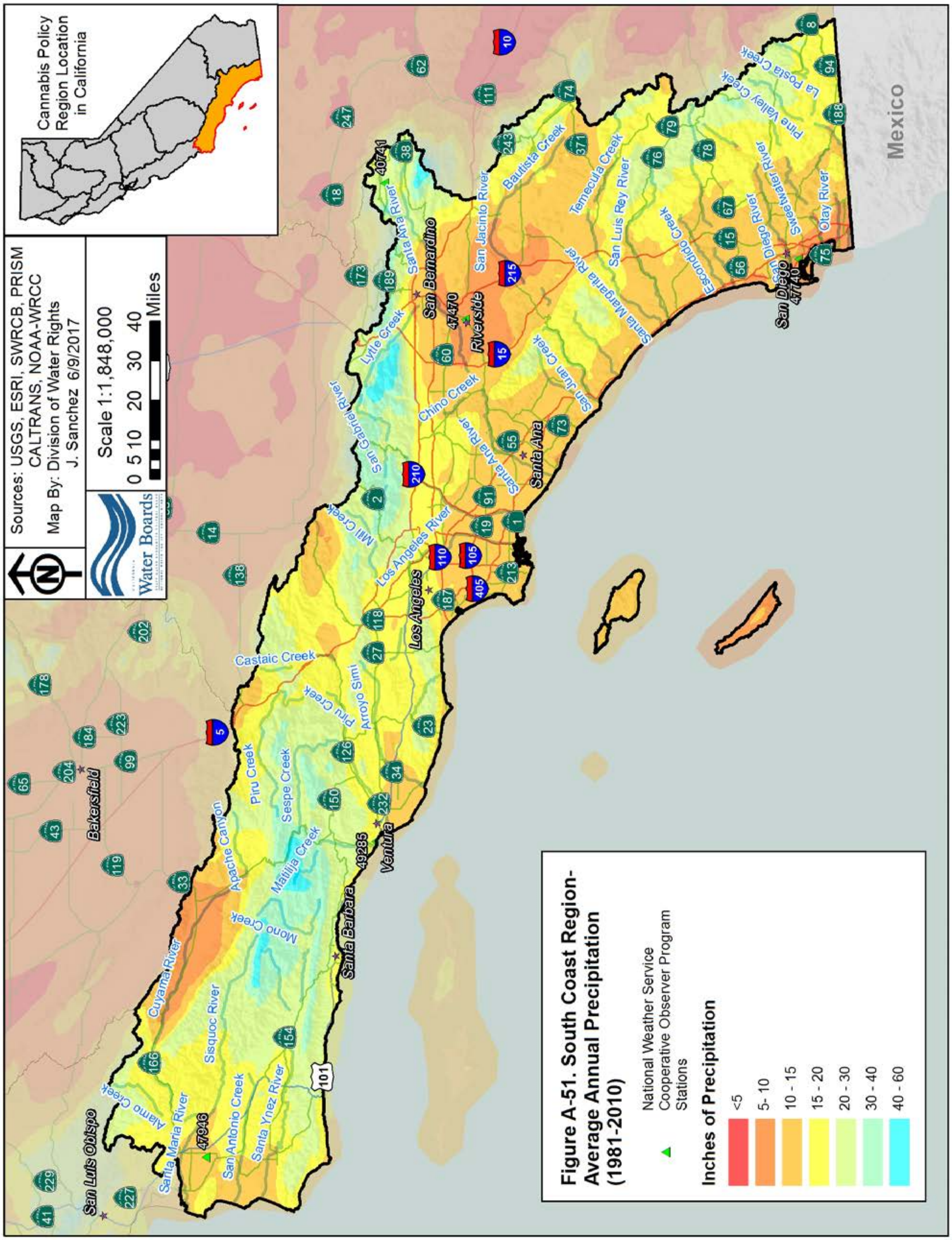

Figure A-51. South Coast Region-Average Annual Precipitation (1981-2010)

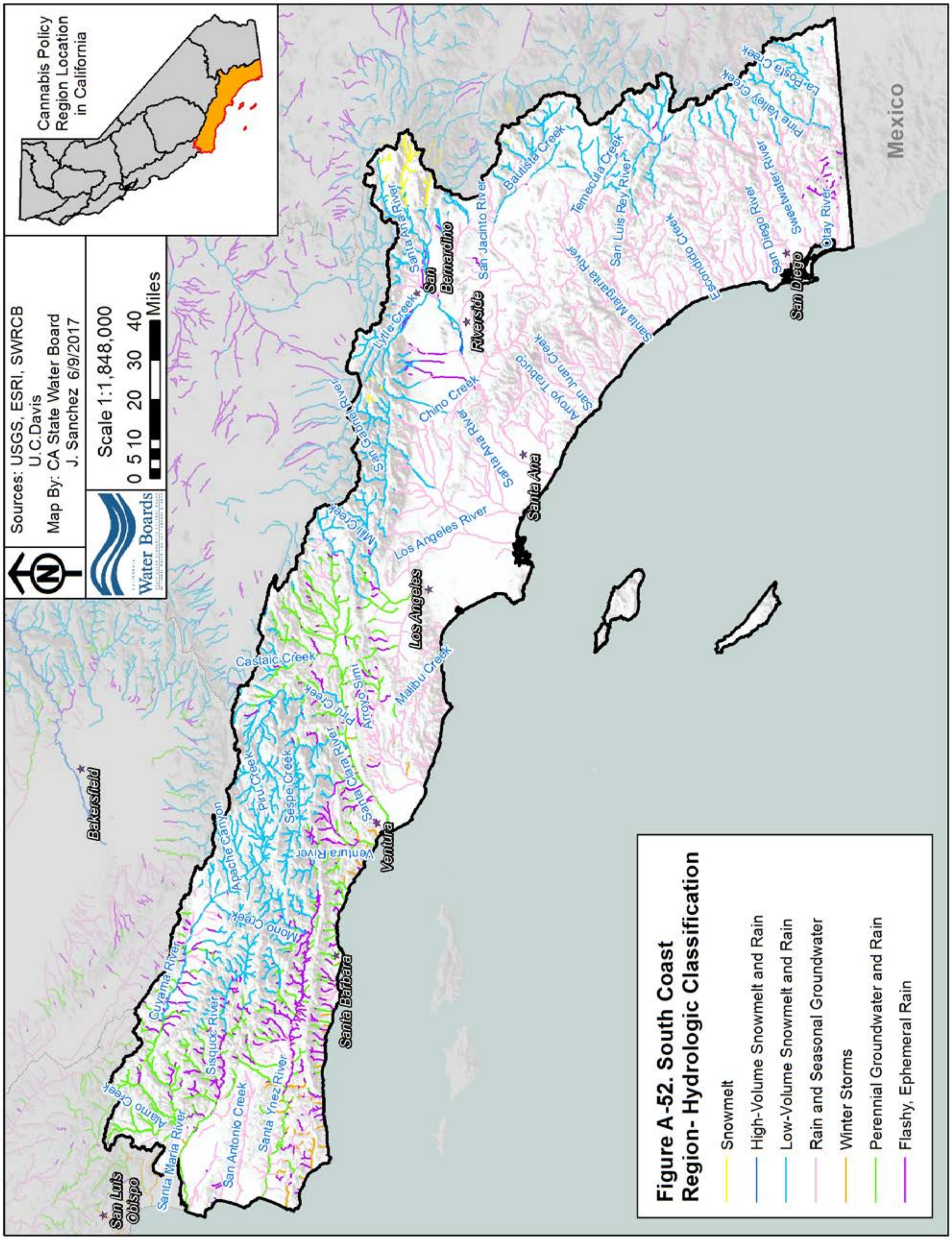

Figure A-52. South Coast Region- Hydrologic Classification

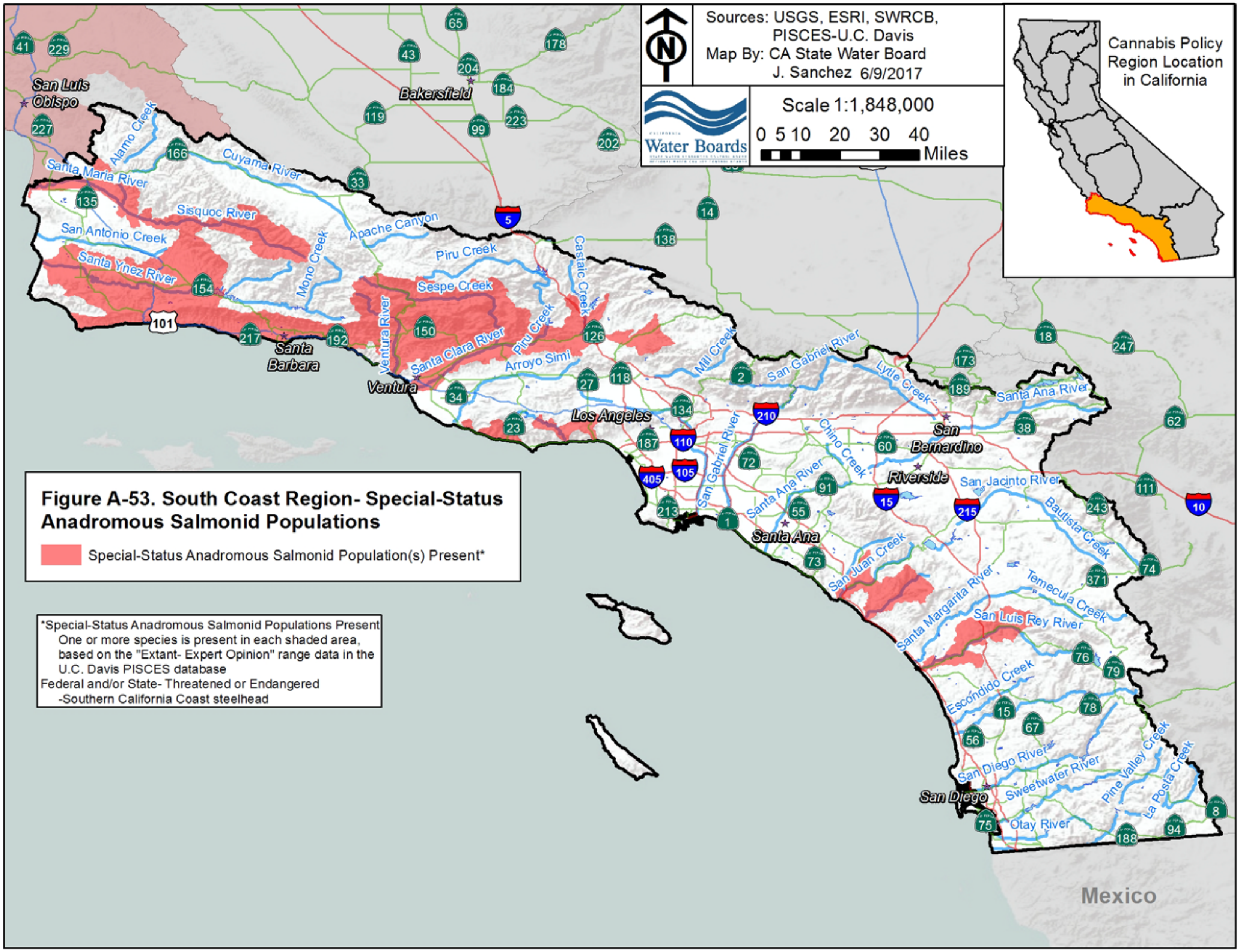

Figure A-53. South Coast Region- Special-Status Anadromous Salmonid Populations

1.10 North East Desert Region

The North East Desert Region covers approximately 3,951 square miles in the northeastern corner of California (Figure A-54). Elevations in this region range from approximately 3,000 feet above sea level to over 8,700 feet above sea level at Hat Mountain. Please refer to Figure A-55 for an elevation map of the region. The region includes the watersheds of the Susan River, Pine Creek, Willow Creek, Red Rock Creek, Long Valley Creek, Bidwell Creek, Bare Creek, and Dry Valley Creek.

1.10.1 Climate and Precipitation

The climate of the North East Desert Region is generally characterized by a cool continental climate with dry summers, and with areas of Semi-arid, steppe climate. Please refer to Figure A-56 for a climatic map of the North East Desert Region.

Temperatures patterns within the North East Desert Region have very little variation. Most of the region exhibits average annual maximum temperatures of 65 degrees Fahrenheit and average annual minimum temperatures of 32 degrees Fahrenheit. Some of the southern portions of the region exhibit slightly higher average annual minimum temperatures of 40 degrees Fahrenheit.

Most of the North East Desert Region receives between 5 to 20 inches of precipitation annually. However, there are a few areas in the most western parts of the region that receive between 40 to 60 inches annually. The amount of precipitation tends to decrease at higher elevations.

Please refer to Figure A-57 for a precipitation map of the region. Please refer to Chart A-16, below, for an illustration of precipitation and temperature conditions in the North East Desert Region.

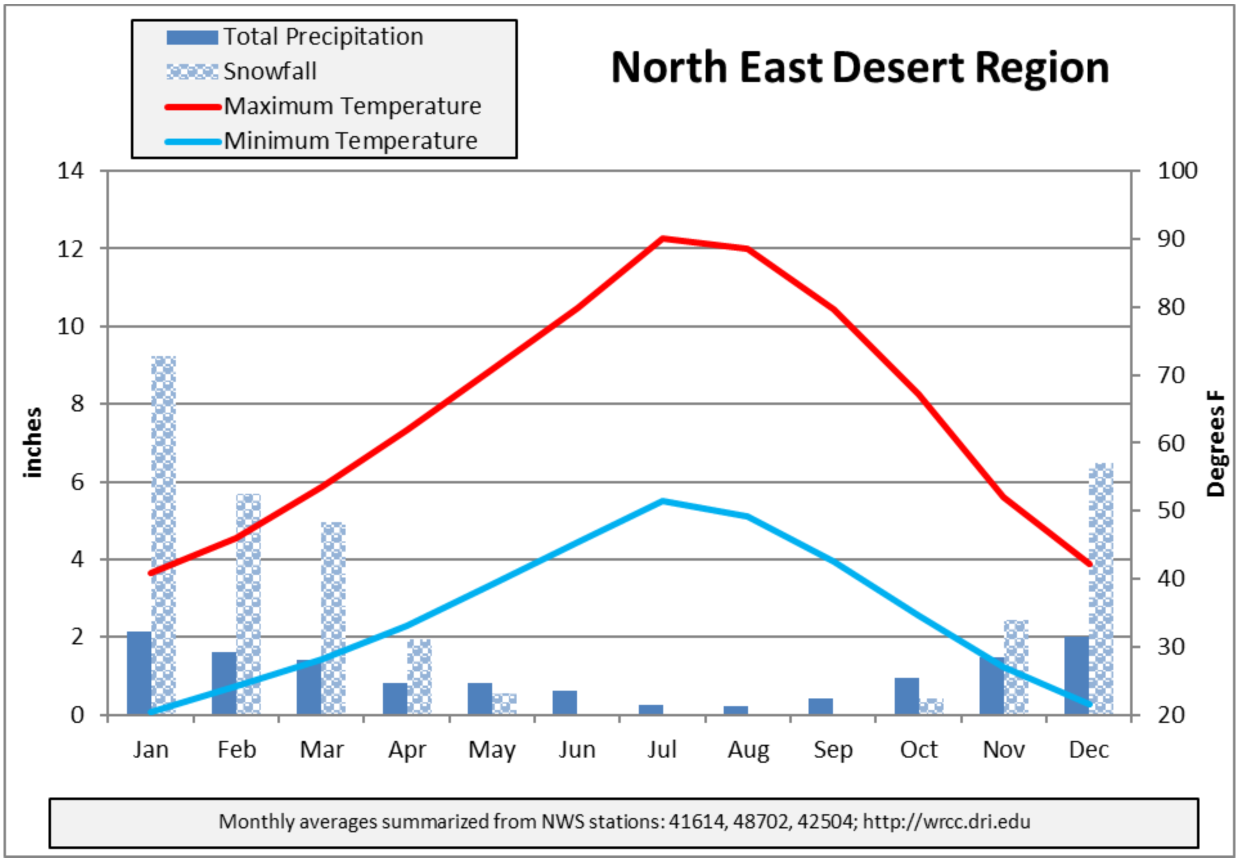

Chart A-16. Average annual patterns of temperature and precipitation in the North East Desert Region.

1.10.2 Hydrology

The hydrology of North East Desert Region streams is dominated by High Elevation and Low Precipitation (HELP) systems. There are a smaller number of streams classified as Flashy, Ephemeral Rain (FER), Perennial Groundwater and Rain (PGR), Snowmelt (SM), and Low-Volume Snowmelt and Rain (LSR) systems. (Lane et al 2016)

Please refer to Figure A-58 for a depiction of the stream classifications within the South Coast Region.

1.10.3 Geology

The North East Desert Region is located in the Basin and Range, Cascade Range, and Modoc Plateau geomorphic provinces. The Cascade Range is a rugged mountain range, and the Modoc Plateau is an elevated volcanic plateau located in the northeastern corner of California. The Cascade Range is generally underlain by igneous rock, including lava flows, pyroclastic flows, and alluvium eroded from volcanic features. The Modoc Plateau is a volcanic table land consisting of lava flows, tuff beds and small volcanic cones. Significant subterranean streamflows occur through porous volcanic features in the Modoc Plateau (CGS 2002).

1.10.4 Anadromous Salmonid Population

No anadromous salmonids are present in the North East Desert Region.

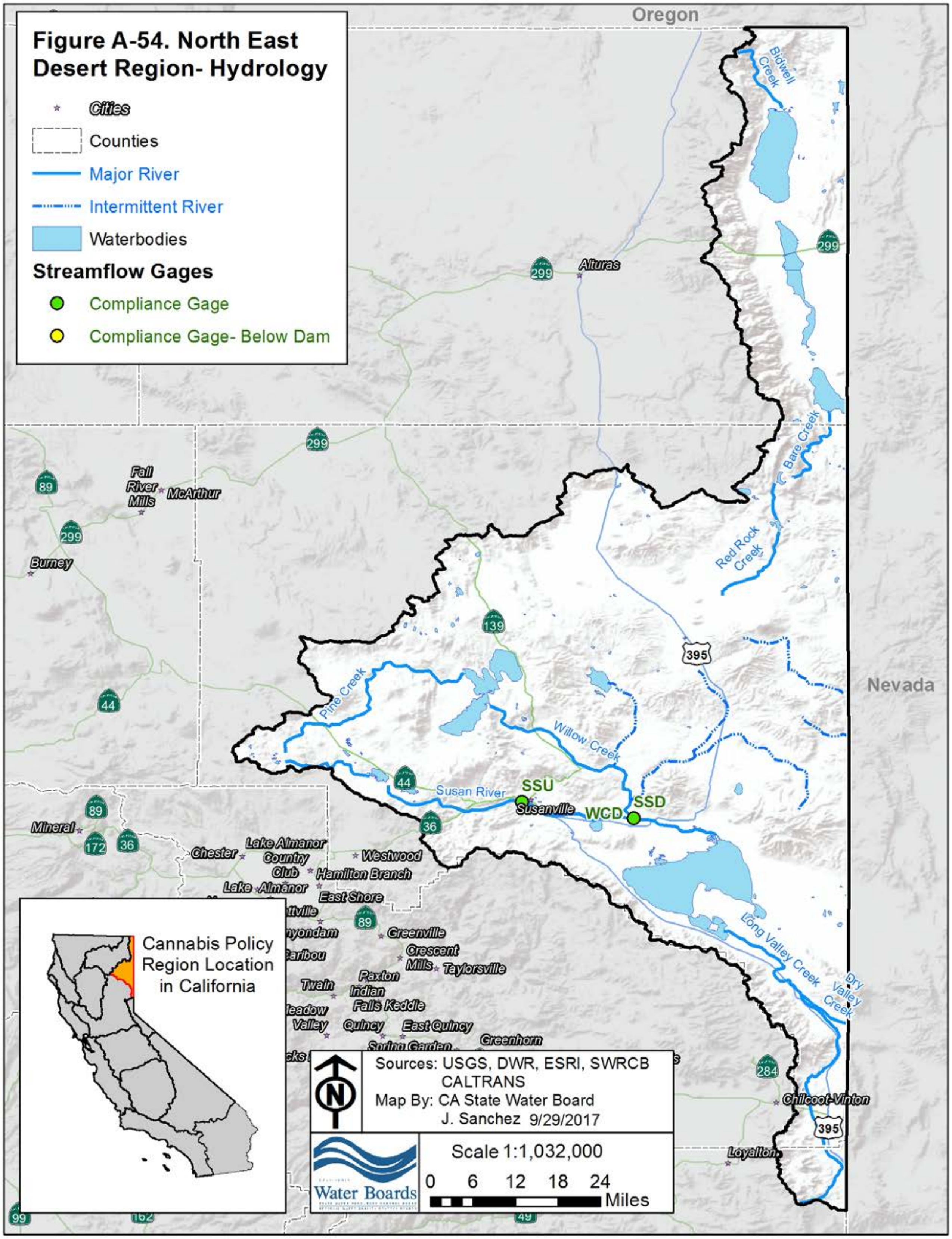

Figure A-54. North East Desert Region- Hydrology

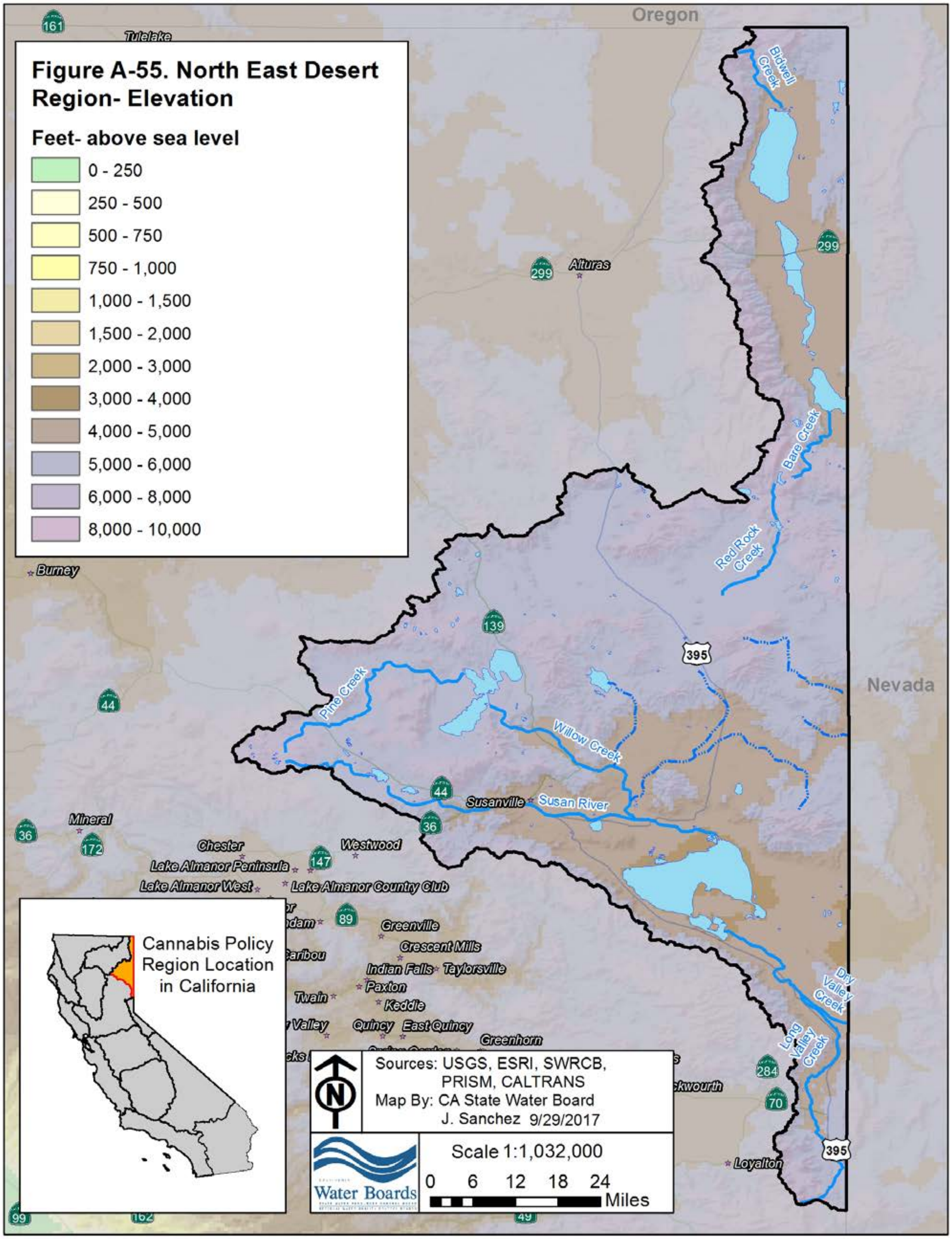
Figure A-55. North East Desert Region- Elevation
Feet- above sea level
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
Oregon
Nevada
Tulelake
Alturas
Burney
Bidwell Creek
Bare Creek
Red Rock Creek
Pine Creek
Willow Creek
Susanville
Susan River
Mineral
Chester
Westwood
Lake Almanor Peninsula
Lake Almanor West
Lake Almanor Country Club
Greenville
Crescent Mills
Indian Falls
Taylorsville
Paxton
Keddie
Twain
Quincy
East Quincy
Greenhorn
Dry Valley Creek
Long Valley Creek
Loyalton
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:1,032,000
0 6 12 18 24 Miles
Water Boards

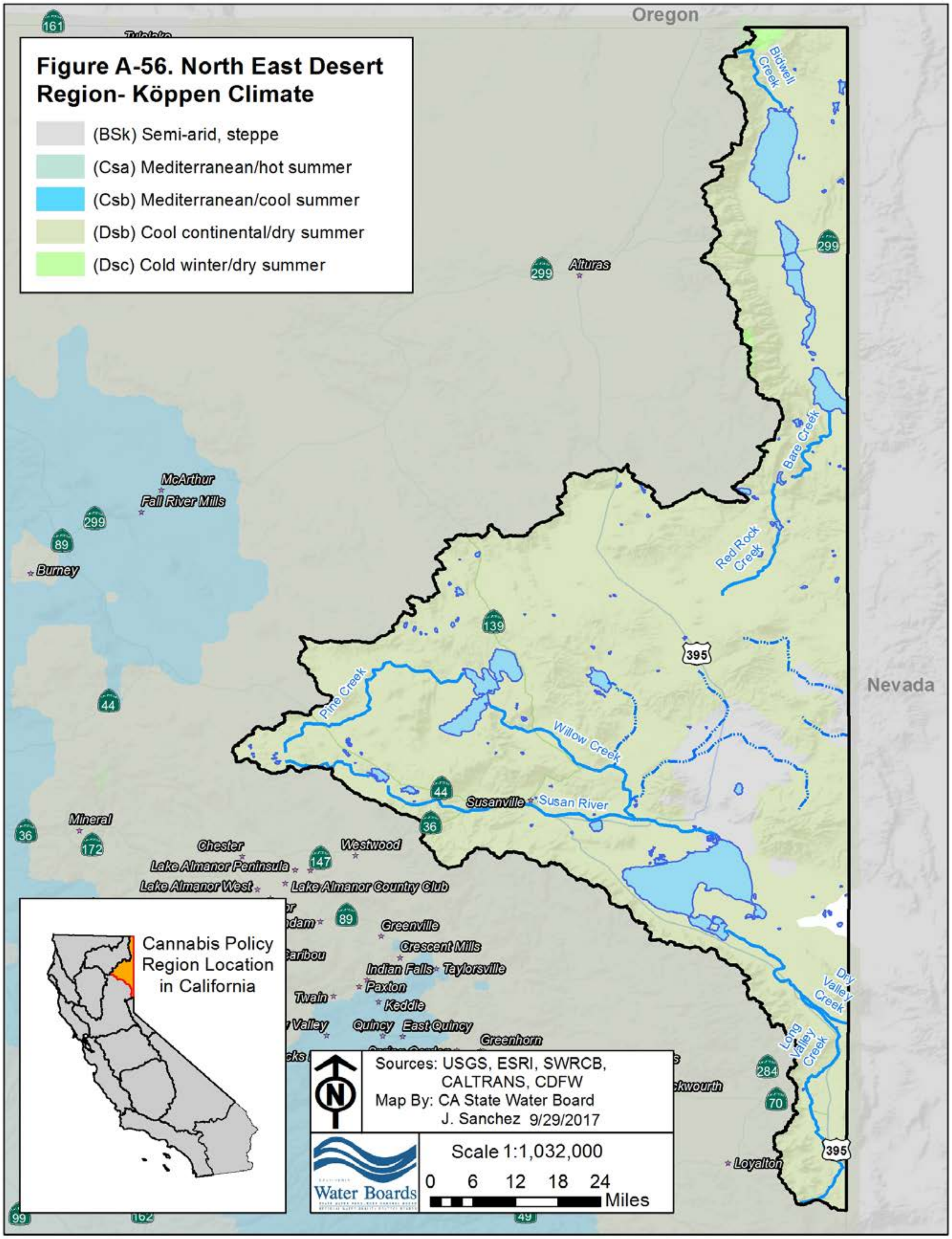

Figure A-56. North East Desert Region- Köppen Climate

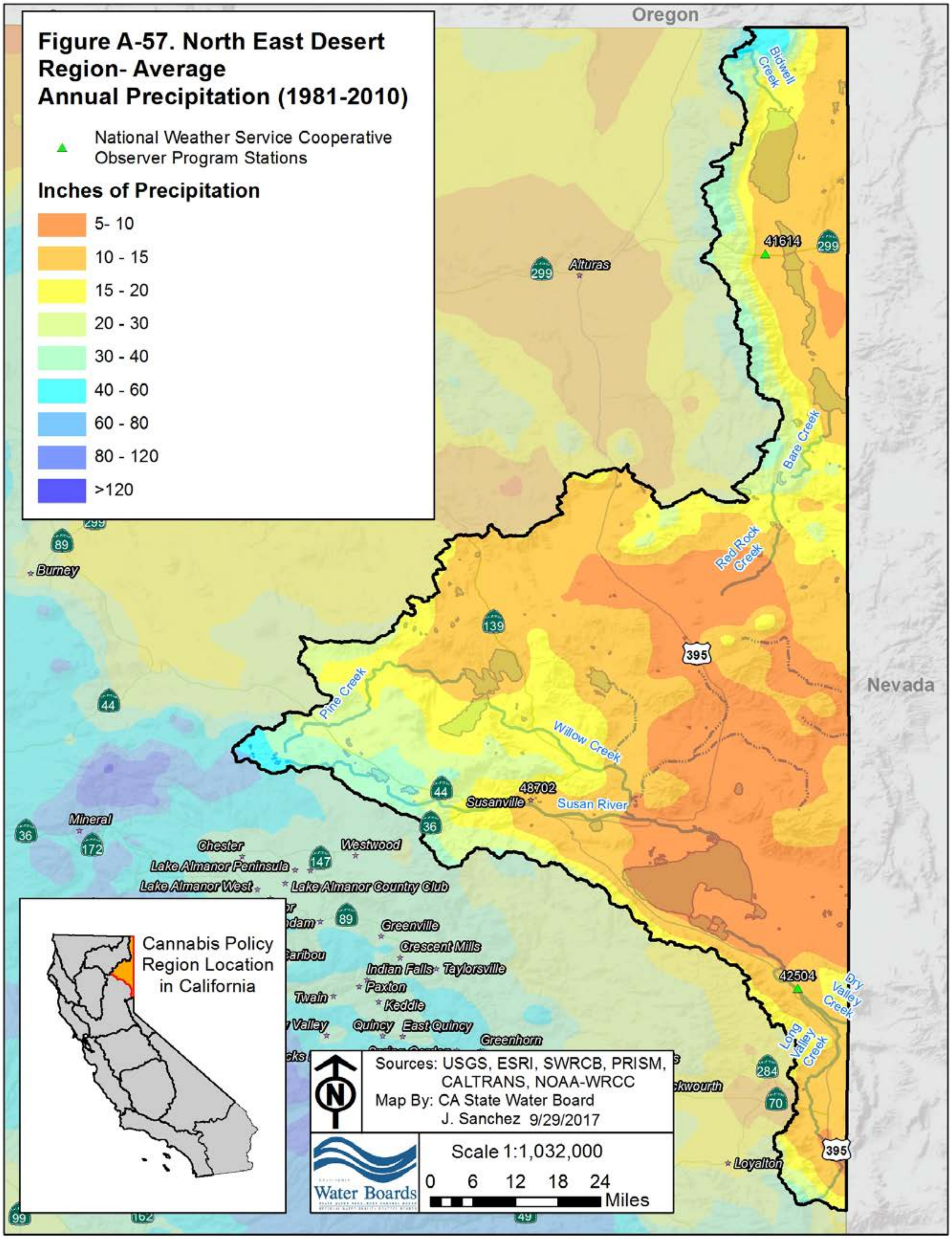
Figure A-57. North East Desert Region- Average Annual Precipitation (1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
5- 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
80 - 120
>120
Oregon
Nevada
Bidwell Creek
41614
Alturas
Bare Creek
Red Rock Creek
Pine Creek
Willow Creek
48702
Susanville
Susan River
Burney
Mineral
Chester
Westwood
Lake Almanor Peninsula
Lake Almanor West
Lake Almanor Country Club
Greenville
Crescent Mills
Indian Falls
Taylorsville
Paxton
Keddie
Twain
Quincy
East Quincy
Greenhorn
42504
Dry Valley Creek
Long Valley Creek
Loyalton
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS, NOAA-WRCC
Map By: CA State Water Board
J. Sanchez 9/29/2017
Scale 1:1,032,000
0 6 12 18 24
Miles
Water Boards

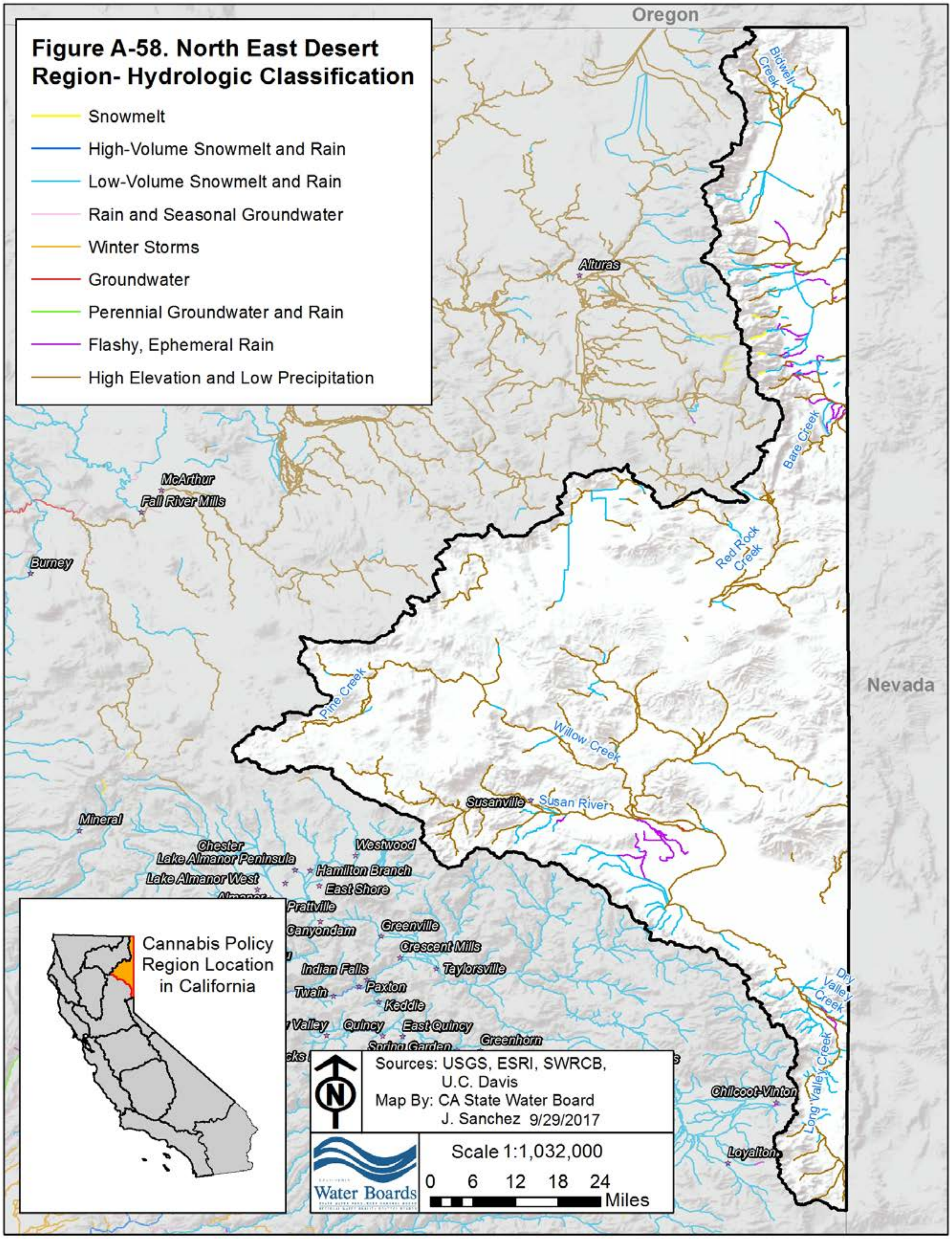
Figure A-58. North East Desert Region- Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
High Elevation and Low Precipitation
Oregon
Nevada
Bidwell Creek
Alturas
Bare Creek
Red Rock Creek
McArthur
Fall River Mills
Burney
Pine Creek
Willow Creek
Susanville
Susan River
Mineral
Chester
Lake Almanor Peninsula
Lake Almanor West
Westwood
Hamilton Branch
East Shore
Prattville
Canyondam
Greenville
Crescent Mills
Indian Falls
Taylorsville
Twain
Paxton
Keddie
Quincy
East Quincy
Spring Garden
Greenhorn
Dry Valley Creek
Long Valley Creek
Chilcoot-Vinton
Loyalton
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, U.C. Davis
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:1,032,000
0 6 12 18 24 Miles
Water Boards

1.11 Tahoe Region

The Tahoe Region covers approximately 2,169 square miles along the eastern boarder of California (Figure A-59). Elevations in this region range from approximately 5,000 to 12,000 feet above sea level. Please refer to Figure A-60 for an elevation map of the region. The region includes the watersheds of the Truckee River, Little Truckee River, Carson River, Walker River, Virginia Creek, Markleeville Creek, Pleasant Valley Creek, and Trout Creek.

1.11.1 Climate and Precipitation

The climate of the Tahoe Region is generally characterized by a cool continental with dry summer climate, with pockets of cold winter with dry summer climate at higher elevations. Please refer to Figure A-61 for a climatic map of the Tahoe Region.

Temperatures patterns within the Tahoe Region have very little variation. Most of the region exhibit average annual maximum temperatures of 65 degrees Fahrenheit and average annual minimum temperatures of 15 degrees Fahrenheit. Some of the higher elevations have cooler annual maximum temperatures around 50 degrees Fahrenheit.

Precipitation patterns vary within the Tahoe Region, with the western side of the Tahoe Region near the Sierra Nevada mountains crest receiving a much larger amount of precipitation annually compared to the eastern side of the region. The western side of the Tahoe Region receives between 60-80 inches of precipitation annually. The amount of precipitation received annually decreases as you move to the east and to the south, with the lowest amounts occurring in the West Walker River and East Walker River watersheds. These two areas receive between 5 and 10 inches of precipitation annually.

Please refer to Figure A-62 for a precipitation map of the region. . Please refer to Charts A-17 and A-18, below, for a comparison of precipitation and temperature conditions for the Nevada Desert area and Sierra Mountains portions of the Tahoe Region

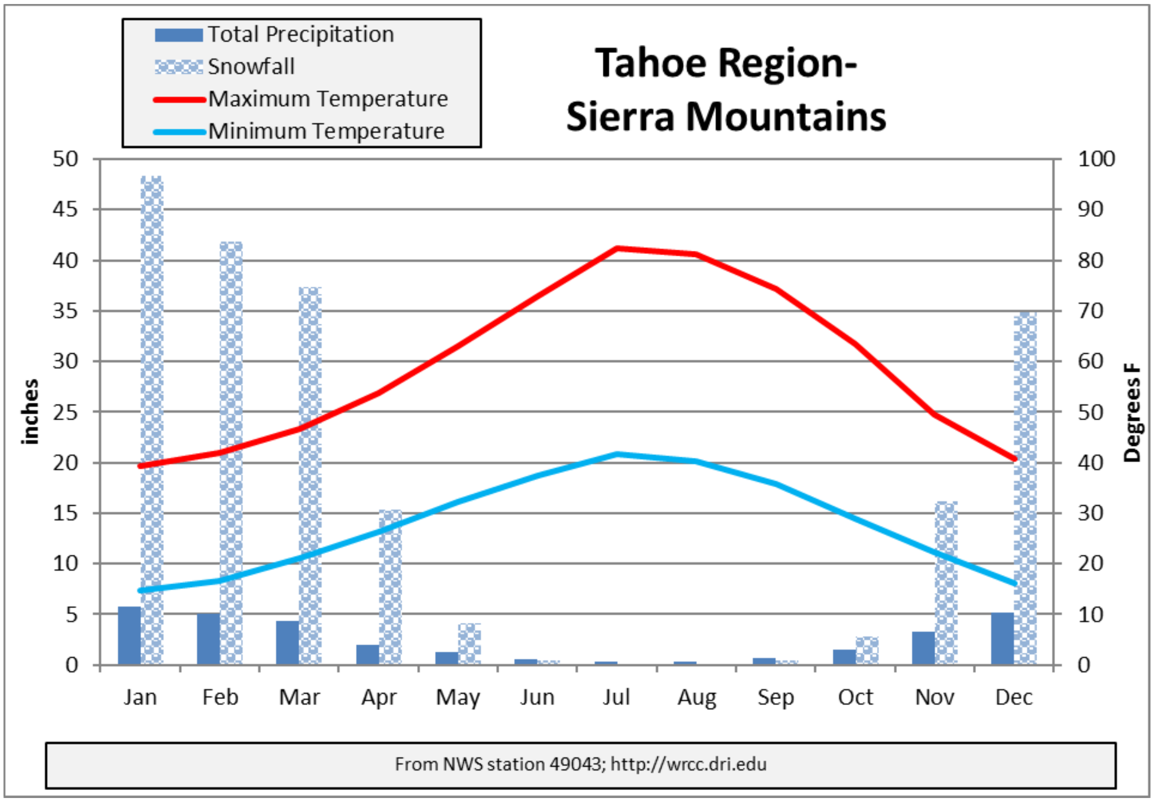

Chart A-17. Average annual patterns of temperature and precipitation, Tahoe Region, Sierra Mountains

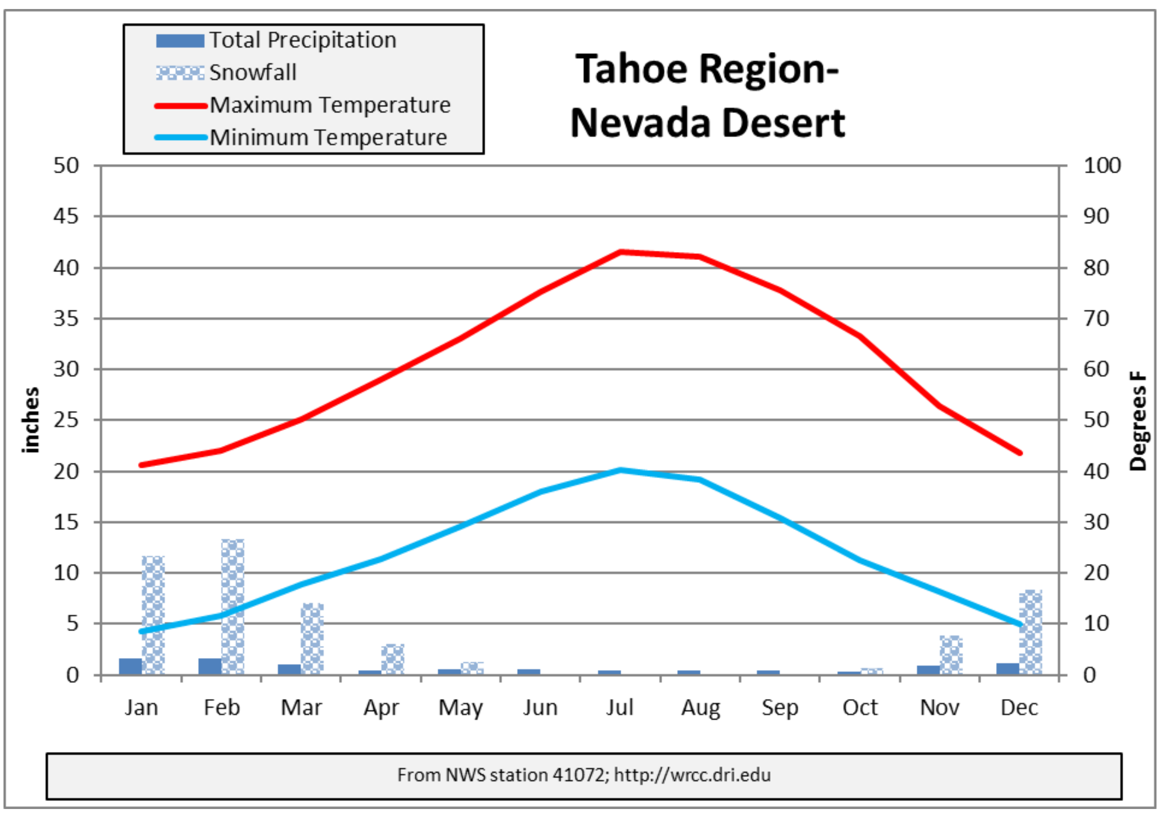

Chart A-18. Average annual patterns of temperature and precipitation, Tahoe Region, Nevada Desert.

1.1.2 Hydrology

The hydrology of Tahoe Region is dependent upon elevation, with higher elevation areas containing streams classified as Snowmelt (SM) systems and lower elevation areas containing Low-Volume Snowmelt and Rain (LSR) streams. (Lane et al 2016)

1.1.3 Geology

The Tahoe Region is predominantly located in the Sierra Nevada Range geomorphic province with the south west corner located in the Basin and Range province. The Sierra Nevada geomorphic province contains steep mountains underlain by a granitic batholith. The foothill regions of the Sierra Nevada geomorphic province are comprised of metamorphic rocks.

1.1.4 Anadromous Salmonid Population

No anadromous salmonids are present in the Tahoe Region.

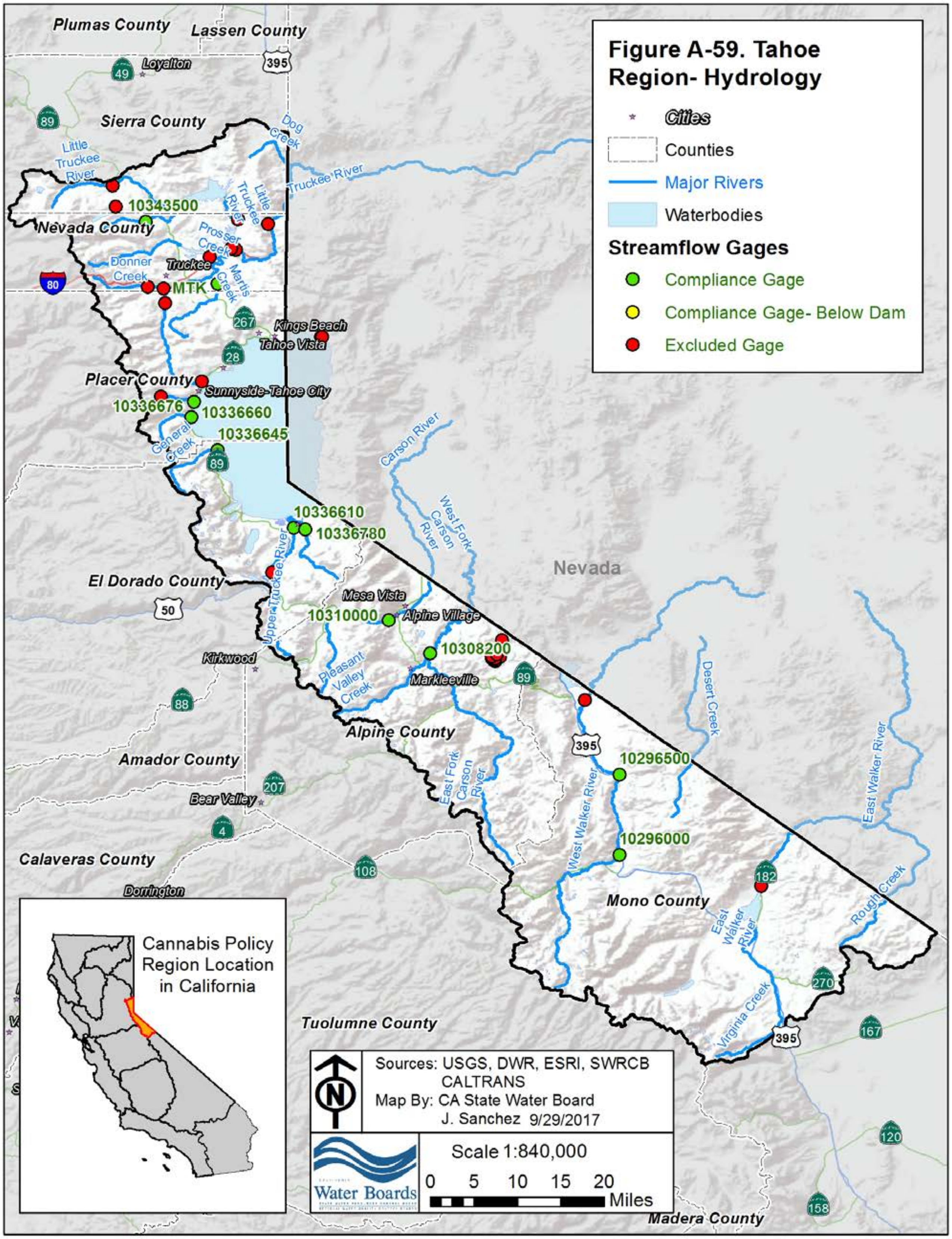
Figure A-59. Tahoe Region- Hydrology
Cities
Counties
Major Rivers
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Plumas County
Lassen County
Sierra County
Nevada County
Placer County
El Dorado County
Alpine County
Amador County
Calaveras County
Tuolumne County
Mono County
Madera County
Nevada
Loyalton
Truckee
Kings Beach
Tahoe Vista
Sunnyside-Tahoe City
Mesa Vista
Alpine Village
Kirkwood
Markleeville
Bear Valley
Dorrington
Little Truckee River
Dog Creek
Truckee River
Prosser Creek
Donner Creek
Martis Creek
General Creek
Carson River
West Fork Carson River
Upper Truckee River
Pleasant Valley Creek
East Fork Carson River
West Walker River
Desert Creek
East Walker River
Rough Creek
Virginia Creek
10343500
MTK
10336676
10336660
10336645
10336610
10336780
10310000
10308200
10296500
10296000
Cannabis Policy Region Location in California
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:840,000
0 5 10 15 20 Miles
Water Boards

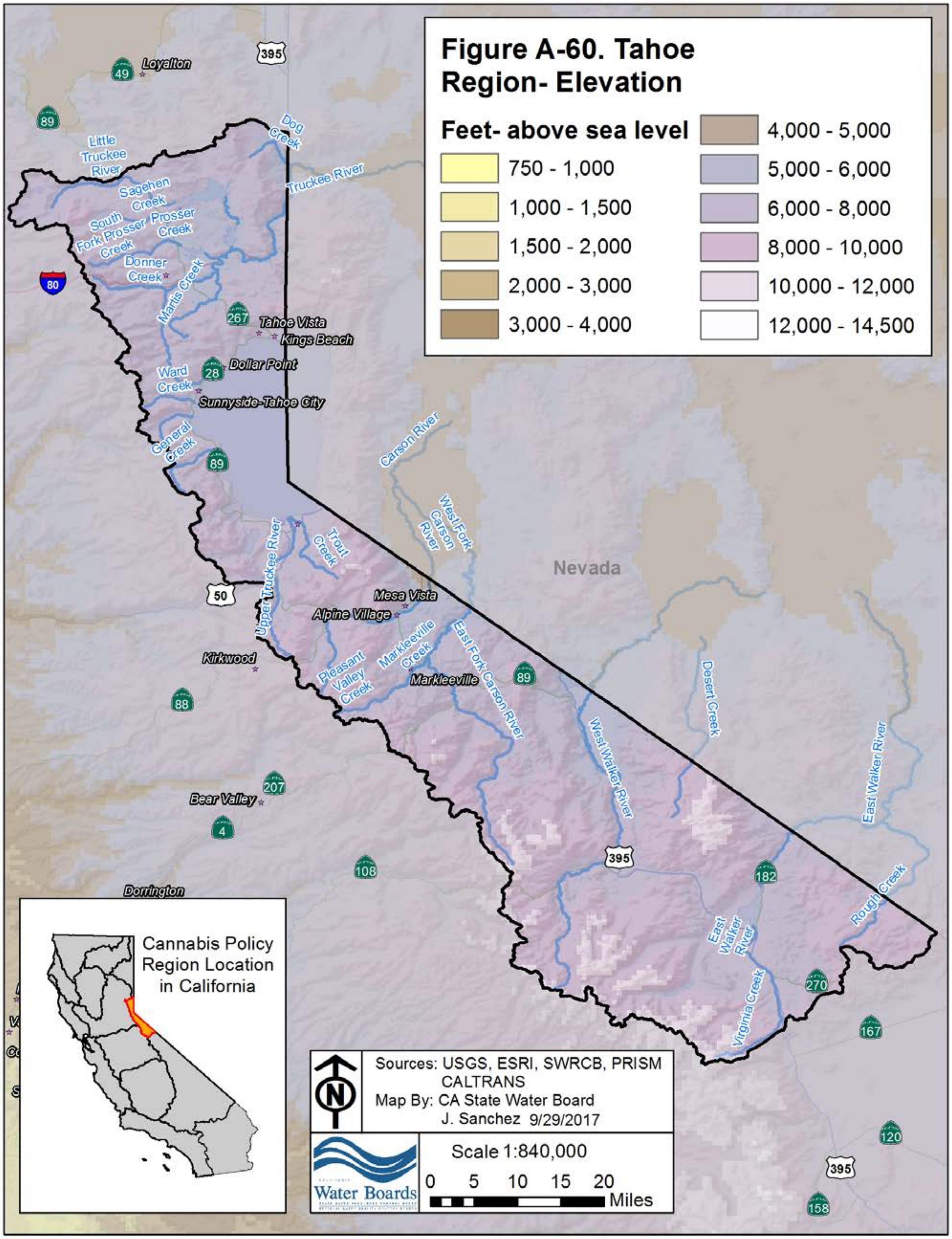

Figure A-60. Tahoe Region- Elevation

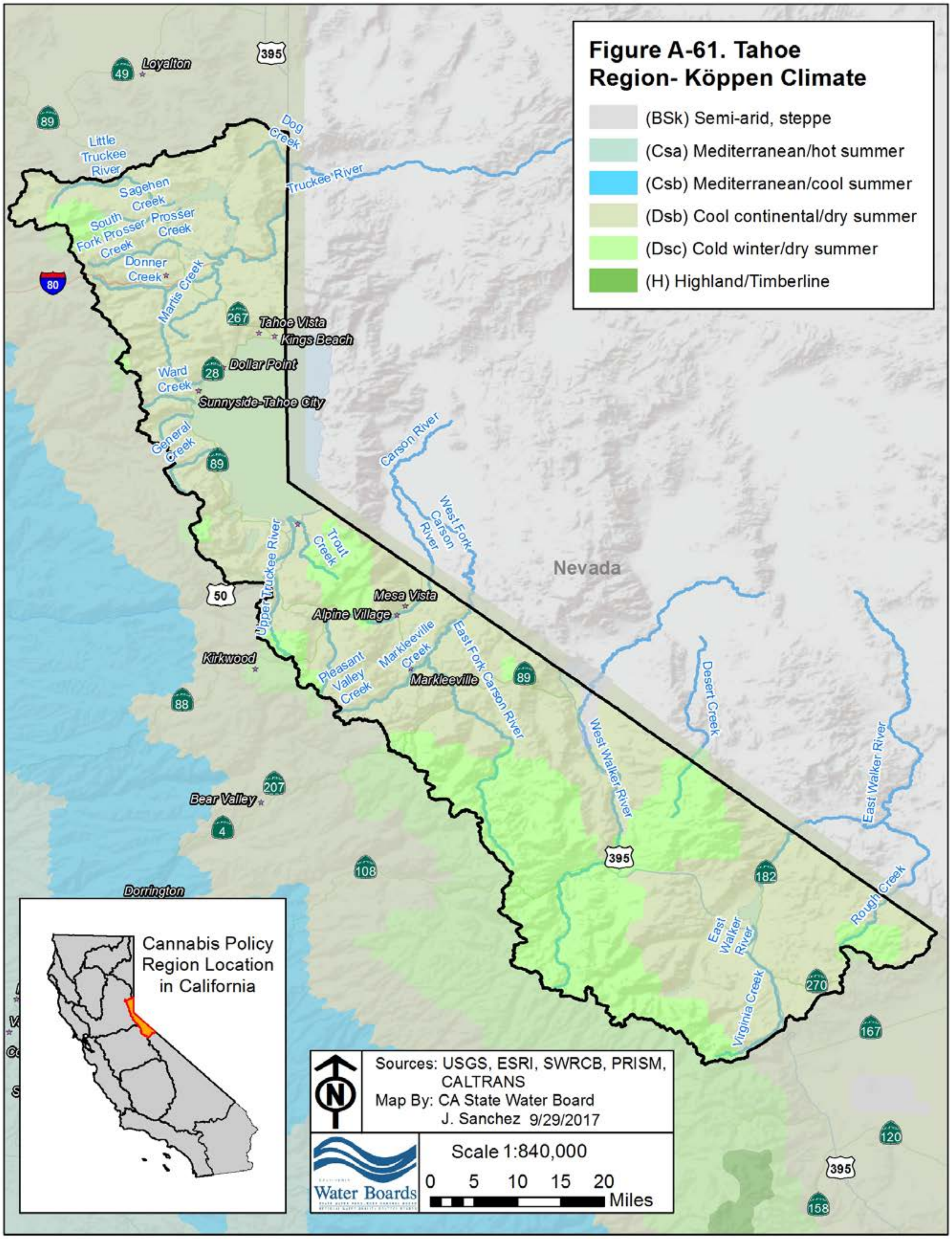
Figure A-61. Tahoe Region- Köppen Climate
(BSk) Semi-arid, steppe
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Dsb) Cool continental/dry summer
(Dsc) Cold winter/dry summer
(H) Highland/Timberline
Loyalton
Little Truckee River
Dog Creek
Truckee River
Sagehen Creek
South Fork Prosser Creek
Prosser Creek
Donner Creek
Martis Creek
Tahoe Vista
Kings Beach
Dollar Point
Ward Creek
Sunnyside-Tahoe City
General Creek
Carson River
West Fork Carson River
Trout Creek
Upper Truckee River
Nevada
Mesa Vista
Alpine Village
Kirkwood
Pleasant Valley Creek
Markleeville Creek
Markleeville
East Fork Carson River
West Walker River
Desert Creek
East Walker River
Bear Valley
Dorrington
East Walker River
Rough Creek
Virginia Creek
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board
J. Sanchez 9/29/2017
Scale 1:840,000
0 5 10 15 20
Miles
Water Boards

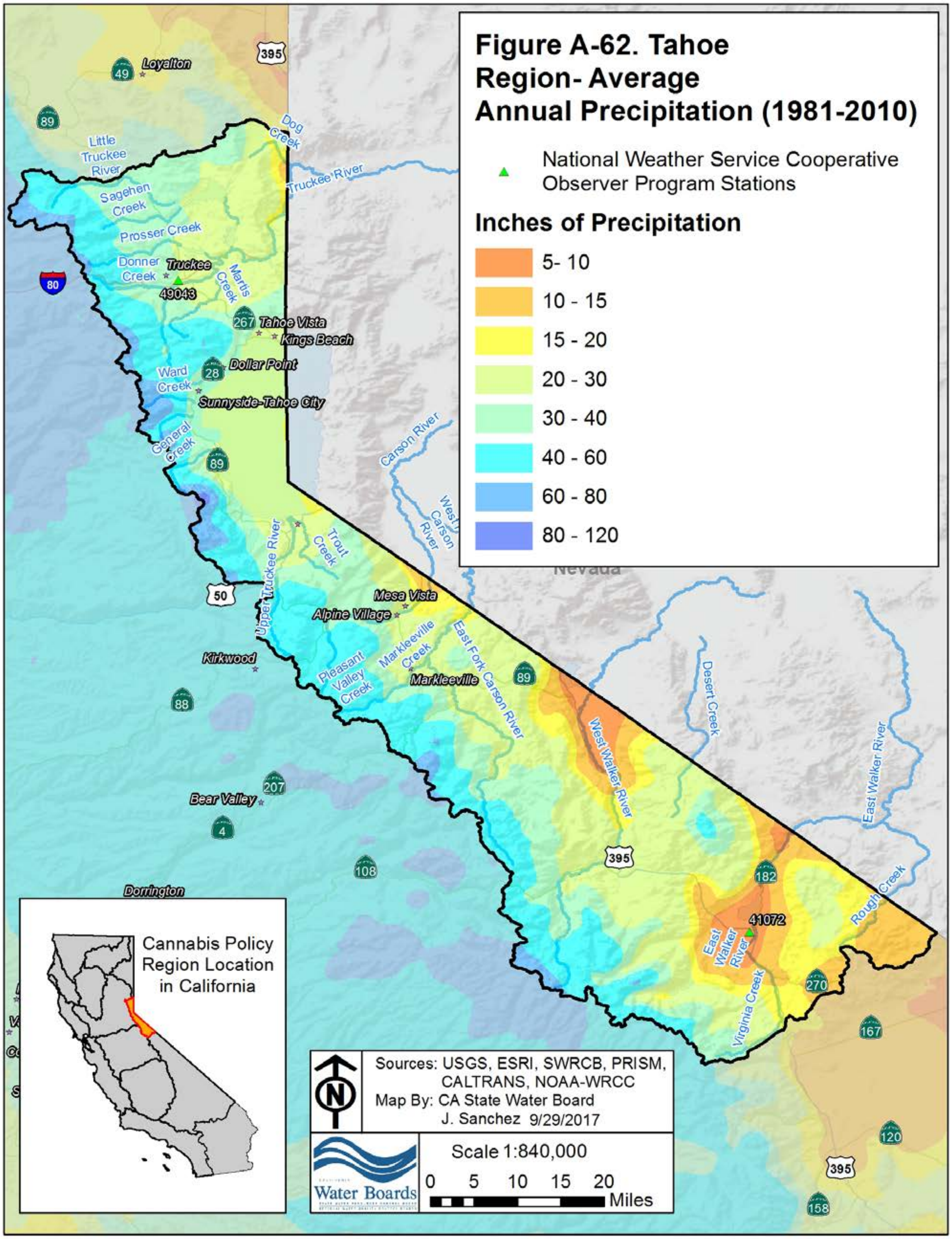
Figure A-62. Tahoe Region- Average Annual Precipitation (1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
5- 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
80 - 120
Loyalton
Little Truckee River
Dog Creek
Truckee River
Sagehen Creek
Prosser Creek
Donner Creek
Truckee
49043
Martis Creek
Tahoe Vista
Kings Beach
Dollar Point
Ward Creek
Sunnyside-Tahoe City
General Creek
Carson River
West Carson River
Upper Truckee River
Trout Creek
Nevada
Mesa Vista
Alpine Village
Kirkwood
Pleasant Valley Creek
Markleeville Creek
Markleeville
East Fork Carson River
Desert Creek
West Walker River
East Walker River
Bear Valley
Dorrington
Rough Creek
41072
East Walker River
Virginia Creek
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS, NOAA-WRCC
Map By: CA State Water Board
J. Sanchez 9/29/2017
Scale 1:840,000
0 5 10 15 20
Miles
Water Boards

1.12 Mono Region

The Mono Region covers approximately 26,673 square miles along the eastern boarder of California (Figure A-63). Elevations in the Mono Region range from 282 feet below sea level at Badwater Basin to over 14,000 feet above sea level at White Mountain Peak. Please refer to Figure A-64 for an elevation map of the region. The region includes the watersheds of Owens River, Bishop Creek, Mill Creek, Rush Creek, Big Pine Creek, and Cottonwood Creek.

1.12.1 Climate and Precipitation

The climate of the Mono Region varies greatly depending upon elevation. The lower elevations are predominately arid low latitude desert and arid mid latitude desert climates. The climate transitions between Semi-arid, steppe; Cold winter with dry summer; and Highland/Timberline as the elevation increases. Please refer to Figure A-65 for a climatic map of the Mono Region.

Temperatures patterns within the Mono Region greatly vary depending upon elevation and location. The southern part of the Mono Region is much warmer with average annual maximum between 75 and 85 degrees Fahrenheit and the average annual minimum temperature between 50 and 60 degrees Fahrenheit. The lowest elevations are the warmest with average annual maximum temperatures reaching 90 degrees Fahrenheit and average annual minimum temperatures between 65 and 72 degrees Fahrenheit. The higher elevations to the north have much cooler temperature patterns with average annual minimum temperatures between 25 and 32 degrees Fahrenheit and average annual maximum temperatures between 40 and 45 degrees Fahrenheit.

Precipitation patterns in the Mono Region are also dependent upon elevation. The low elevation areas to the west and south within the Mono Region receive less than five inches of precipitation annually, while the northern areas of high elevation can receive up to 40 inches of precipitation annually.

Please refer to Figure A-66 for a precipitation map of the region. Please refer to Chart A-19, below, for an illustration of precipitation and temperature conditions in the Mono Region.

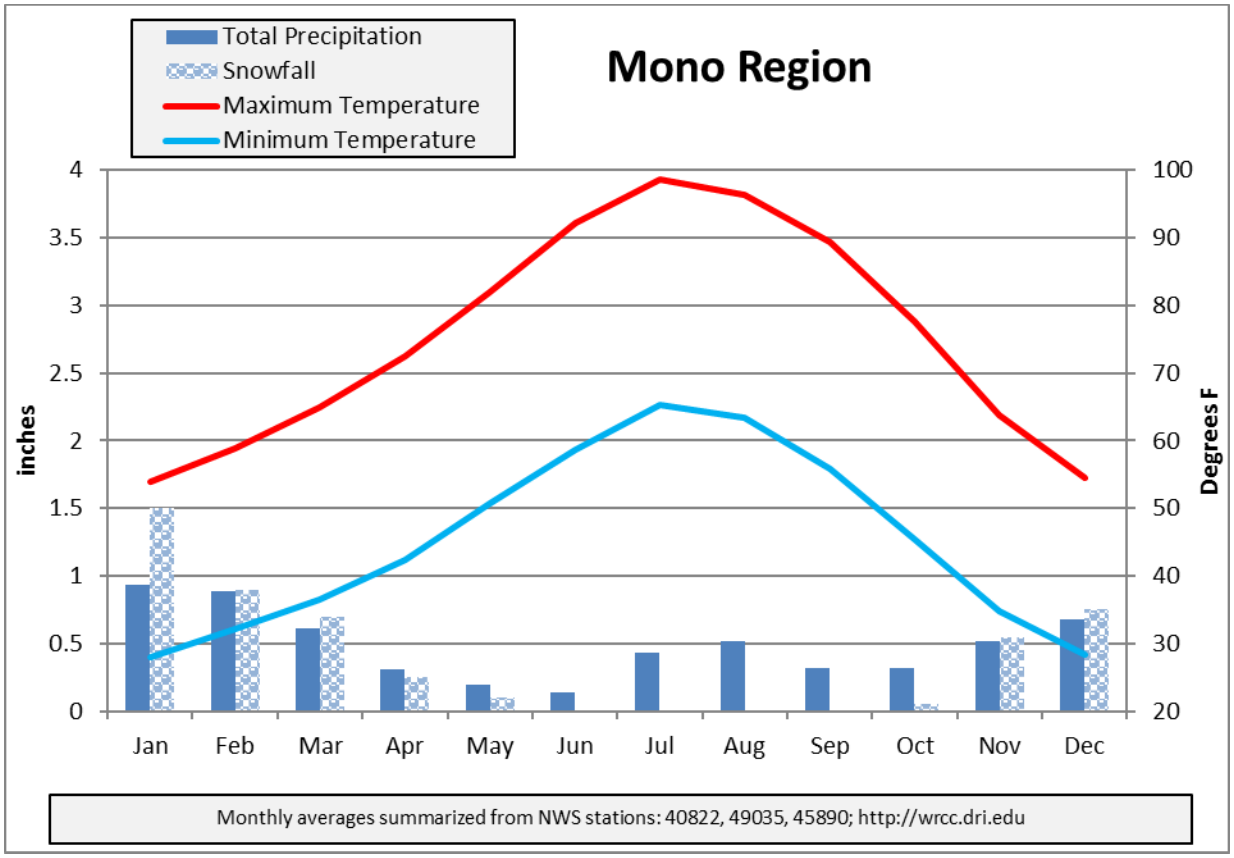

Chart A-19. Average annual patterns of temperature and precipitation, Mono Region.

1.12.2 Hydrology

The hydrology of Mono Region is dependent upon elevation. The lower elevation areas contain streams that are classified as Flashy, Ephemeral Rain (FER) or Low-Volume Snowmelt and Rain (LSR) systems. The streams found at the higher elevations in the northern part of the Mono Region are classified as Snowmelt (SM) systems. There is also an influence of Groundwater (GW) systems within the Owens River watershed. (Lane et al 2016)

Please refer to Figure A-67 for a depiction of the stream classifications within the Mono Region.

1.12.3 Geology

The Mono Region is located in the Sierra Nevada, Basin and Range, and Mojave Desert geomorphic provinces. The Sierra Nevada geomorphic province contains steep mountains underlain by a granitic batholith. The foothill regions of the Sierra Nevada geomorphic province are comprised of metamorphic rocks.

1.12.4 Anadromous Salmonid Population

No anadromous salmonids are present in the Mono Region.

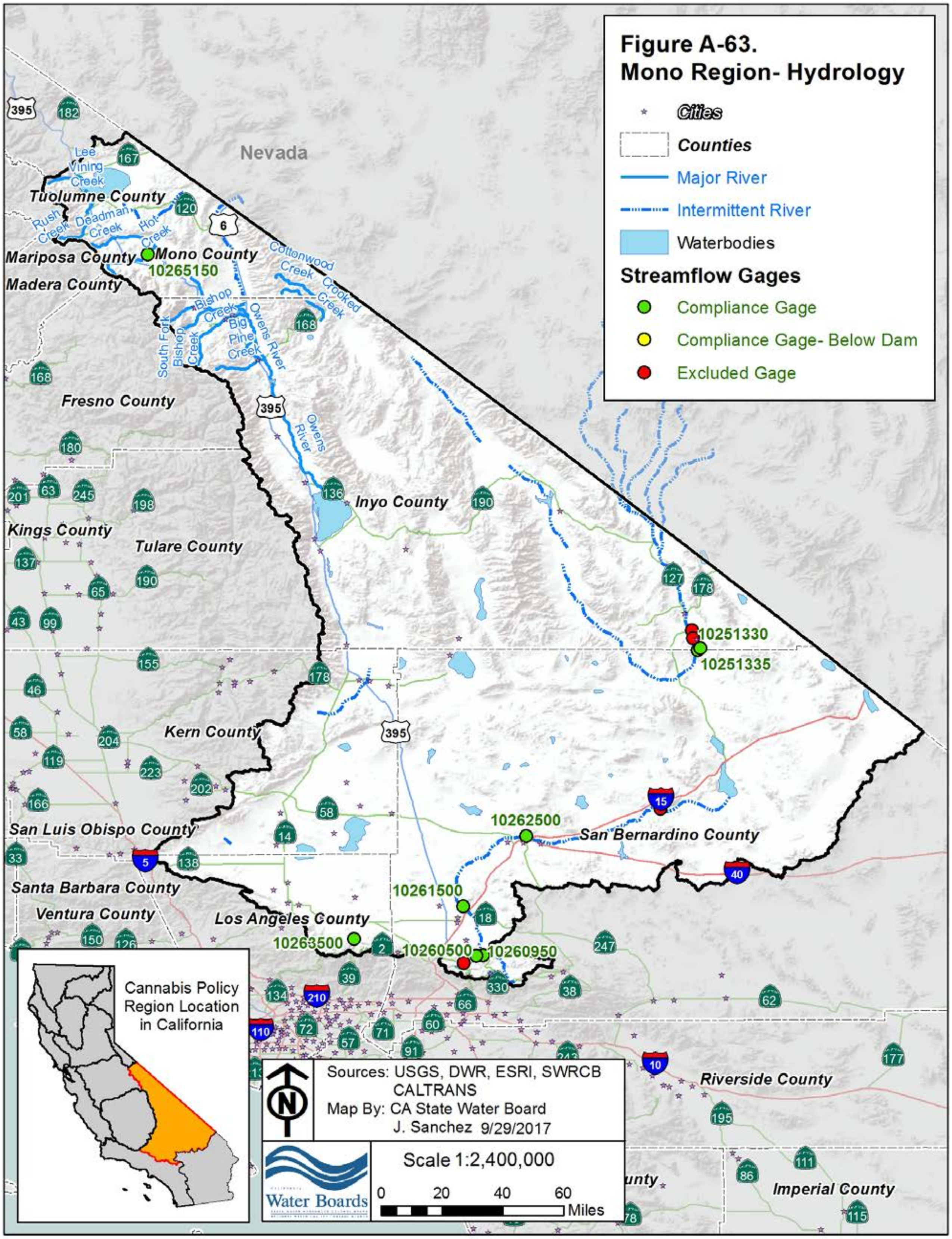
Figure A-63.
Mono Region- Hydrology
Cities
Counties
Major River
Intermittent River
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Nevada
Tuolumne County
Mariposa County
Mono County
Madera County
Fresno County
Inyo County
Kings County
Tulare County
Kern County
San Luis Obispo County
Santa Barbara County
Ventura County
Los Angeles County
San Bernardino County
Riverside County
Imperial County
Lee Vining Creek
Rush Creek
Deadman Creek
Hot Creek
Cottonwood Creek
Crooked Creek
Bishop Creek
South Fork Bishop Creek
Big Pine Creek
Owens River
10265150
10251330
10251335
10262500
10261500
10263500
10260500
10260950
Cannabis Policy Region Location in California
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:2,400,000
0 20 40 60 Miles
Water Boards

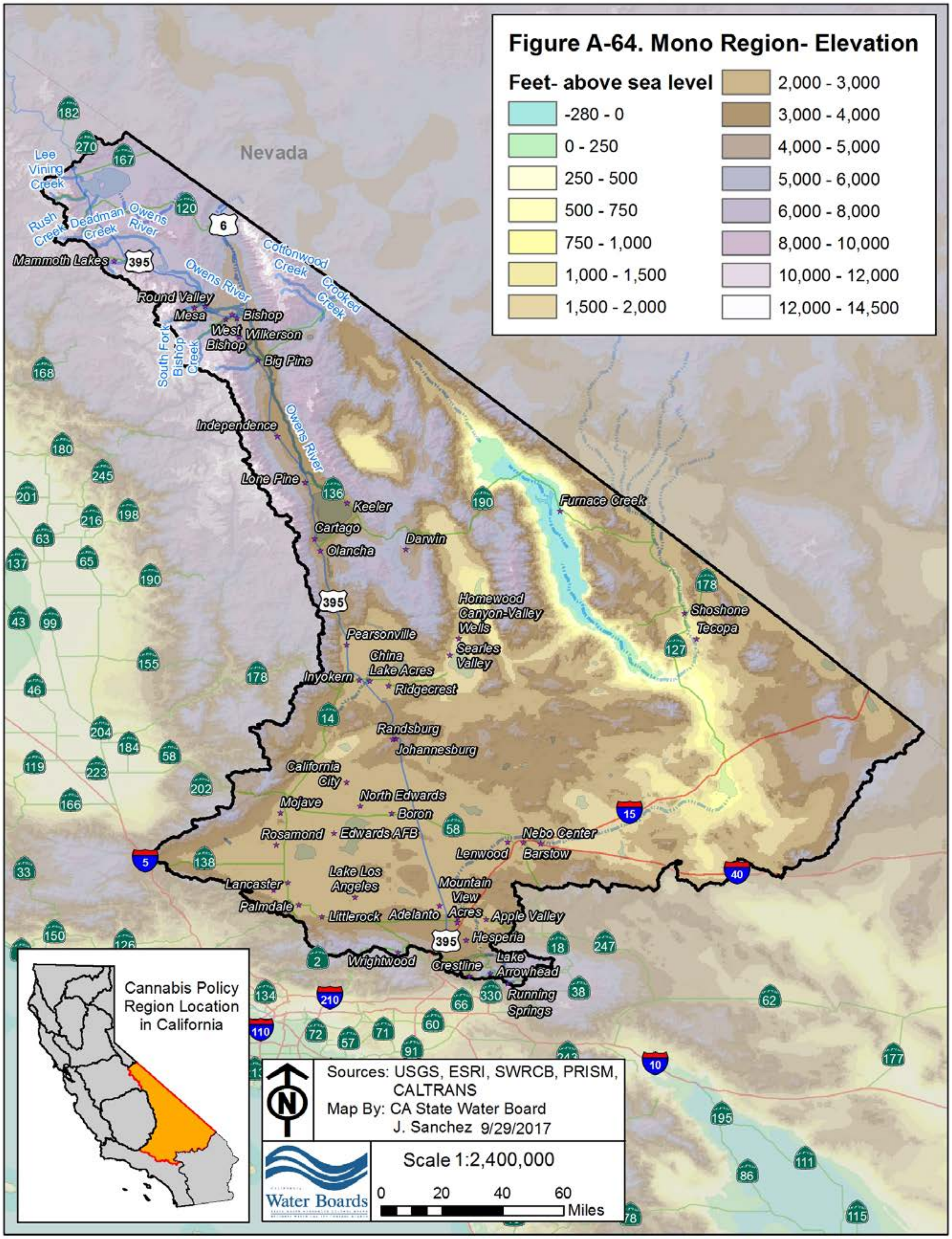

Figure A-64. Mono Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
10,000 - 12,000
12,000 - 14,500
Nevada
Mammoth Lakes
Round Valley
Mesa
Bishop
West Bishop
Wilkerson
Big Pine
Independence
Lone Pine
Keeler
Cartago
Olancha
Darwin
Furnace Creek
Homewood Canyon-Valley Wells
Searles Valley
Shoshone
Tecopa
Pearsonville
China Lake Acres
Inyokern
Ridgecrest
Randsburg
Johannesburg
California City
North Edwards
Mojave
Boron
Rosamond
Edwards AFB
Nebo Center
Lenwood
Barstow
Lake Los Angeles
Lancaster
Palmdale
Littlerock
Adelanto
Mountain View Acres
Apple Valley
Hesperia
Wrightwood
Crestline
Lake Arrowhead
Running Springs
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:2,400,000
0 20 40 60 Miles
Water Boards

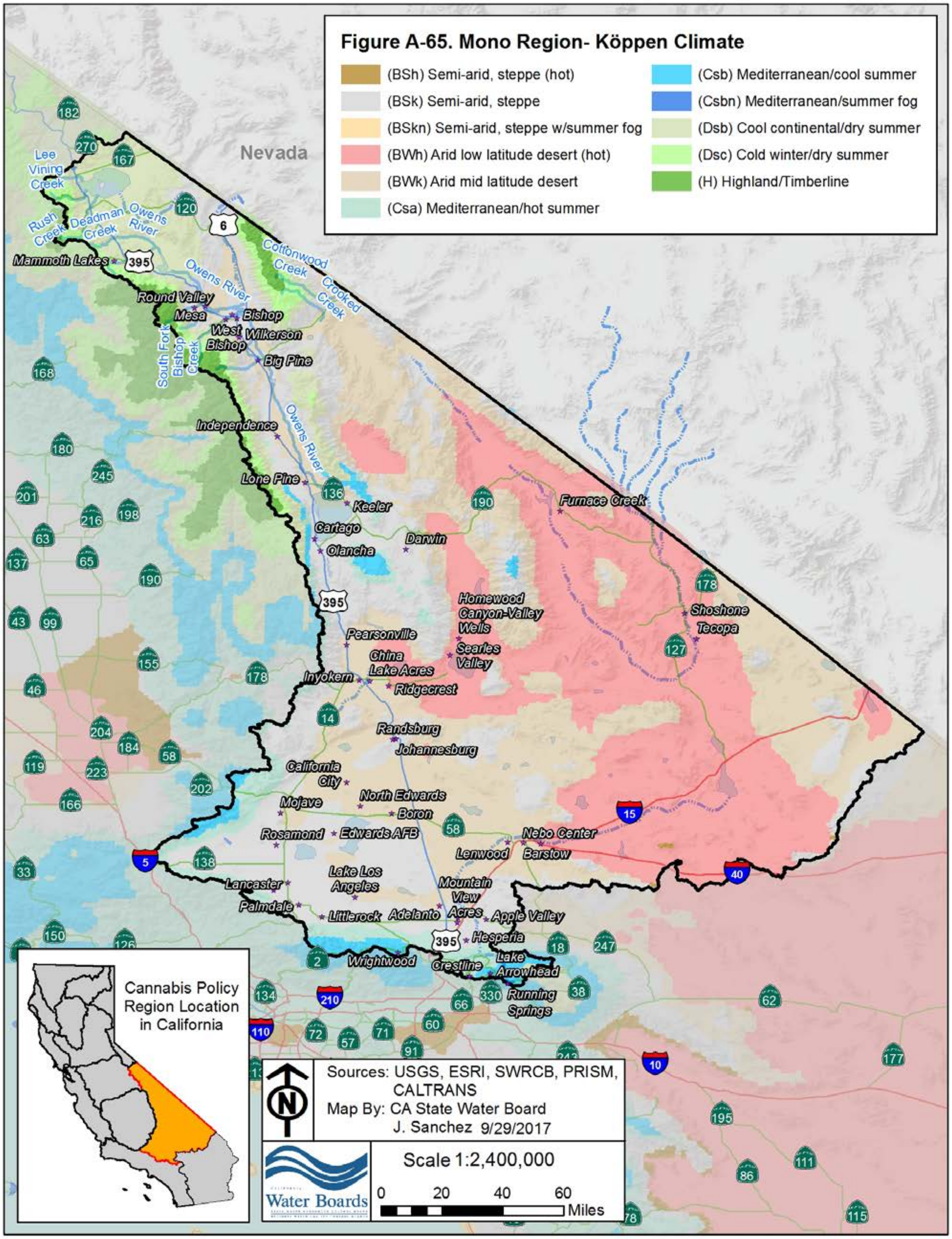

Figure A-65. Mono Region- Köppen Climate
(BSh) Semi-arid, steppe (hot)
(BSk) Semi-arid, steppe
(BSkn) Semi-arid, steppe w/summer fog
(BWh) Arid low latitude desert (hot)
(BWk) Arid mid latitude desert
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Csbn) Mediterranean/summer fog
(Dsb) Cool continental/dry summer
(Dsc) Cold winter/dry summer
(H) Highland/Timberline
Nevada
Lee Vining Creek
Rush Creek
Deadman Creek
Owens River
Mammoth Lakes
Cottonwood Creek
Crooked Creek
Round Valley
Mesa
Bishop
West Bishop
Wilkerson
Big Pine
South Fork Bishop Creek
Independence
Lone Pine
Keeler
Cartago
Olancha
Darwin
Furnace Creek
Homewood Canyon-Valley Wells
Searles Valley
Shoshone
Tecopa
Pearsonville
China Lake Acres
Inyokern
Ridgecrest
Randsburg
Johannesburg
California City
North Edwards
Mojave
Boron
Rosamond
Edwards AFB
Nebo Center
Lenwood
Barstow
Lake Los Angeles
Lancaster
Palmdale
Littlerock
Adelanto
Mountain View Acres
Apple Valley
Hesperia
Wrightwood
Crestline
Lake Arrowhead
Running Springs
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:2,400,000
0 20 40 60 Miles
Water Boards

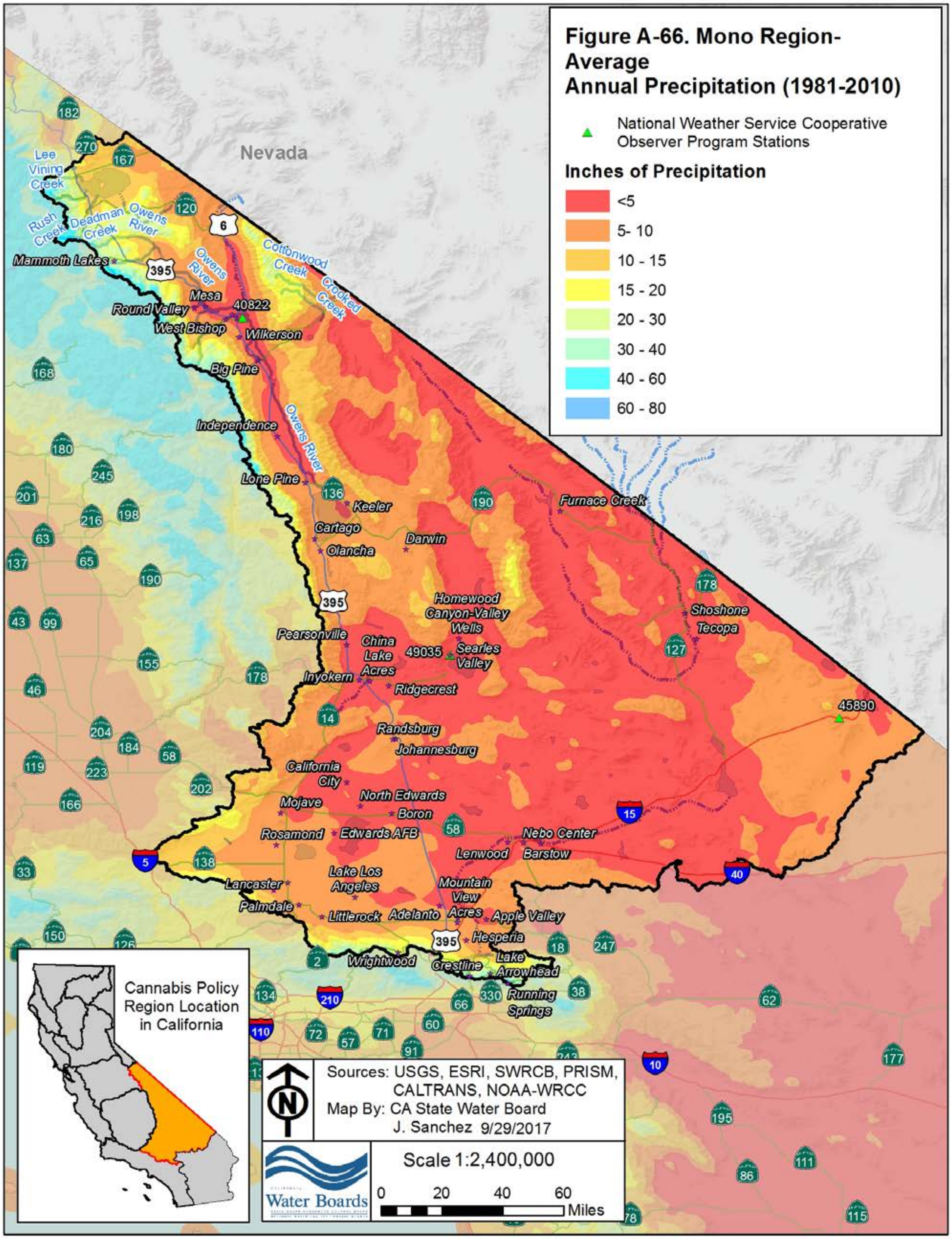

Figure A-66. Mono Region-Average Annual Precipitation (1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
<5
5- 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
Nevada
Lee Vining Creek
Rush Creek
Deadman Creek
Owens River
Mammoth Lakes
Cottonwood Creek
Crooked Creek
Mesa
Round Valley
West Bishop
40822
Wilkerson
Big Pine
Independence
Lone Pine
Keeler
Cartago
Olancha
Darwin
Furnace Creek
Homewood Canyon-Valley Wells
Shoshone
Tecopa
Pearsonville
China Lake Acres
49035
Searles Valley
Inyokern
Ridgecrest
45890
Randsburg
Johannesburg
California City
North Edwards
Mojave
Boron
Rosamond
Edwards AFB
Nebo Center
Lenwood
Barstow
Lake Los Angeles
Lancaster
Mountain View Acres
Palmdale
Littlerock
Adelanto
Apple Valley
Hesperia
Wrightwood
Crestline
Lake Arrowhead
Running Springs
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS, NOAA-WRCC
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:2,400,000
0 20 40 60 Miles
Water Boards

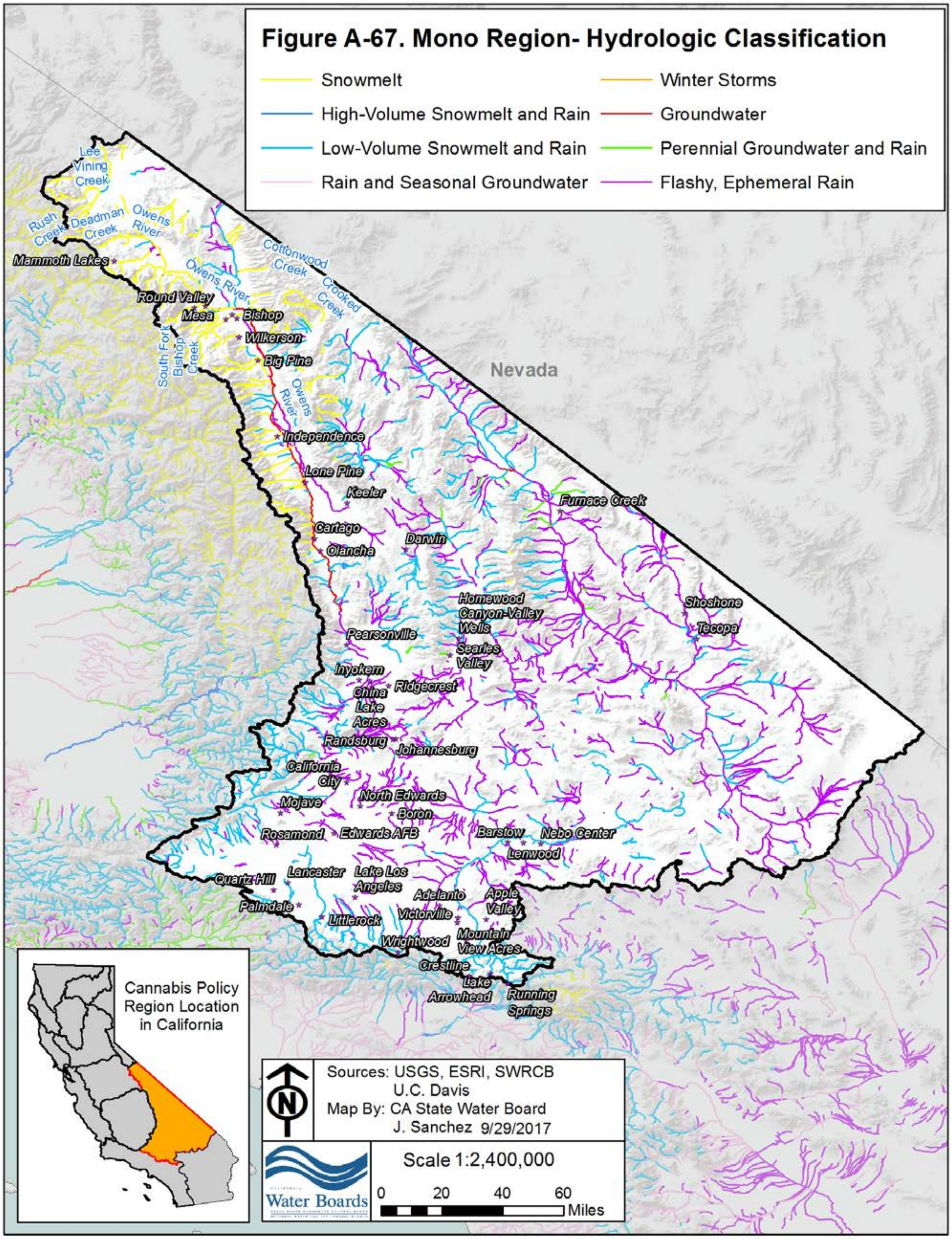

Figure A-67. Mono Region- Hydrologic Classification
Snowmelt
Winter Storms
High-Volume Snowmelt and Rain
Groundwater
Low-Volume Snowmelt and Rain
Perennial Groundwater and Rain
Rain and Seasonal Groundwater
Flashy, Ephemeral Rain
Lee Vining Creek
Rush Creek
Deadman Creek
Owens River
Mammoth Lakes
Cottonwood Creek
Crooked Creek
Round Valley
Mesa
Bishop
Wilkerson
Big Pine
South Fork Bishop Creek
Nevada
Independence
Lone Pine
Keeler
Furnace Creek
Cartago
Darwin
Olancha
Homewood Canyon-Valley Wells
Shoshone
Tecopa
Pearsonville
Searles Valley
Inyokern
Ridgecrest
China Lake Acres
Randsburg
Johannesburg
California City
North Edwards
Mojave
Boron
Rosamond
Edwards AFB
Barstow
Nebo Center
Lenwood
Lancaster
Lake Los Angeles
Quartz Hill
Adelanto
Apple Valley
Palmdale
Littlerock
Victorville
Mountain View Acres
Wrightwood
Crestline
Lake Arrowhead
Running Springs
Cannabis Policy Region Location in California
Sources: USGS, ESRI, SWRCB U.C. Davis
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:2,400,000
0 20 40 60 Miles
Water Boards

1.13 Kern Region

The Kern Region covers approximately 16,859 square miles in central southern California (Figure A-68). The Kern Region covers the southernmost part of the San Joaquin Valley. Elevations of the Kern Region vary greatly with elevations in the valley floor being near sea level and the highest elevation of 14,505 feet above sea level at Mount Whitney, the highest peak in the contiguous United States. Please refer to Figure A-69 for an elevation map of the region. The region includes the watersheds of the Kings River, Tule River, Kaweah River, Deer Creek, Poso Creek, and Kern River.

1.13.1 Climate and Precipitation

The climate of the Kern Region varies greatly with most changes related to changes in elevation. The valley area is dominated by Semi-arid, steppe climate with some Arid low latitude desert areas in the south and to the west. The climate transitions to Mediterranean with hot summers; Mediterranean with cool summers; Semi-arid, steppe, cold winter with dry summer; and Highland/Timberline in the eastern part of the region and at higher elevations of the Sierra Nevada Mountain Range. Please refer to Figure A-70 for a climatic map of the Kern Region.

Temperature patterns in the Kern Region are also driven by elevation, with cooler temperatures being found at the higher elevations at the eastern part of the region. At the higher elevations, average annual minimum temperatures are between 15 and 25 degrees Fahrenheit, and average annual maximum temperatures can reach between 40 and 45 degrees Fahrenheit. The lowest elevations experience average annual minimum temperatures between 50 and 55 degrees Fahrenheit and average annual maximum temperatures up to 85 degrees Fahrenheit.

Precipitation also varies greatly within the Kern Region. The highest annual average precipitation occurs in the eastern portion of the region at higher elevations of the Sierra Nevada Mountain Range with up to 60 inches of precipitation occurring on an annual average. The least amount of annual average precipitation occurs at the southern part of the valley floor where less than five inches of precipitation falls on an annual basis.

Please refer to Figure A-71 for a precipitation map of the region. Please refer to Charts A-20 and A-21, below, for a comparison of precipitation and temperature conditions for the valley floor and Sierra Mountains portions of the Kern Region

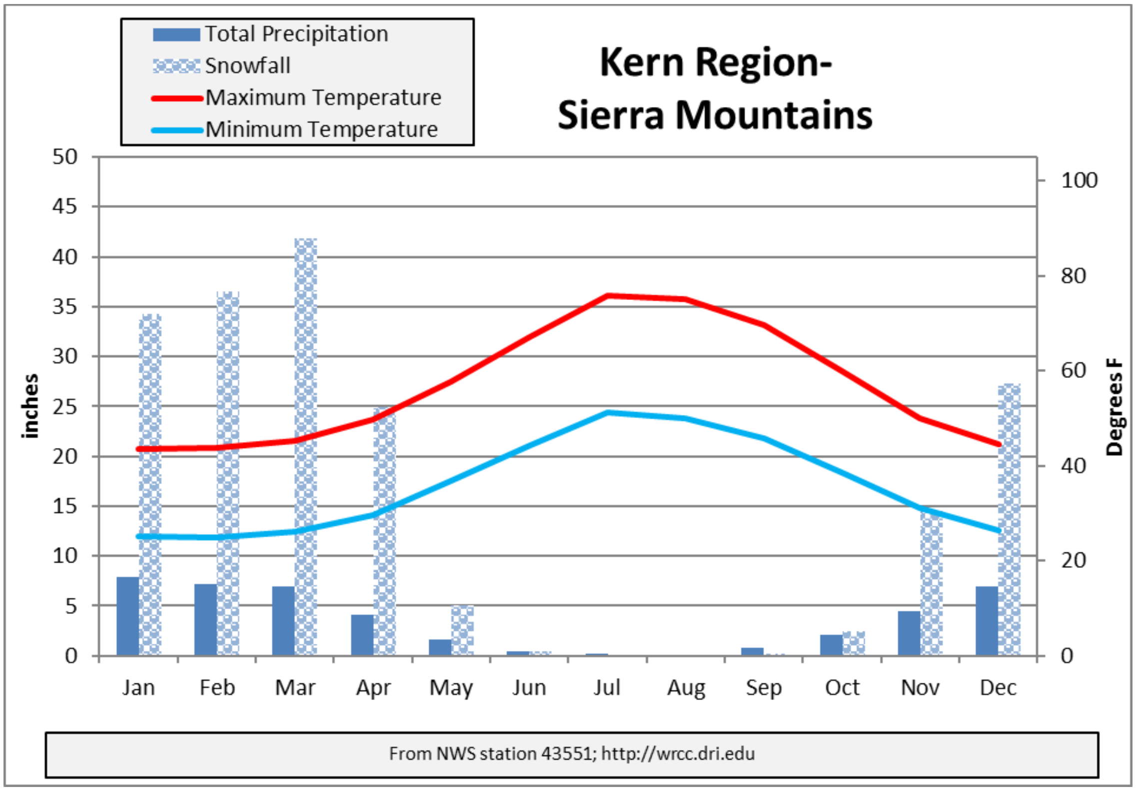

Chart A-20. Average annual patterns of temperature and precipitation, Kern Region, Sierra Mountains

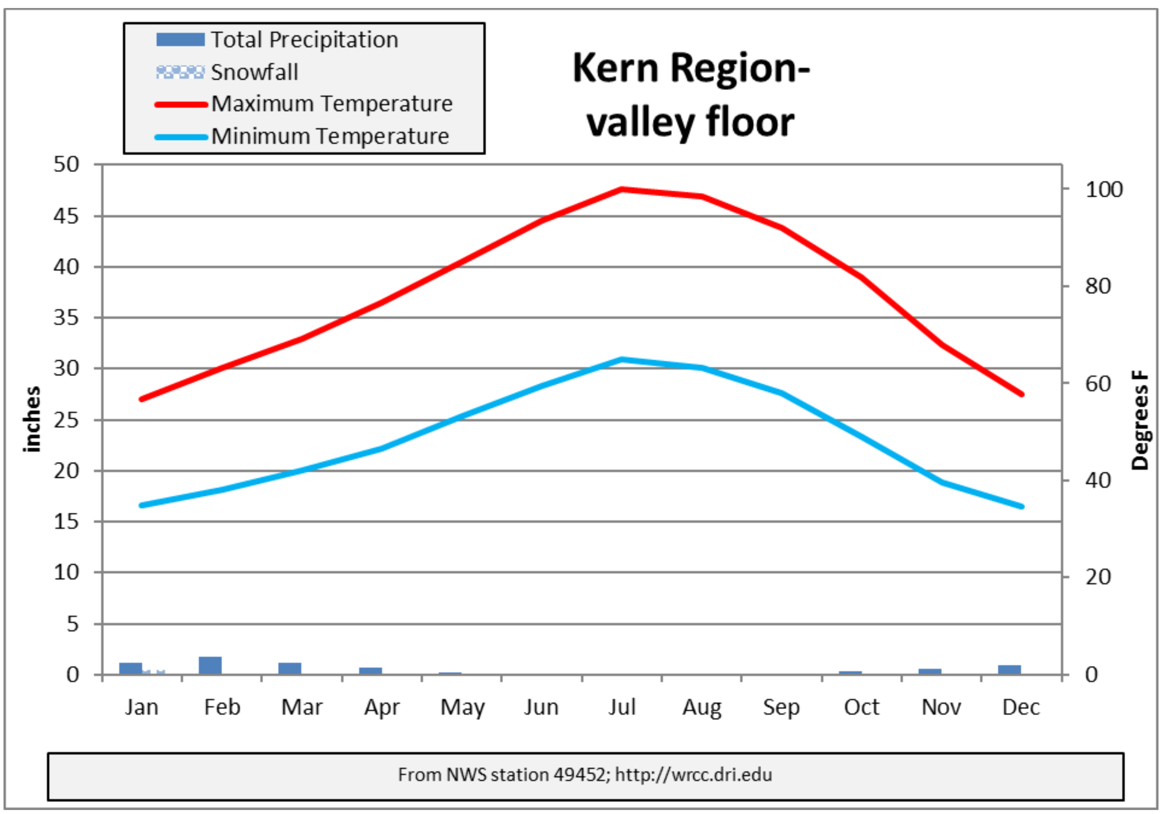

Chart A-21. Average annual patterns of temperature and precipitation, Kern Region, valley floor.

1.13.2 Hydrology

The hydrology of Kern Region streams varies greatly depending upon elevation. The major streams at the valley floor are classified as High Volume Snowmelt and Rain (HSR) systems. In the lower foothills to the east, the streams are a mix of Low-Volume Snowmelt and Rain (LSR) and Perennial Groundwater and Rain (PGR) systems. The highest elevations in the eastern part of the Kern Region are dominated by Snowmelt (SM) systems. The higher elevations located in the western part of the region contain a mix of PGR and Flashy, Ephemeral Rain (FER) systems. (Lane et al 2016)

Please refer to Figure A-72 for a depiction of the stream classifications within the South Coast Region.

1.13.3 Geology

The Kern Region is located in the Sierra Nevada, Great Valley, and Coastal Ranges geomorphic provinces. The Sierra Nevada geomorphic province contains steep mountains underlain by a granitic batholith. The foothill regions of the Sierra Nevada geomorphic province are comprised of metamorphic rocks. The Coast Ranges geomorphic province is comprised of sedimentary and metamorphic rock and alluvial deposits in valleys and along the coastline. The Great Valley geomorphic province consist of a large alluvial plain.

1.13.4 Anadromous Salmonid Population

Two special-status ESU, DPS, or DTE are currently extant within the Kern Region (Figure A-53):

- CV FR Chinook salmon.
- CV LFR Chinook salmon.

The CV FR and CV LFR Chinook salmon populations are each listed as species of special concern by CDFW and, jointly, as a species of concern by NMFS (Moyle et al. 2015, NMFS 2017).

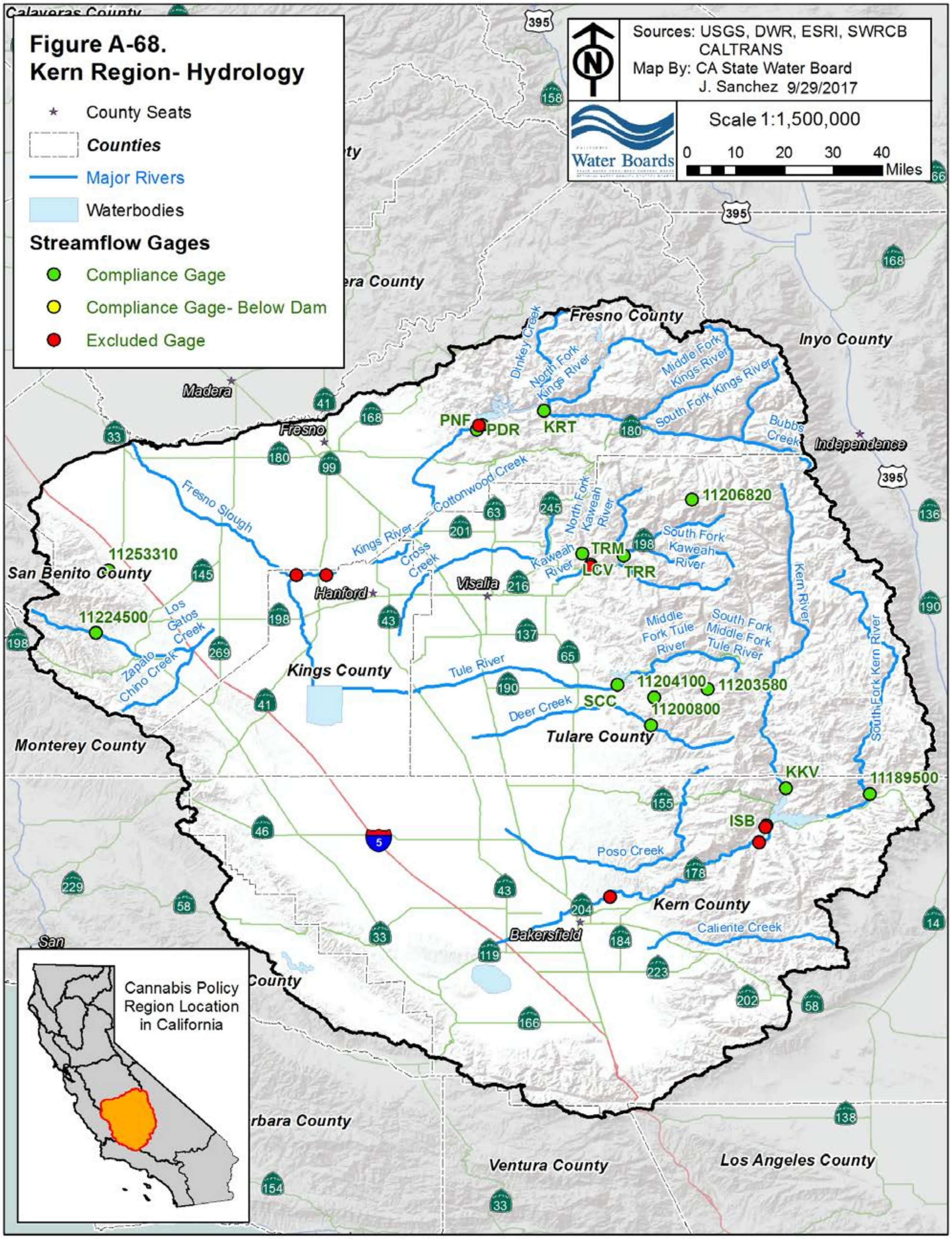
Figure A-68.
Kern Region- Hydrology
County Seats
Counties
Major Rivers
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Sources: USGS, DWR, ESRI, SWRCB
CALTRANS
Map By: CA State Water Board
J. Sanchez 9/29/2017
Water Boards
Scale 1:1,500,000
0 10 20 30 40
Miles
Cannabis Policy
Region Location
in California
Fresno County
Inyo County
San Benito County
Kings County
Monterey County
Tulare County
Kern County
Ventura County
Los Angeles County
Madera
Fresno
Hanford
Visalia
Bakersfield
Independence
Fresno Slough
Kings River
Cross Creek
Cottonwood Creek
Dinkey Creek
North Fork Kings River
Middle Fork Kings River
South Fork Kings River
Bubbs Creek
North Fork Kaweah River
South Fork Kaweah River
Kaweah River
Kern River
South Fork Kern River
Middle Fork Tule River
South Fork Middle Fork Tule River
Tule River
Deer Creek
Poso Creek
Caliente Creek
Los Gatos Creek
Zapato Chino Creek
PNF
PDR
KRT
TRM
LCV
TRR
SCC
KKV
ISB
11206820
11253310
11224500
11204100
11203580
11200800
11189500

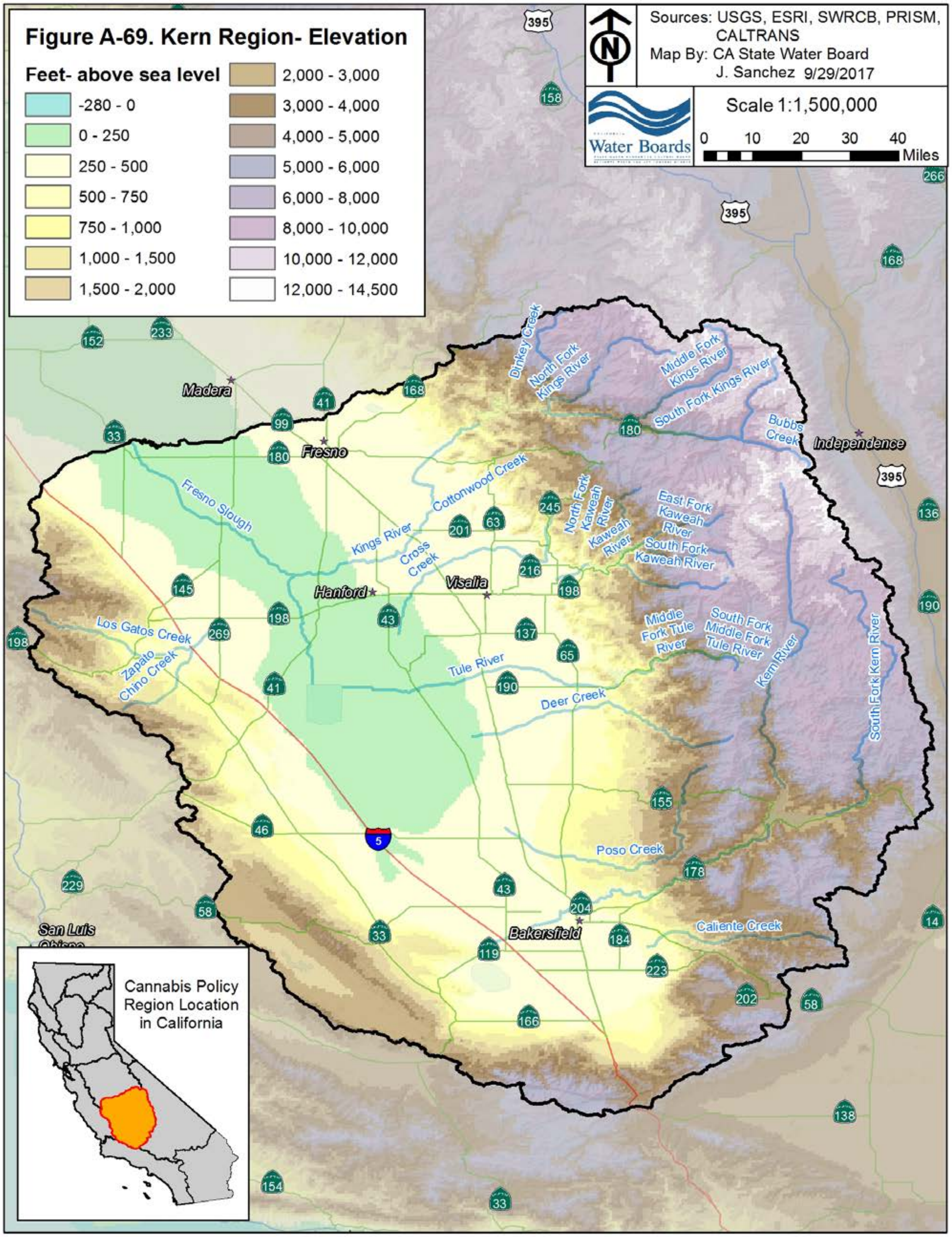
Figure A-69. Kern Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
10,000 - 12,000
12,000 - 14,500
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board
J. Sanchez 9/29/2017
Water Boards
Scale 1:1,500,000
0 10 20 30 40 Miles
Madera
Fresno
Hanford
Visalia
Bakersfield
Independence
San Luis Obispo
Dinkey Creek
North Fork Kings River
Middle Fork Kings River
South Fork Kings River
Bubbs Creek
Cottonwood Creek
Fresno Slough
Kings River
Cross Creek
North Fork Kaweah River
Kaweah River
East Fork Kaweah River
South Fork Kaweah River
Los Gatos Creek
Zapato Chino Creek
Middle Fork Tule River
South Fork Middle Fork Tule River
Kern River
South Fork Kern River
Tule River
Deer Creek
Poso Creek
Caliente Creek
Cannabis Policy Region Location in California

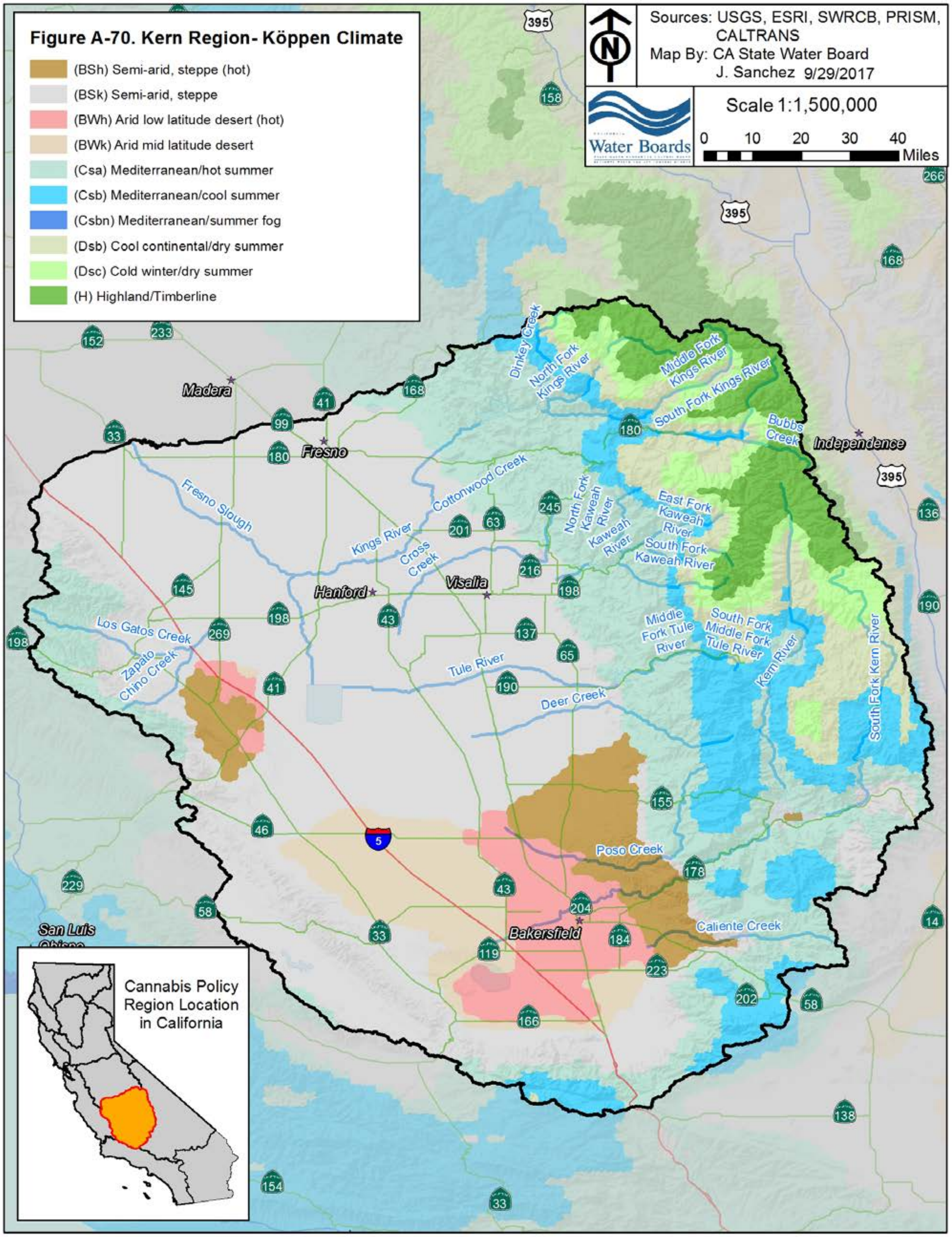
Figure A-70. Kern Region- Köppen Climate
(BSh) Semi-arid, steppe (hot)
(BSk) Semi-arid, steppe
(BWh) Arid low latitude desert (hot)
(BWk) Arid mid latitude desert
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Csbn) Mediterranean/summer fog
(Dsb) Cool continental/dry summer
(Dsc) Cold winter/dry summer
(H) Highland/Timberline
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board
J. Sanchez 9/29/2017
Scale 1:1,500,000
0 10 20 30 40 Miles
Water Boards
Madera
Fresno
Hanford
Visalia
Bakersfield
Independence
San Luis Obispo
Dinkey Creek
North Fork Kings River
Middle Fork Kings River
South Fork Kings River
Bubbs Creek
Cottonwood Creek
Fresno Slough
Kings River
Cross Creek
North Fork Kaweah River
Kaweah River
East Fork Kaweah River
South Fork Kaweah River
Middle Fork Tule River
South Fork Middle Fork Tule River
Kern River
South Fork Kern River
Los Gatos Creek
Zapato Chino Creek
Tule River
Deer Creek
Poso Creek
Caliente Creek
Cannabis Policy Region Location in California

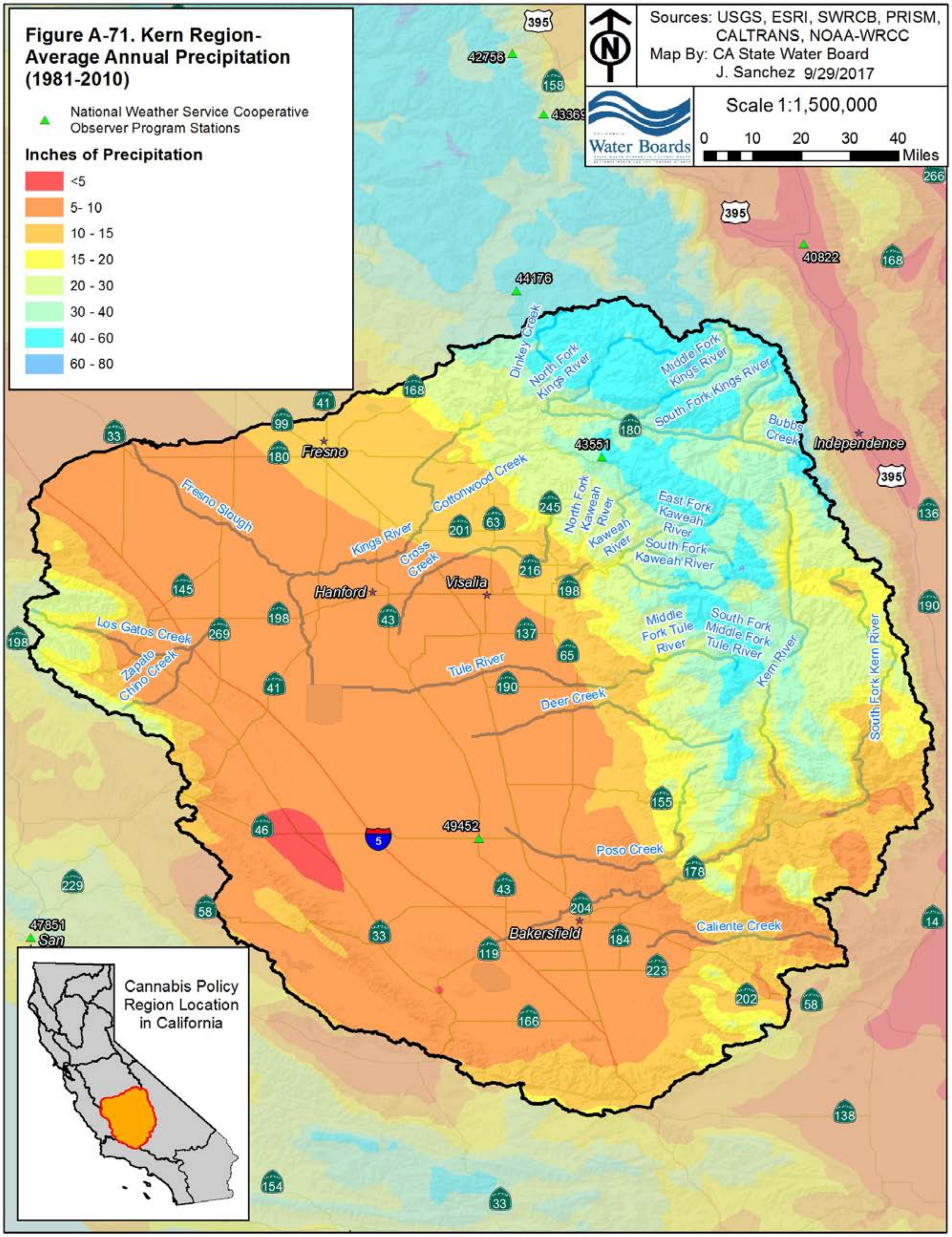
Figure A-71. Kern Region-
Average Annual Precipitation
(1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
<5
5- 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
60 - 80
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS, NOAA-WRCC
Map By: CA State Water Board
J. Sanchez 9/29/2017
Water Boards
Scale 1:1,500,000
0 10 20 30 40
Miles
Fresno
Hanford
Visalia
Bakersfield
Independence
Dinkey Creek
North Fork Kings River
Middle Fork Kings River
South Fork Kings River
Bubbs Creek
Cottonwood Creek
Fresno Slough
Kings River
Cross Creek
North Fork Kaweah River
Kaweah River
East Fork Kaweah River
South Fork Kaweah River
Middle Fork Tule River
South Fork Middle Fork Tule River
Kern River
South Fork Kern River
Los Gatos Creek
Zapato Chino Creek
Tule River
Deer Creek
Poso Creek
Caliente Creek
42756
43369
40822
44176
43551
49452
47851
Cannabis Policy Region Location in California

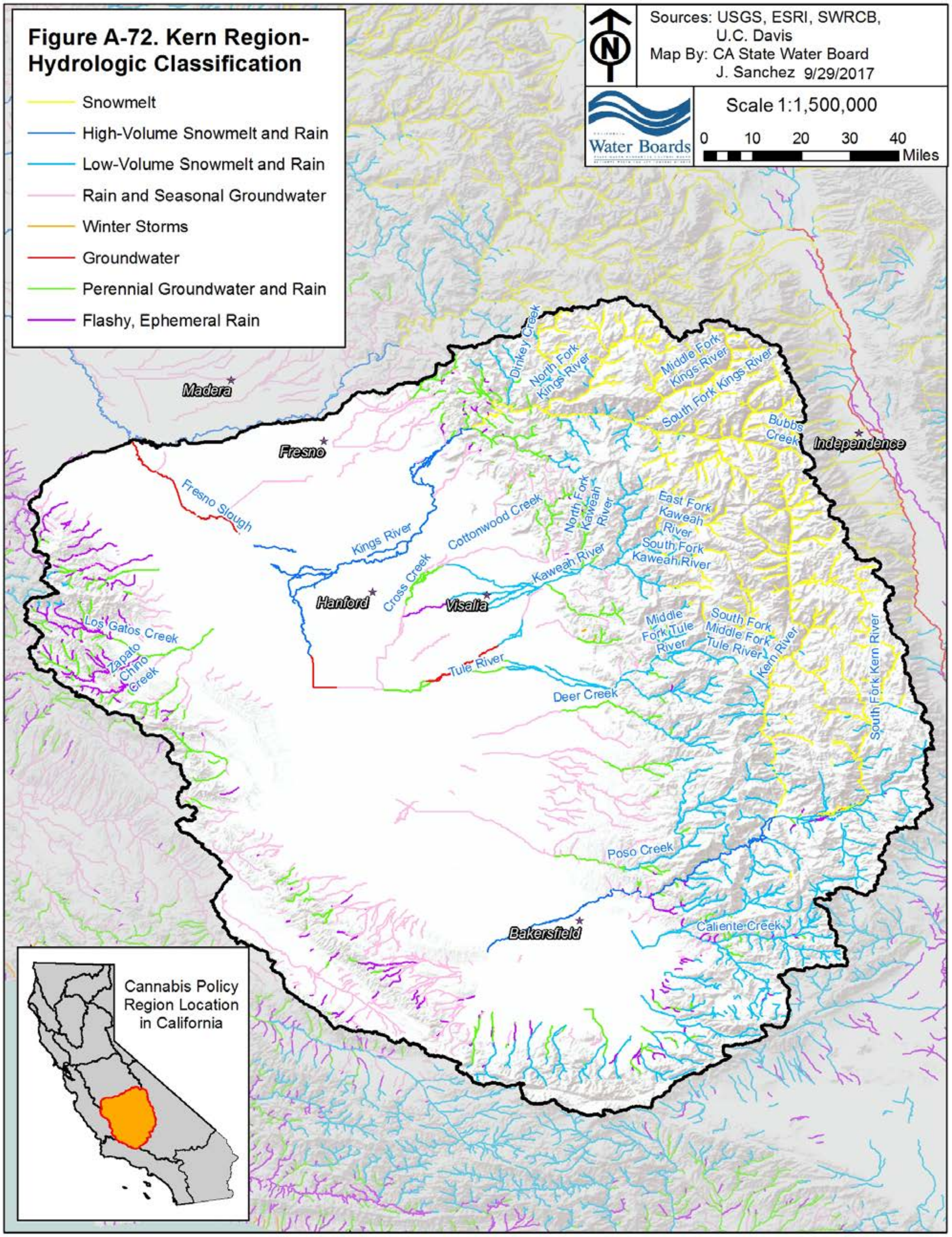
Figure A-72. Kern Region-Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Winter Storms
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
Sources: USGS, ESRI, SWRCB, U.C. Davis
Map By: CA State Water Board
J. Sanchez 9/29/2017
Water Boards
Scale 1:1,500,000
0 10 20 30 40 Miles
Madera
Fresno
Hanford
Visalia
Bakersfield
Independence
Dinkey Creek
North Fork Kings River
Middle Fork Kings River
South Fork Kings River
Bubbs Creek
Fresno Slough
Kings River
Cottonwood Creek
North Fork Kaweah River
East Fork Kaweah River
South Fork Kaweah River
Kaweah River
Cross Creek
Los Gatos Creek
Zapato Chino Creek
Middle Fork Tule River
South Fork Middle Fork Tule River
Kern River
South Fork Kern River
Tule River
Deer Creek
Poso Creek
Caliente Creek
Cannabis Policy Region Location in California

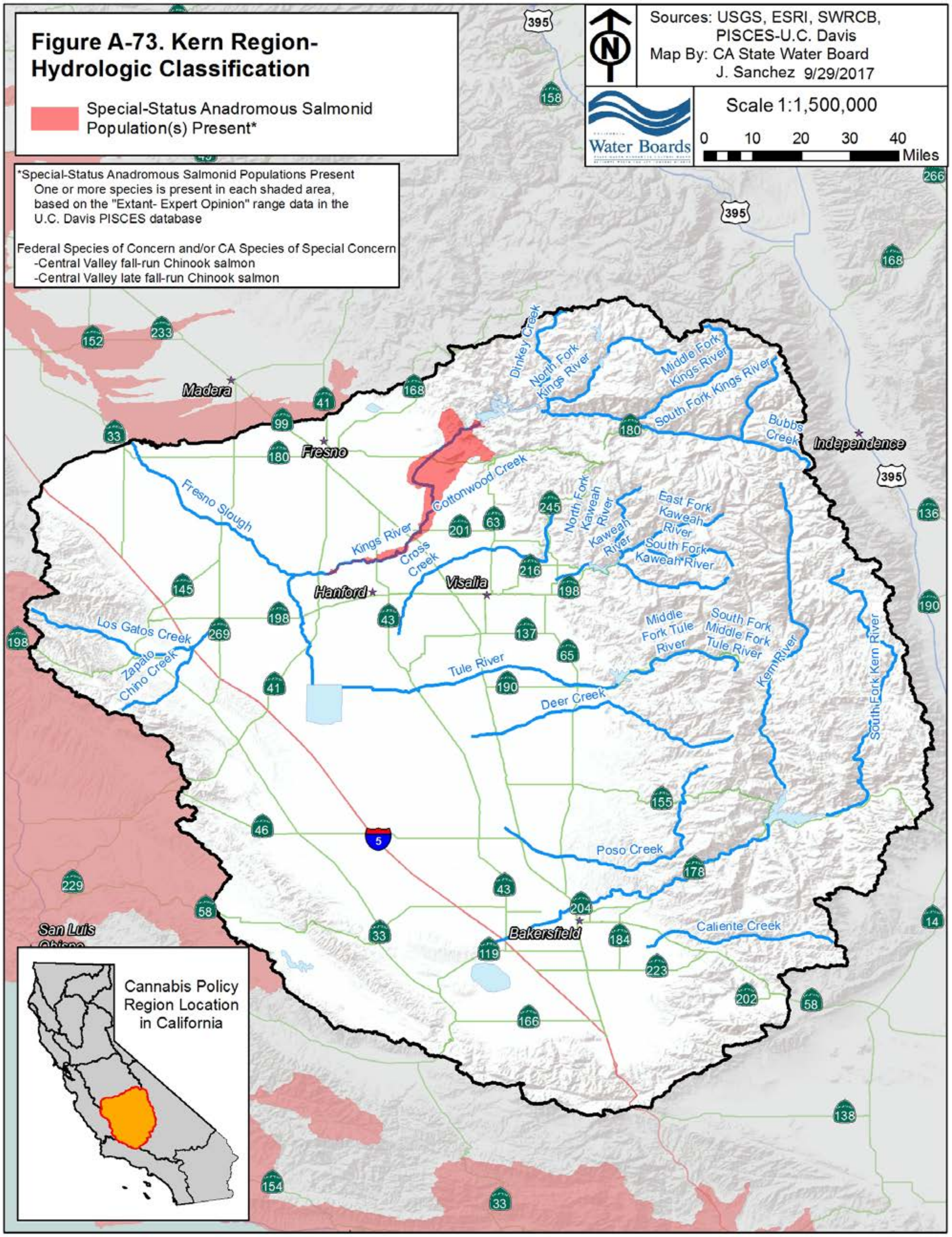

Figure A-73. Kern Region-
Hydrologic Classification
Special-Status Anadromous Salmonid Population(s) Present*
*Special-Status Anadromous Salmonid Populations Present
One or more species is present in each shaded area, based on the "Extant- Expert Opinion" range data in the U.C. Davis PISCES database
Federal Species of Concern and/or CA Species of Special Concern
-Central Valley fall-run Chinook salmon
-Central Valley late fall-run Chinook salmon
Sources: USGS, ESRI, SWRCB, PISCES-U.C. Davis
Map By: CA State Water Board
J. Sanchez 9/29/2017
Water Boards
Scale 1:1,500,000
0 10 20 30 40 Miles
Madera
Fresno
Hanford
Visalia
Bakersfield
Independence
San Luis Obispo
Fresno Slough
Kings River
Cross Creek
Cottonwood Creek
Dinkey Creek
North Fork Kings River
Middle Fork Kings River
South Fork Kings River
Bubbs Creek
North Fork Kaweah River
Kaweah River
East Fork Kaweah River
South Fork Kaweah River
Los Gatos Creek
Zapato Chino Creek
Middle Fork Tule River
South Fork Middle Fork Tule River
Tule River
Deer Creek
Kern River
South Fork Kern River
Poso Creek
Caliente Creek
Cannabis Policy Region Location in California

1.14 South East Desert Region

The South East Desert Region covers approximately 19,859 square miles in the southeastern corner of California (Figure A-74). Elevations in this region range from approximately 226 feet below sea level at Bombay Beach to over 11,000 feet above sea level at San Gorgonio Mountain. Please refer to Figure A-75 for an elevation map of the region. The region includes the watersheds of the Alamo River, New River, and Colorado River.

1.14.1 Climate and Precipitation

The climate of the South East Desert Region is generally characterized by an Arid low latitude desert climate (hot). There are small micro climates at the higher elevations of the western part of the region. These consist of Semi-arid steppe, Mediterranean with cool summer, Mediterranean with hot summer, and Arid mid latitude desert. Please refer to Figure A-76 for a climatic map of the South East Desert Region.

Temperatures patterns within the South East Desert Region vary only slightly with most of the region seeing very high annual maximum temperatures. The higher elevations of the western part of the South East Desert region exhibit average annual maximum temperatures over 80 degrees Fahrenheit and annual minimum temperatures of 45 degrees Fahrenheit. The inner areas of the South East Desert Region have average annual maximum temperatures of 90 degrees Fahrenheit and average minimum temperatures of 60 degrees Fahrenheit.

Annual average precipitation throughout the South East Desert Region is minimal, with most areas receiving less than five inches of precipitation annually. The western part of the South East Desert Region receives a little more with some areas receiving between 5 and 20 inches of precipitation annually. The areas of higher precipitation tend to be in areas of higher elevation.

Please refer to Figure A-77 for a precipitation map of the region. Please refer to Chart A-22, below, for an illustration of precipitation and temperature conditions in the South East Desert Region.

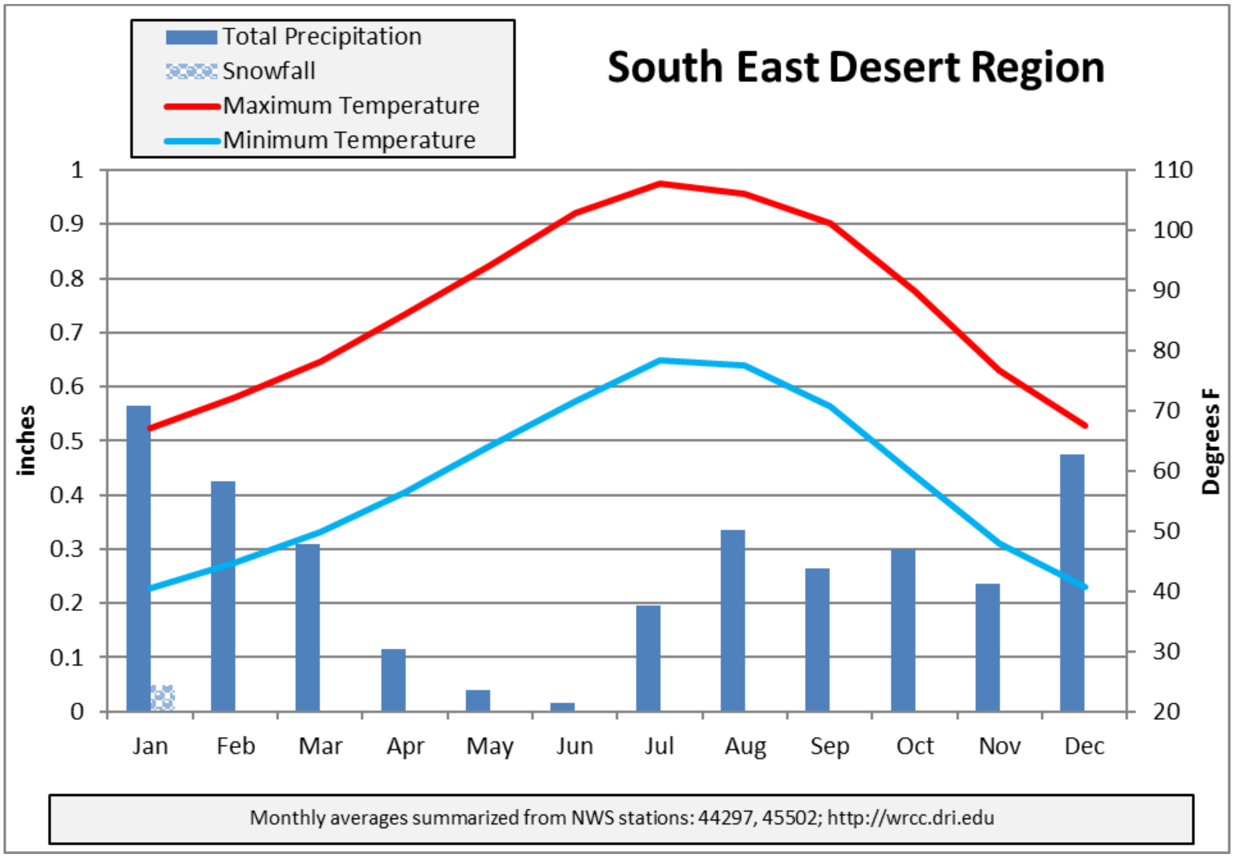

Chart A-22. Average annual patterns of temperature and precipitation, South East Desert Region.

1.14.2 Hydrology

The hydrology of South East Desert Region streams is dominated by Flashy, Ephemeral Rain (FER) systems. At higher elevations in the western part of the South East Desert Region there are streams characterized as Low-Volume Snowmelt and Rain (LSR) systems. (Lane et al 2016)

Please refer to Figure A-78 for a depiction of the stream classifications within the South Coast Region.

1.14.3 Geology

The South East Desert Region is located in the Mojave Desert, Colorado Desert, Peninsular Ranges, and Transverse Ranges geomorphic provinces. The Transverse Ranges geomorphic province contains steep mountain ranges and valleys oriented perpendicular to the other coastal mountain ranges. The Peninsular Ranges geomorphic province is characterized by topography similar to the Coast Ranges, but with rock types more similar to the Sierra Nevada mountains.

1.14.4 Anadromous Salmonid Population

No anadromous salmonids are present in the South East Desert Region.

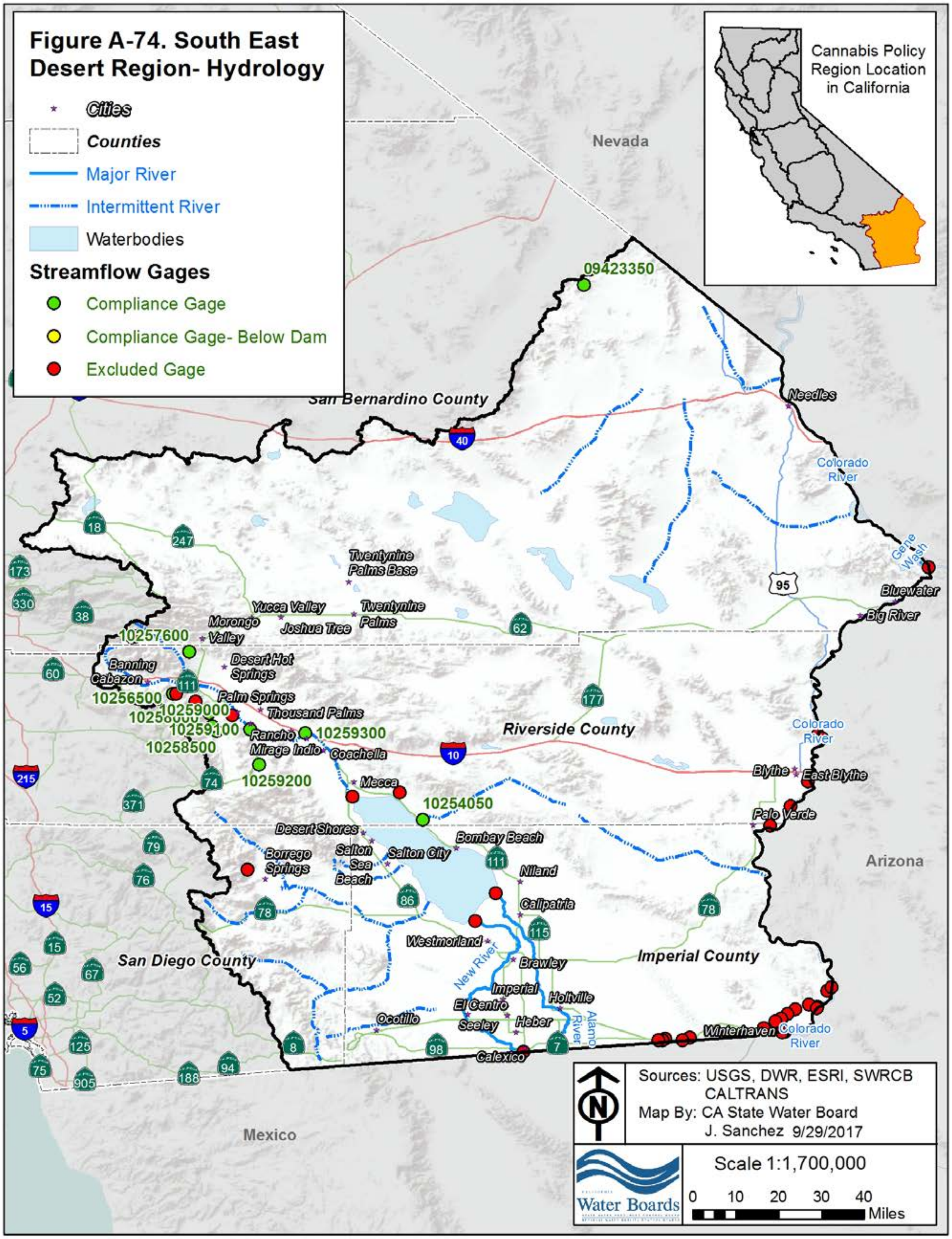
Figure A-74. South East Desert Region- Hydrology
Cities
Counties
Major River
Intermittent River
Waterbodies
Streamflow Gages
Compliance Gage
Compliance Gage- Below Dam
Excluded Gage
Cannabis Policy Region Location in California
Nevada
Arizona
Mexico
San Bernardino County
Riverside County
San Diego County
Imperial County
09423350
10257600
10256500
10259000
10259100
10259300
10258500
10259200
10254050
Needles
Colorado River
Gene Wash
Bluewater
Big River
Blythe
East Blythe
Palo Verde
Twentynine Palms Base
Yucca Valley
Twentynine Palms
Morongo Valley
Joshua Tree
Desert Hot Springs
Banning
Cabazon
Palm Springs
Thousand Palms
Rancho Mirage
Indio
Coachella
Mecca
Desert Shores
Bombay Beach
Borrego Springs
Salton Sea Beach
Salton City
Niland
Calipatria
Westmorland
Brawley
New River
Imperial
Holtville
El Centro
Seeley
Heber
Alamo River
Ocotillo
Calexico
Winterhaven
Sources: USGS, DWR, ESRI, SWRCB CALTRANS
Map By: CA State Water Board
J. Sanchez 9/29/2017
Water Boards
Scale 1:1,700,000
0 10 20 30 40 Miles

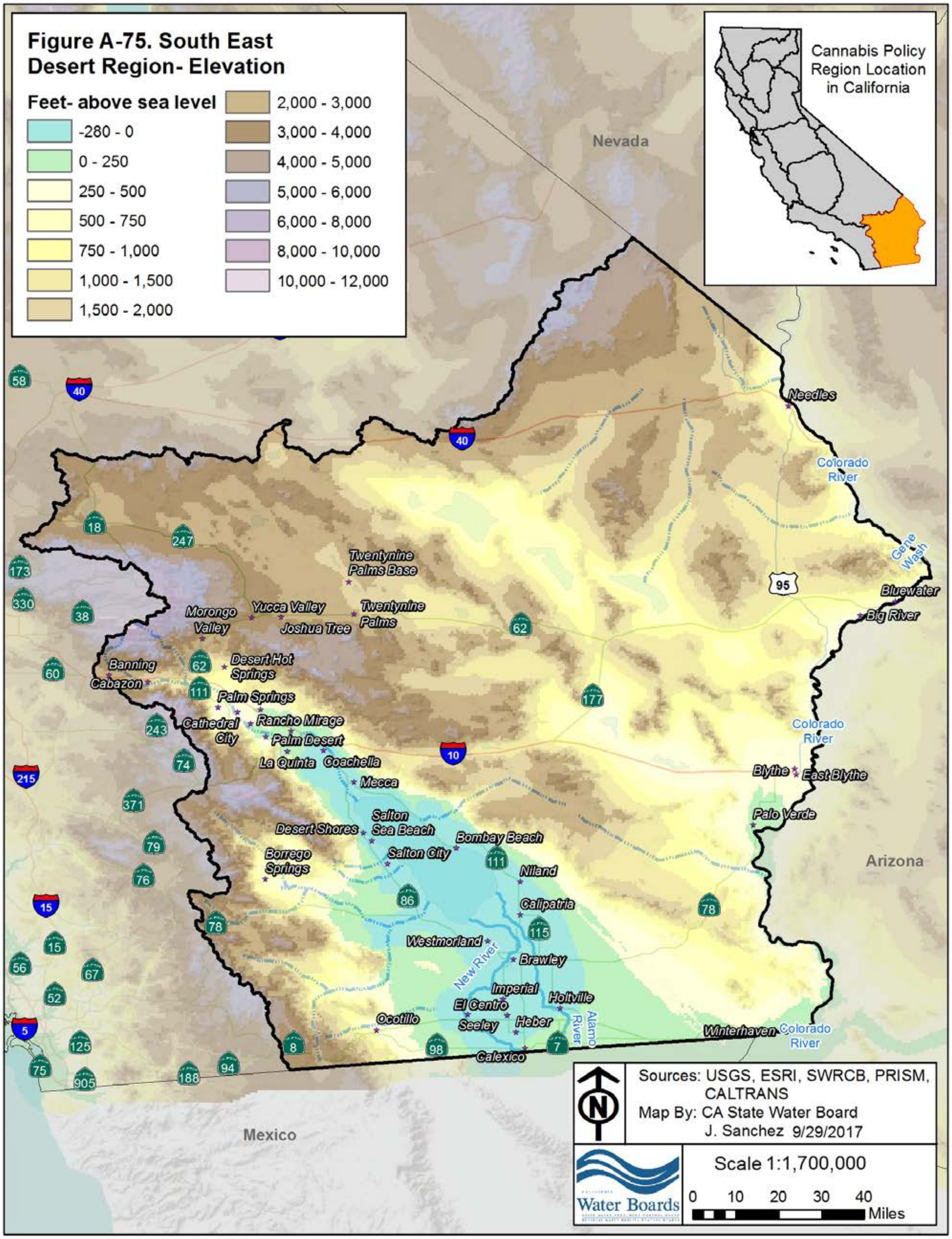

Figure A-75. South East Desert Region- Elevation
Feet- above sea level
-280 - 0
0 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 3,000
3,000 - 4,000
4,000 - 5,000
5,000 - 6,000
6,000 - 8,000
8,000 - 10,000
10,000 - 12,000
Cannabis Policy Region Location in California
Nevada
Arizona
Mexico
Needles
Colorado River
Gene Wash
Bluewater
Big River
Twentynine Palms Base
Yucca Valley
Twentynine Palms
Morongo Valley
Joshua Tree
Banning
Cabazon
Desert Hot Springs
Palm Springs
Cathedral City
Rancho Mirage
Palm Desert
La Quinta
Coachella
Mecca
Blythe
East Blythe
Palo Verde
Salton Sea Beach
Desert Shores
Bombay Beach
Borrego Springs
Salton City
Niland
Calipatria
Westmorland
Brawley
New River
Imperial
Holtville
El Centro
Ocotillo
Seeley
Heber
Alamo River
Calexico
Winterhaven
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board
J. Sanchez 9/29/2017
Scale 1:1,700,000
0 10 20 30 40 Miles
Water Boards

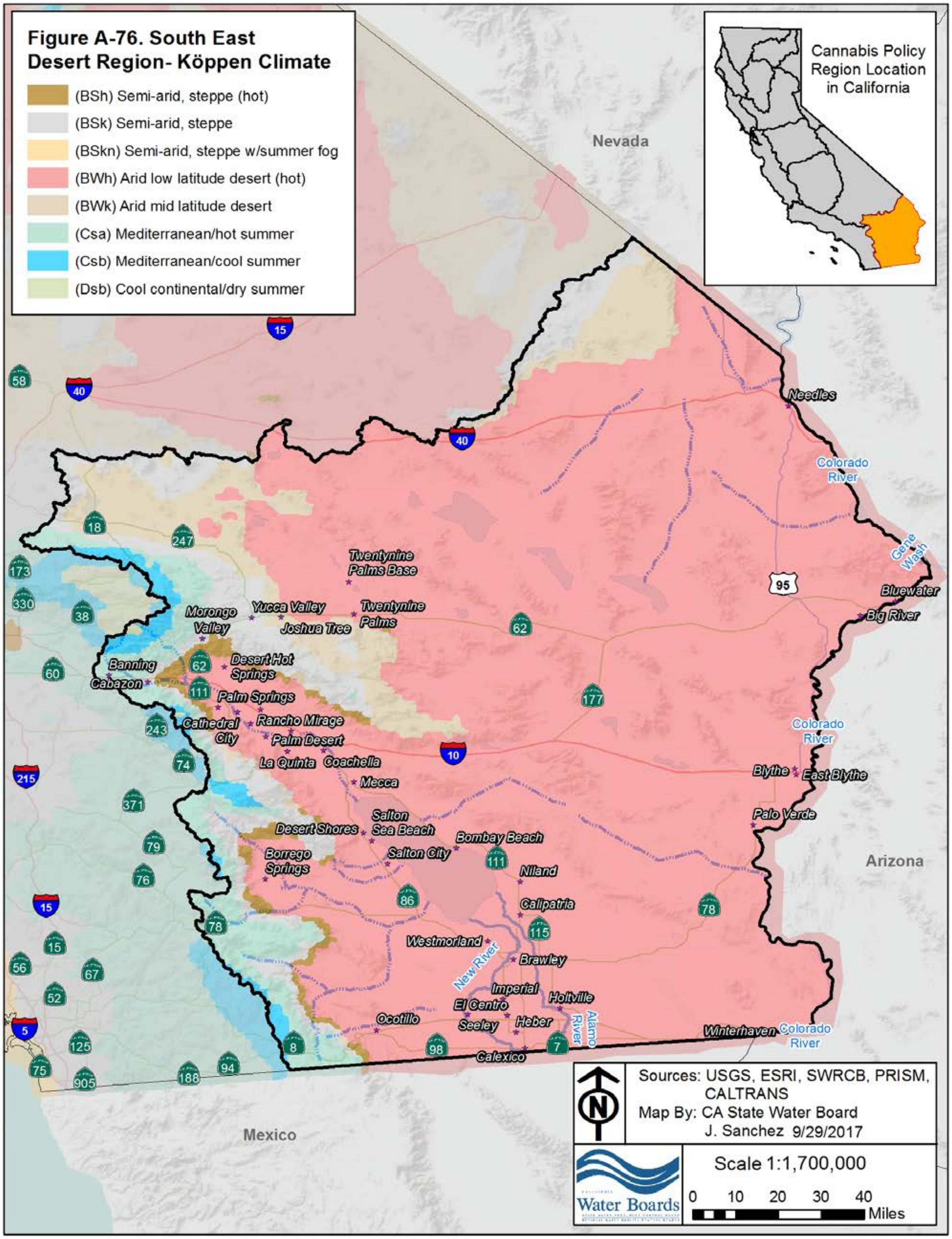

Figure A-76. South East Desert Region- Köppen Climate
(BSh) Semi-arid, steppe (hot)
(BSk) Semi-arid, steppe
(BSkn) Semi-arid, steppe w/summer fog
(BWh) Arid low latitude desert (hot)
(BWk) Arid mid latitude desert
(Csa) Mediterranean/hot summer
(Csb) Mediterranean/cool summer
(Dsb) Cool continental/dry summer
Cannabis Policy Region Location in California
Nevada
Arizona
Mexico
Needles
Colorado River
Gene Wash
Bluewater
Big River
Twentynine Palms Base
Twentynine Palms
Yucca Valley
Morongo Valley
Joshua Tree
Banning
Cabazon
Desert Hot Springs
Palm Springs
Cathedral City
Rancho Mirage
Palm Desert
La Quinta
Coachella
Mecca
Blythe
East Blythe
Palo Verde
Salton Sea Beach
Desert Shores
Bombay Beach
Salton City
Borrego Springs
Niland
Calipatria
Westmorland
New River
Brawley
Imperial
Holtville
El Centro
Seeley
Heber
Ocotillo
Alamo River
Winterhaven
Calexico
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS
Map By: CA State Water Board
J. Sanchez 9/29/2017
Scale 1:1,700,000
0 10 20 30 40 Miles
Water Boards

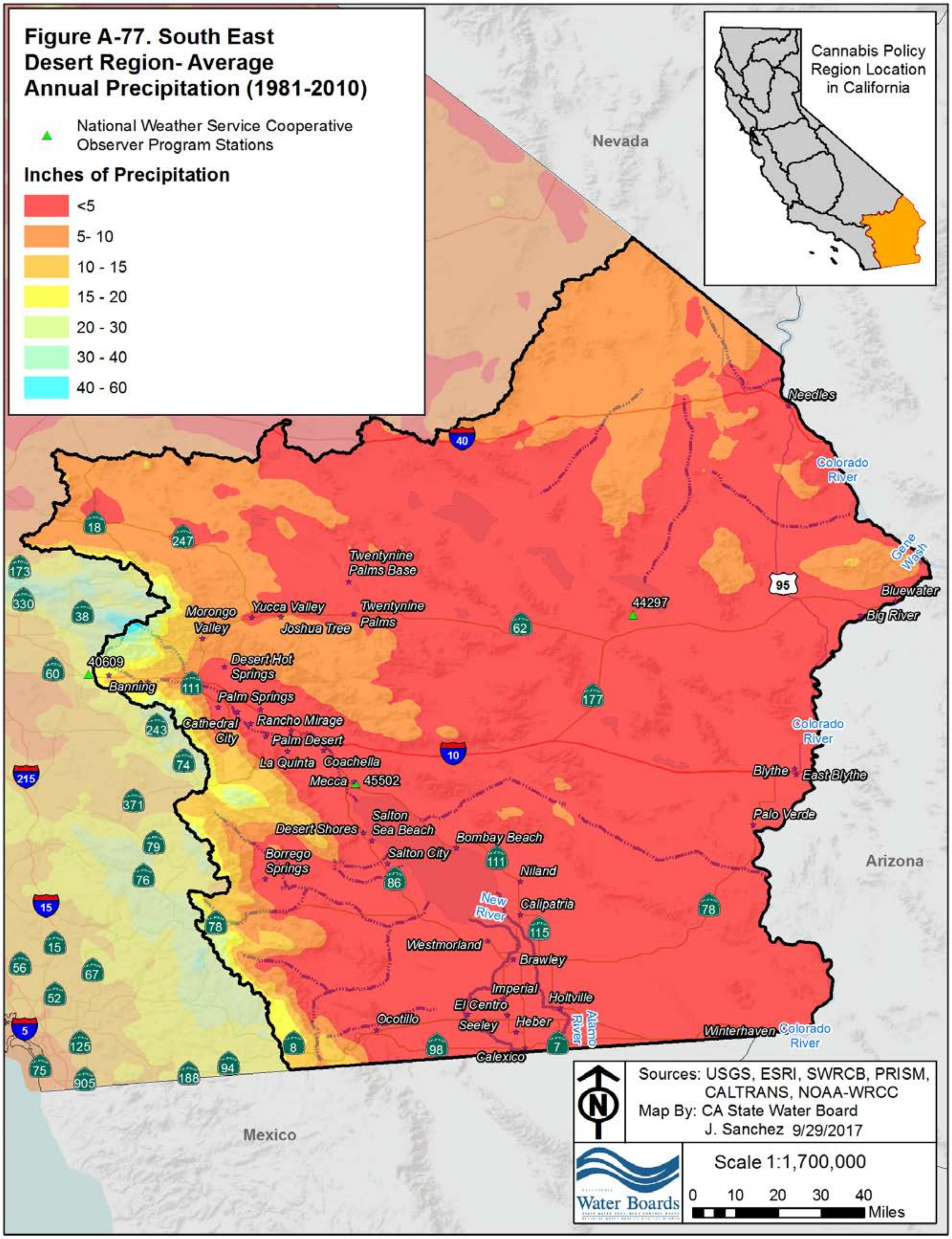
Figure A-77. South East Desert Region- Average Annual Precipitation (1981-2010)
National Weather Service Cooperative Observer Program Stations
Inches of Precipitation
<5
5- 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 60
Cannabis Policy Region Location in California
Nevada
Arizona
Mexico
Needles
Colorado River
Gene Wash
Bluewater
Big River
Twentynine Palms Base
Yucca Valley
Twentynine Palms
Morongo Valley
Joshua Tree
44297
40609
Banning
Desert Hot Springs
Palm Springs
Cathedral City
Rancho Mirage
Palm Desert
La Quinta
Coachella
Mecca
45502
Blythe
East Blythe
Palo Verde
Salton Sea Beach
Desert Shores
Bombay Beach
Borrego Springs
Salton City
Niland
New River
Calipatria
Westmorland
Brawley
Imperial
Holtville
El Centro
Ocotillo
Seeley
Heber
Alamo River
Calexico
Winterhaven
Sources: USGS, ESRI, SWRCB, PRISM, CALTRANS, NOAA-WRCC
Map By: CA State Water Board
J. Sanchez 9/29/2017
Scale 1:1,700,000
0 10 20 30 40
Miles
Water Boards

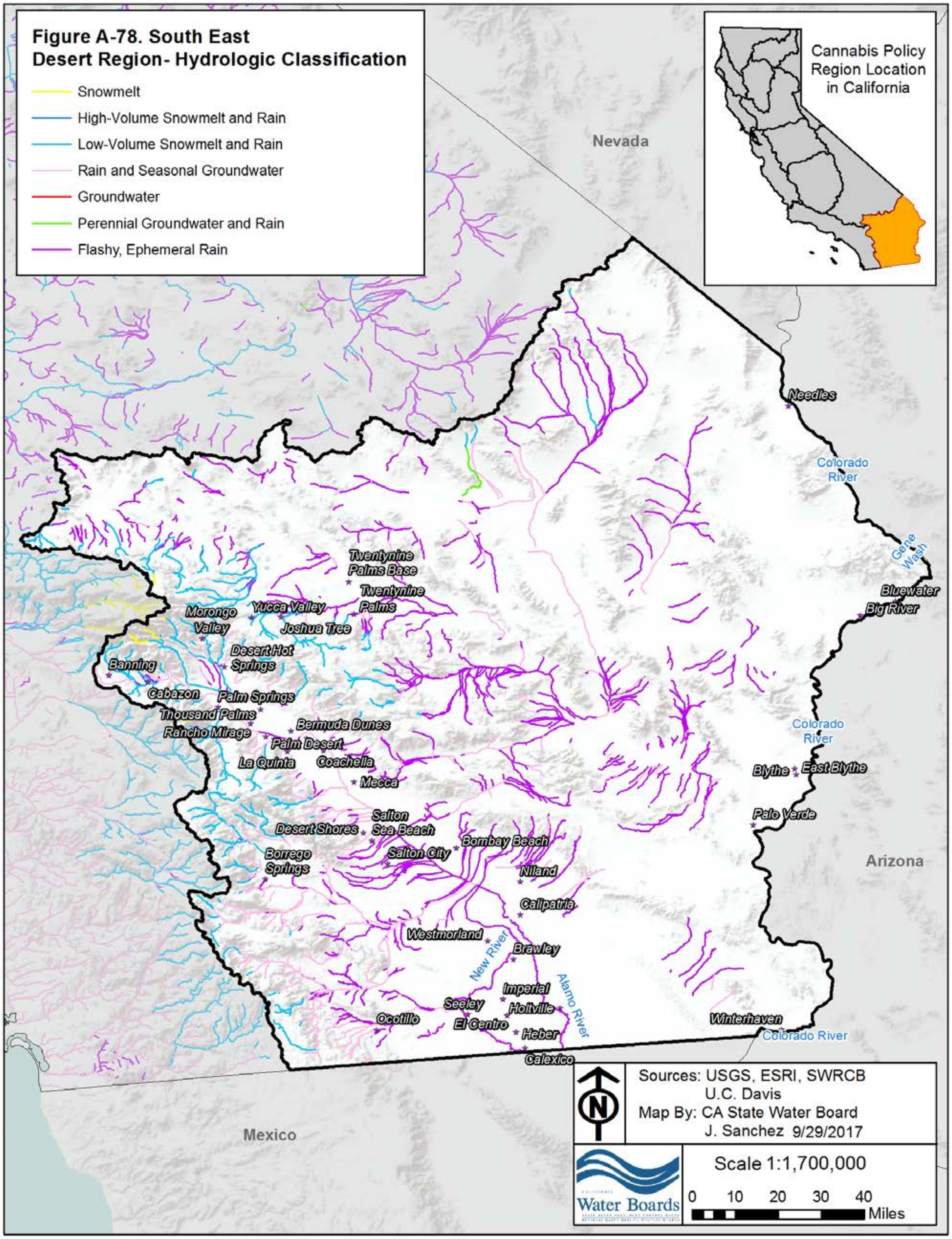

Figure A-78. South East Desert Region- Hydrologic Classification
Snowmelt
High-Volume Snowmelt and Rain
Low-Volume Snowmelt and Rain
Rain and Seasonal Groundwater
Groundwater
Perennial Groundwater and Rain
Flashy, Ephemeral Rain
Cannabis Policy Region Location in California
Nevada
Arizona
Mexico
Needles
Colorado River
Gene Wash
Bluewater
Big River
Twentynine Palms Base
Twentynine Palms
Yucca Valley
Morongo Valley
Joshua Tree
Desert Hot Springs
Banning
Cabazon
Palm Springs
Thousand Palms
Rancho Mirage
Bermuda Dunes
Palm Desert
La Quinta
Coachella
Mecca
Blythe
East Blythe
Palo Verde
Salton Sea Beach
Desert Shores
Bombay Beach
Salton City
Borrego Springs
Niland
Calipatria
Westmorland
Brawley
New River
Alamo River
Imperial
Holtville
Seeley
El Centro
Heber
Ocotillo
Calexico
Winterhaven
Sources: USGS, ESRI, SWRCB U.C. Davis
Map By: CA State Water Board J. Sanchez 9/29/2017
Scale 1:1,700,000
0 10 20 30 40 Miles
Water Boards

State Water Resources Control Board

Cannabis Cultivation Policy

Staff Report

Appendix 2
Salmonid Life Histories

February 5, 2019

Table of Contents

List of Figures

1.0 Special-Status[1] Anadromous Salmonids

The streams and rivers of California serve as habitat to 16 special-status anadromous salmonid populations, including Chinook salmon, coho salmon, and steelhead evolutionarily significant units (ESUs), distinct population segments (DPSs), or distinct taxonomic entities[2] (DTEs). This technical appendix discusses the general life history characteristics and the major threats to the viability of each special-status anadromous salmonid ESU, DPS, and DTE in California. Figure 1 is included to aid visualization of life stage timing for each referenced ESU/DPS/DTE. Please note that California's streams and rivers also support other important aquatic and aquatic-dependent species, such as non-anadromous fish populations; however, anadromous salmonids are the focus of this appendix.

1.1 Southern Oregon/Northern California Coastal Chinook Salmon

1.1.1 Status and Distribution

The Southern Oregon/Northern California Coastal (SONCC) Chinook salmon ESU is a special-status species listed as a species of special concern[3] by the California Department of Fish and Wildlife (CDFW). The SONCC Chinook salmon ESU includes Chinook salmon populations in streams from Cape Blanco, Oregon, south to the Klamath River, including Klamath River tributaries from the mouth to the confluence with the Trinity River (Figure 2). SONCC Chinook salmon populations in California include populations in the Smith River and a few lower Klamath River tributaries, including Blue Creek. SONCC Chinook salmon are considered fall-run Chinook salmon based on the population's life-history timing. (Moyle et al. 2015).

1.1.2 Life History

In general, SONCC Chinook salmon rear in freshwater for up to one year, migrate to the ocean, spend one to four years maturing in the marine environment and return to freshwater to spawn. Most SONCC Chinook salmon adults re-enter freshwater in the late fall, when stream flows typically increase, however SONCC Chinook salmon may enter Blue Creek as early as September or as late as December. SONCC Chinook salmon spawning typically begins in October or November and continues into January or February. Most SONCC Chinook salmon

[1] For the purposes of the Cannabis Cultivation Policy, the term "special-status" refers to species or distinct populations that are federally listed as threatened or endangered, listed as threatened or endangered by the state of California, listed as a species of concern by the National Marine Fisheries Service (NMFS), or listed as species of special concern by the California Department of Fish and Wildlife (CDFW). No California salmonids were federally proposed for listing as threatened or endangered or designated as a State Candidate for threatened or endangered listing by the state of California at the time of the preparation of this report (CDFW 2017b). Pink and chum salmon, which are noted as likely species of special concern by Moyle et al., are discussed in section 2.0 of this appendix (2015).

[2] The term "distinct taxonomic entity" (DTE) is applied in this document in reference to salmonid populations given consideration by CDFW as distinct, or separate, taxa, but that are not currently designated as individual ESUs or DPSs by NMFS.

[3] CDFW defines California fish species of special concern to be "those species, subspecies, Evolutionary Significant Unit, or Distinct Population Segment of native fish that currently satisfy one or more of the following (not necessarily mutually exclusive) criteria: are known to spawn in California's inland waters; are not already listed under either federal or state endangered species acts (or both); are experiencing, or formerly experienced, population declines or range retractions that, if continued, could qualify them for listing as threatened or endangered status; [and/or] have naturally small populations exhibiting high susceptibility to risk from stressors that, if realized, could lead to declines that would qualify them for listing as threatened or endangered" (CDFW 2017a).

spawn in the middle reaches of coastal tributaries. As with all salmon, SONCC Chinook salmon spawn only once and die shortly after spawning. (Moyle et al. 2015)

SONCC Chinook salmon eggs incubate in redds for 40 to 60 days before hatching. The newly hatched fish, called alevins, remain in the redds for an additional four to six weeks before emerging into the water column as fry. SONCC Chinook salmon fry emergence occurs in the lower Klamath tributaries between February and mid-April. Some SONCC Chinook fry out-migrate to the ocean within weeks of emergence, while others may rear in freshwater for two months up to more than one year. If stream temperatures remain below 20 degrees Celsius, juvenile SONCC Chinook salmon will continue to rear instream throughout their first summer. A 1995-96 study of Blue Creek found fry outmigration began before mid-March, peaked in late April and late May, and continued into August. An earlier study of returning adults, using scale aging, found that most had reared in freshwater for two to six months as juveniles. Following outmigration, SONCC Chinook salmon generally spend one to four years maturing in the marine environment before returning to freshwater streams to spawn, primarily as three- and four-year-olds (Gale et al. 1998, Moyle et al. 2015).

1.1.3 Threats to Viability

SONCC Chinook salmon are subject to a number of population viability threats. Overall, the threat to the viability of SONCC Chinook salmon population is considered to be of moderate concern. Major anthropogenic factors limiting or potentially limiting SONCC Chinook salmon population viability include: hatcheries, estuary alteration, fisheries harvest, transportation, logging, rural residential development, and grazing. In addition, SONCC Chinook salmon populations may be impacted by climate change, especially as a result of temperature increases, changes to ocean conditions, and sea level rise. Factors of lesser concern that may impact SONCC Chinook salmon populations include major dams, agriculture, fire, recreation, and alien species (Moyle et al. 2015). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, existing roads and road development, logging, and rural development.

1.2 California Coastal Chinook Salmon

1.2.1 Status and Distribution

The California Coastal (CC) Chinook salmon ESU is a special-status species, listed as threatened under the federal Endangered Species Act (ESA). The CC Chinook salmon ESU includes Chinook salmon populations located in all coastal watersheds from Redwood Creek in Humboldt County south to the Russian River and its tributaries (Figure 2). The CC Chinook salmon ESU also includes seven artificial propagation programs. (CDFW 2017b)

1.2.2 Life History

The California coastal region historically supported both ocean-type Chinook salmon, which were predominantly fall-run Chinook salmon, and stream-type Chinook salmon, which were predominantly spring-run Chinook salmon. CC spring-run Chinook salmon, which relied on spring and summer snowmelt during adult spawning migration, are presumed to be extirpated likely due to low flows, high water temperatures, and sandbars, which develop in smaller coastal watersheds during the summer months and serve as a barrier to migration. Today, the CC Chinook salmon ESU includes only CC fall-run Chinook salmon. (NMFS 2015)

CC fall-run Chinook salmon have a differently-timed life history than CC spring-run Chinook salmon. In general, CC fall-run Chinook salmon rear in freshwater for a few weeks up to several months, migrate to the ocean, spend two to five years maturing in the marine environment, and then return to freshwater to spawn in the fall season. (Fall-run adults can produce stream-type progeny, although ocean-type is far more common [NMFS 2015, p. 42, para. 1].) CC fall-run Chinook salmon adults return to freshwater between August and January at an advanced stage of maturity. CC fall-run Chinook salmon move rapidly to their low-elevation spawning grounds on the mainstem or lower tributaries of coastal rivers, and spawn within a few weeks of freshwater entry. As with all salmon, CC Chinook salmon spawn only once, and die shortly after spawning. Female Chinook salmon will guard or defend redds from predators for two to four weeks prior to their deaths. (NMFS 2015)

CC Chinook salmon eggs incubate in redds for 40 to 60 days before hatching, depending on water temperature. The newly hatched alevins remain in the redds for an additional four to six weeks, typically emerging into the water column as fry between December and mid-April. Ocean-type fry of juvenile CC Chinook salmon generally out-migrate to the marine environment within a few weeks to several months after emergence, usually between April and July. A strong environmental cue for the initiation of smoltification, a physiological transformation to prepare the fish for survival in a saline environment, appears to be an increase in water temperature. After out-migrating, CC Chinook salmon generally spend two to five years maturing in the marine environment before migrating back to freshwater to spawn. Some Chinook salmon, termed jacks (males) or jills (females), may return to freshwater to spawn one or more years early. (Moyle 2002, NMFS 2015)

The uncommon stream-type CC Chinook salmon life history differs from the ocean-type in several significant ways. First, stream-type CC Chinook salmon adult spawning migration takes place during spring and summer, typically between April and August, instead of during the fall and early winter months. Second, stream-type CC Chinook salmon adults enter freshwater when sexually immature and hold in cold, headwater tributaries for up to several months to complete maturation prior to spawning during fall. Lastly, stream-type juvenile CC Chinook salmon frequently reside in freshwater for a much longer period of one year or more prior to outmigration. (NMFS 2015)

1.2.3 Threats to Viability

CC Chinook salmon are subject to a number of population viability threats. All CC Chinook salmon life stages are affected by population viability threats, with the greatest impacts falling on adults, followed by pre-smolts, smolts, and eggs. NMFS identified that the highest severity and most extensive threat sources to the CC Chinook salmon, inclusive of all life stages, are: channel modification, roads and railroads, logging and wood harvesting, water diversions and impoundments, and severe weather patterns. Threats of lesser severity or extent include: disease, predation, and competition; livestock farming and ranching; mining; fire, fuel management, and fire suppression; residential and commercial development; agriculture; fishing and collecting; recreational areas and activities; and hatcheries and aquaculture (NMFS 2015). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, water diversions and impoundments, channel modification, logging and wood harvesting, and existing roads and road development.

1.3 Klamath Mountains Province Steelhead

1.3.1 Status and Distribution

The Klamath Mountains Province (KMP) steelhead distinct population segment (DPS) is a special-status species, which is listed as a species of special concern by CDFW. The KMP steelhead DPS includes coastal watersheds in northern California and southern Oregon, spanning the Klamath River watershed in California north to the Elk River watershed in Oregon (Figure 3). (Moyle et al. 2015)

1.3.2 Life History

In general, the KMP steelhead rear in freshwater for two years, migrate to the ocean to spend two to three years maturing in the marine environment, and then return to freshwater to spawn. KMP steelhead exhibit two reproductive ecotypes, termed ocean maturing and stream maturing. Ocean-maturing KMP steelhead enter freshwater when sexually mature. These steelhead are also generally called winter steelhead based on the timing of their spawning migration. Winter steelhead spawning migration typically begins in November, but may begin as early as September, and continues into April. Winter steelhead spawning typically peaks before March. (Moyle et al 2015)

Stream-maturing KMP steelhead enter freshwater while sexually immature and complete their maturation in-river over the course of several months. This reproductive strategy is used by both runs of stream-maturing KMP steelhead: summer steelhead and fall steelhead. Summer steelhead enter freshwater as early as March and continue as late as July, though April to June is typical. KMP summer steelhead spawning begins in late December and peaks in January. Fall steelhead enter the Klamath Basin between July and November and migrate into spawning reaches in the Klamath and Trinity Rivers between August and November. Fall steelhead spawn between January and May. Steelhead are capable of spawning more than once and adult steelhead may survive spawning to migrate back to the ocean and return to freshwater to spawn again in subsequent years. One study found that between 40 to 64 percent of spawning KMP summer steelhead were repeat spawners. (Moyle et al. 2015)

KMP steelhead eggs incubate in redds for 18 to 80 days, depending on water temperature. Upon hatching, the alevins remain in the redds for an additional two to six weeks. In the Trinity River, KMP steelhead fry emerge from their redds beginning in April and migrate downstream from May through July; presumably, KMP steelhead in other rivers and streams within their native range exhibit similar fry emergence timing. If spawned in intermittent streams, as may be the case with summer steelhead, fry move into perennial streams soon after emergence. In late fall and winter, further downstream movement of KMP steelhead fry occurs, coinciding with periods of higher flows and lower water temperatures. The juveniles then spend their second year rearing in the river mainstem. Generally, after spending two years in freshwater, juvenile KMP steelhead out-migrate to the ocean where they continue maturing for one to three years before returning to freshwater to spawn. (Moyle et al. 2015)

A portion of all KMP steelhead variants (i.e., winter, fall, and summer steelhead) exhibit the half-pounder life-history strategy. Under this strategy, subadults, called half-pounders, return to the lower and middle Klamath River in late summer and early fall to overwinter, after having typically spent only two to four months in the Klamath estuary or near-shore environments, before out-migrating back to the ocean the following spring. Only a small portion of half-pounders will attain sexual maturity during this freshwater residency. (Moyle et al. 2015)

1.3.3 Threats to Viability

KMP steelhead are subject to a number of population viability threats. Overall, the threat to the viability of KMP steelhead populations is considered to be of high concern. Stream-maturing steelhead, especially summer steelhead, are particularly vulnerable to near-term extinction (Moyle et al. 2015, KMPS, p. 1, para. 1). Major anthropogenic factors likely contributing to the decline of KMP steelhead include dams, diversions, logging, and agriculture (2015, KMPS, p.

18, para. 3). Climate change is also projected to negatively affect KMP steelhead populations, especially since seasonal water temperatures and flows are already marginal in many areas (2015, p. 24, Table 6). KMP steelhead population viability threats of lesser concern include grazing, transportation, fire, estuary alteration, hatcheries, rural residential development, urbanization, instream mining, hard rock mining, recreation, harvest, and alien species (Moyle et al. 2015, KMPS, p. 22, Table 5). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: diversions, agriculture, existing roads and road development, logging, and rural development.

1.4 Northern California Steelhead

1.4.1 Status and Distribution

The Northern California (NC) steelhead DPS is a special-status species, and is listed as threatened under the federal ESA (CDFW 2017b). The NC steelhead DPS includes steelhead populations in California coastal watersheds, spanning Redwood Creek in Humboldt County south to the Gualala River watershed (Figure 3).

1.4.2 Life History

In general, NC steelhead rear in freshwater for one to four years, migrate to the ocean to spend one to four years maturing in the marine environment, and return to freshwater to spawn. NC steelhead exhibit two reproductive ecotypes, termed ocean-maturing, or winter-run, and stream-maturing, or summer-run (NMFS 2007b). Ocean-maturing (winter-run) NC steelhead adult migration occurs between November and April. Adult winter-run NC steelhead migrate when sexually mature and spawn shortly after freshwater entry (NMFS 2015). The timing of NC steelhead freshwater entry is correlated with higher flow events and, for some populations, sandbar breaches, which can be a barrier to upstream migration (NMFS 2015). In contrast, stream-maturing (summer-run) NC steelhead return to freshwater between May and October while sexually immature. NC summer-run steelhead complete their maturation in freshwater prior to spawning, which typically occurs in January and February (NMFS 2015).

After spawning, NC steelhead may become trapped in freshwater by low spring flows while out-migrating and held until higher flows return in fall. One study found that of adult steelhead trapped in freshwater during the spring season, 40 percent were still alive by late October. Another study found repeat spawners made up about 17 percent of a given year’s spawning run. (NMFS 2015)

NC steelhead eggs incubate in redds for approximately 25 to 35 days depending on water temperature. Upon hatching, the alevins remain in the redds for an additional two to three weeks before emerging into the water column as fry. Fry and juvenile NC steelhead freshwater residency varies according to habitat productivity (i.e., the rate of generation of biomass). In productive habitats, such as lagoons or relatively warm streams, juveniles may reach sufficient size to out-migrate after one year. In less productive habitats, such as small coastal streams with dense riparian canopies and low, cool summer baseflows, juvenile NC steelhead typically rear for two or more years before out-migrating. Juvenile NC steelhead outmigration usually occurs in late winter and spring, but NC steelhead populations in the northern portion of the DPS may continue outmigration into the summer months. The process of smoltification, which prepares juvenile steelhead for the saline ocean environment, is triggered by environmental cues, such as an increased water temperature and photoperiod (i.e., day length). (NMFS 2015)

NC steelhead ocean residency varies according to several life history strategies. Following outmigration, steelhead may spend up to four years maturing in the marine environment, though one or two years is typical. Additionally, NC steelhead populations in the Mad and Eel River watersheds include a half-pounder life history strategy. These half-pounders return from the ocean after only two to four months to overwinter in freshwater and then return to the ocean the following spring. (NMFS 2015)

1.4.3 Threats to Viability

NC steelhead are subject to a number of population viability threats. All NC steelhead life stages are affected by population viability threats, with the greatest impacts occurring to winter-rearing juveniles, followed by summer adults and summer-rearing juveniles (NMFS 2015, Vol. III, p. 52, para. 1). The highest severity and most extensive population viability threat sources to NC steelhead, inclusive of all life stages, are roads and railroads, water diversions and impoundments, logging and wood harvesting, and channel modification (NMFS 2015, Vol. III, p. 62 para. 1). Threats of lesser severity or extent include: severe weather patterns; livestock farming and ranching; disease, predation, and competition; fire, fuel management, and fire suppression; mining; agriculture; fishing and collecting; hatcheries and aquaculture; residential and commercial development; and recreational areas and activities (NMFS 2015, Vol. III, p. 64, Figure 23). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, water diversions and impoundments, channel modification, logging and wood harvesting, and existing roads and road development.

1.5 Southern Oregon/Northern California Coast Coho Salmon

1.5.1 Status and Distribution

The Southern Oregon/Northern California Coast (SONCC) coho salmon ESU is a special-status species listed as threatened under the federal ESA and the California ESA (CDFW 2017b). The SONCC coho salmon ESU includes all naturally spawned coho salmon populations in coastal streams north of Punta Gorda, California, and south of Cape Blanco, Oregon (Figure 4). The SONCC coho salmon ESU also includes coho salmon produced by three artificial propagation programs (NMFS 2014a).

1.5.2 Life History

SONCC coho salmon generally adhere to a three-year life cycle. SONCC coho salmon typically rear in freshwater for one year, migrate to the ocean to spend two years maturing in the marine environment, and then return to freshwater to spawn. Adult SONCC coho salmon migration may begin as early as late August, but typically occurs from October to March; peak adult SONCC coho salmon migration occurs between November and January. Adult SONCC coho salmon migration generally coincides with fall high streamflow events that are sufficient to breach sandbars at the mouth of SONCC coho salmon watersheds. SONCC coho salmon spawning grounds are typically located within 240 km of the coast, either along the coast, in small tributaries of larger rivers, or in headwater streams. Females tend to spawn soon after arriving at spawning grounds, usually between November and January; however, SONCC coho salmon may hold for days to months after arriving prior to spawning. As with all salmon, SONCC coho salmon spawn only once, and die shortly after spawning. Female SONCC coho salmon will guard their redds until their deaths, approximately four to 15 days after spawning. (NMFS 2014a)

SONCC coho salmon eggs typically incubate in redds between November and April for approximately 38 to 48 days, depending on water temperature. Upon hatching, alevins remain in the redds for an additional four to 10 weeks, depending on both water temperature and dissolved oxygen conditions, before emerging into the water column as fry. SONCC coho salmon emergence typically occurs between March and July and peaks in March and May. SONCC coho salmon fry may move upstream or downstream after emergence and may utilize a wide variety of habitat for rearing, including lakes, sloughs, side channels, estuaries, beaver ponds, low gradient tributaries, and large areas of slack water. By about mid-June, SONCC coho salmon fry transition to the juvenile life stage. (NMFS 2014a)

In some basins, juvenile SONCC coho salmon exhibit at least four life-history strategies, which vary according to the timing of outmigration and the duration of riverine or estuarine residency. SONCC coho salmon life history strategies range from immediate outmigration to the estuarine environment following emergence, to rearing primarily in freshwater for up to two years. The dominant SONCC coho salmon life-history strategy involves rearing within natal watersheds for one year prior to out-migrating to the ocean. Some juvenile SONCC coho salmon may exhibit finer-scale habitat switching, such as juvenile SONCC coho salmon that rear in estuaries during spring, summer, and fall, and then return to freshwater upstream to over winter.

SONCC coho salmon juvenile outmigration timing varies from March or earlier in Roach Creek, tributary to the Klamath River, and Ten Mile Creek, tributary to the Eel River, and continues until as late as August on the South Fork Eel River. Typical outmigration appears to occur in spring, between April and June. Depending on the opportunity and the capacity of the estuary, juvenile SONCC coho salmon may spend a few days to a few weeks in estuaries completing smoltification prior to out-migrating to the ocean. Following outmigration, most SONCC coho salmon spend approximately 18 months in the ocean before returning to their natal streams to spawn as three-year olds; however, some males, called jacks, may return to freshwater to spawn after only five to seven months. (NMFS 2014a)

1.5.3 Threats to Viability

SONCC coho salmon are subject to a number of population viability threats. These population viability threats collectively affect all stages of the SONCC coho salmon life cycle; however, NMFS identifies juvenile SONCC coho salmon to be the most limited life stage[4]. The highest severity and most extensive threat sources to the SONCC coho salmon in California identified by NMFS, inclusive of all life stages, are[5]: roads, channelization and diking, dams and diversions, climate change, timber harvest, and agricultural practices. Threats of lesser severity or extent include: high severity fire; invasive, non-native, and alien species; road stream crossing barriers; urban, industrial, and residential development; hatcheries; mining and gravel extraction; and fishing and collecting (NMFS 2014a). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agricultural practices, dams and diversions, channelization and diking, timber harvest, roads, and roads stream crossing barriers.

1.6 Upper Klamath-Trinity Rivers Spring-Run Chinook Salmon

1.6.1 Status and Distribution

The Upper Klamath-Trinity Rivers spring-run (UKTR SR) Chinook salmon DTE is listed as a species of special concern by CDFW. UKTR SR Chinook salmon are found in the Klamath River watershed, in major tributaries above the confluence of the Klamath and Trinity Rivers (Figure 2). Although all naturally spawned populations of Chinook salmon in the Klamath River

[4] The SONCC coho salmon ESU includes the following watersheds that have no territory within the state of California: Elk River, Lower Rogue River, Chetco River, Brush Creek, Mussel Creek, Hunter Creek, Pistol River, and Upper Rogue River (NMFS 2014a).

[5] Population viability threats listed here consider only those stream systems that have at least some of their territory within the state of California.

basin are included in the Upper Klamath-Trinity Rivers (UKTR) Chinook salmon ESU, CDFW treats UKTR SR Chinook salmon as a distinct taxon, because this population represents an essential UKTR Chinook salmon life-history strategy, and separate management strategies compared to UKTR fall-run Chinook salmon. (Moyle et al. 2015)

1.6.2 Life History

In general, UKTR SR Chinook salmon rear in freshwater for up to one year, migrate to the ocean, spend two to five years maturing in the marine environment, and return to freshwater to spawn. UKTR SR Chinook salmon enter the Klamath River estuary between March and July, while they are sexually immature. Peak UKTR SR Chinook salmon adult migration occurs between May and early June. UKTR SR Chinook salmon generally hold in cold water streams for two to four months and spawn in September and October. As with all salmon, UKTR SR Chinook salmon spawn only once, and die shortly after spawning. (Moyle et al. 2015)

UKTR SR Chinook salmon eggs incubate in redds for 40 to 60 days under optimal egg incubation conditions. Upon hatching, the alevins remain in the redds for an additional four to six weeks. UKTR SR Chinook salmon fry emerge from their redds during the fall, winter, and spring months. UKTR SR Chinook salmon fry emergence begins as early as November in the Trinity River and December in the Klamath River, and can last until late May. UKTR SR Chinook salmon fry generally spend less than one year rearing in freshwater before migrating to the ocean, which typically occurs from February through mid-June. Following outmigration, UKTR SR Chinook salmon generally spend one to four years maturing in the marine environment before returning to freshwater to spawn, primarily as three- and four-year-olds. (Moyle et al 2015)

1.6.3 Threats to Viability

UKTR SR Chinook salmon are subject to a number of population viability threats. Overall, the threat to the viability of UKTR SR Chinook salmon populations is considered to be of critical concern. Major anthropogenic factors limiting or potentially limiting UKTR SR Chinook salmon population viability include major dams, logging, and hatcheries. Wild UKTR SR Chinook salmon populations are also highly vulnerable to climate change and poaching. UKTR SR Chinook salmon population viability threats of lesser concern include agriculture, grazing, instream mining, transportation, harvest, rural residential development, fire, mining, recreation, urbanization, estuary alteration, and alien species (Moyle et al. 2015). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, logging, existing roads and road development, and rural development.

1.7 Upper Klamath-Trinity Rivers Fall-Run Chinook Salmon

1.7.1 Status and Distribution

The Upper Klamath-Trinity Rivers fall-run (UKTR FR) Chinook salmon DTE is listed as a species of special concern under the California ESA. UKTR FR Chinook salmon are found in the Klamath River watershed, in major tributaries above the confluence of the Klamath and Trinity Rivers (Figure 2). UKTR FR Chinook salmon along with UKTR SR Chinook salmon constitute a single ESU; however, CDFW treats the two runs as separate taxa because the two runs exhibit distinct life history strategies. (Moyle et al. 2015)

1.7.2 Life History

In general, UKTR FR Chinook salmon rear in freshwater for up to one year, migrate to the ocean, spend two to five years maturing in the marine environment, and return to freshwater to spawn. UKTR FR Chinook salmon typically enter the Klamath River estuary beginning in early July through September and hold in the estuary for a few weeks before initiating further upstream migration between mid-July and October. UKTR FR Chinook salmon spawning peaks during November in most Klamath and Trinity River tributaries and tapers off in December; in the Trinity River watershed, UKTR FR Chinook salmon spawning typically peaks four to six weeks after UKTR SR Chinook spawning. As with all salmon, UKTR FR Chinook salmon spawn only once, and die shortly after spawning. (Moyle et al. 2015)

UKTR FR Chinook salmon eggs incubate in redds for 40 to 60 days under optimal egg incubation conditions. Upon hatching, the alevins remain in redds for an additional four to six weeks. UKTR FR Chinook salmon fry typically emerge from redds in late winter or spring, depending on water temperatures. (Moyle et al. 2015)

There are at least four distinct juvenile UKTR FR life history strategies. The most predominant juvenile life history strategy is characterized by a short period of freshwater residence, during which fry forage in freshwater streams, followed by outmigration to the ocean during summer. The next most common juvenile life history strategy is characterized by a longer period of freshwater residence, during which fry rear in tributaries or cool-water areas through summer, followed by outmigration during fall to mid-winter. A small portion of UKTR FR Chinook salmon fry rear for an entire year in freshwater before out-migrating to the ocean in the spring. A fourth life history variation in which males rear to maturity in freshwater has also recently been described. Following outmigration, UKTR FR Chinook salmon generally spend one to four years maturing in the marine environment before returning to freshwater to spawn, primarily as three- and four-year-olds. (Moyle et al 2015)

1.7.3 Threats to Viability

UKTR FR Chinook salmon are subject to a number of population viability threats. Overall, the threat to the viability of UKTR FR Chinook salmon populations is considered to be of moderate concern. Major anthropogenic factors limiting or potentially limiting UKTR FR Chinook salmon population viability include: major dams; and agriculture, including water diversions, warm water temperature, and pollutant inputs. UKTR FR Chinook salmon population viability threats of lesser concern include logging, hatcheries, grazing, instream mining, transportation, harvest, rural residential development, fire, mining, recreation, urbanization, estuary alteration, and alien species (Moyle et al. 2015). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, logging, existing roads and road development, warm water temperature, pollutant inputs, and rural development.

1.8 Sacramento River Winter-Run Chinook Salmon

1.8.1 Status and Distribution

The Sacramento River winter-run (SRWR) Chinook salmon ESU is a special-status species listed as endangered under the federal ESA and the California ESA (CDFW 2017b). Historically, SRWR Chinook salmon spawned in the cold, spring-fed tributaries of the upper Sacramento River Basin. SRWR Chinook salmon spawning is now restricted to the stretches of the Sacramento River downstream of Keswick Dam, a complete barrier to upstream SRWR Chinook salmon migration (Figure 5). The SRWR Chinook salmon ESU also includes fish that are propagated at the Livingston Stone National Fish Hatchery.

1.8.2 Life History

In general, SRWR Chinook salmon rear in freshwater for 5 to 10 months, migrate to the ocean, spend one to three years maturing in the marine environment, and then return to freshwater to spawn. SRWR Chinook salmon adult upstream migration typically begins in December and lasts through July, and peak migration occurs between February and April (CDFW 2015). SRWR Chinook salmon are sexually immature when upstream migration begins, and SRWR Chinook salmon must hold for several months in suitable freshwater habitat prior to spawning to complete maturation (NMFS 2014b). Historically, SRWR Chinook salmon spawned in the cold, spring-fed tributaries of the upper Sacramento River Basin; however, with the construction of the Keswick Dam, SRWR Chinook salmon migration and spawning are now restricted to the stretches of the Sacramento River downstream of the dam. Spawning now occurs primarily in the mainstem of the Sacramento River between Keswick Dam and Battle Creek, with the majority of spawning occurring in the 14 miles between the Keswick Dam and the Redding Water Treatment Plant. SRWR Chinook salmon spawning typically occurs between April and August and peaks in May and June (CDFW 2015). As with all salmon, SRWR Chinook salmon spawn only once, and die shortly after spawning.

Because SRWR Chinook salmon spawning occurs during late spring and summer months, SRWR Chinook salmon require stream reaches with cold water sources that will protect embryos and juveniles from warm ambient conditions. Within the appropriate egg incubation temperature range, eggs incubate for 40 to 60 days. Upon hatching, SRWR Chinook salmon alevins remain in redds for an additional four to six weeks before emerging into the water column as fry, usually between mid-June and mid-October. Upon emergence, SRWR Chinook salmon fry may immediately begin migration downstream until reaching the San Francisco Bay/Sacramento – San Joaquin Delta (Bay-Delta) estuary, or may reside in freshwater for several weeks or up to one year. Typically, after five to nine months in fresh or estuarine waters, juvenile SRWR Chinook salmon migrate to the ocean; migration between the Bay-Delta and the ocean usually occurs between January and June. Following outmigration, SRWR Chinook salmon typically spend one to three years maturing in the marine environment before migrating back to freshwater to spawn. (NMFS 2014b)

1.8.3 Threats to Viability

SRWR Chinook salmon are subject to a number of population viability threats. SRWR Chinook salmon population stressors collectively affect all life history stages. Major SRWR Chinook salmon stressors include: passage impediments and barriers; flow fluctuations, water pollution, and warm water temperatures; loss of juvenile rearing habitat (e.g., lost natural river morphology and function, and lost riparian habitat and instream cover); predation; ocean harvest; changes in Delta hydrology, diversion into the central Delta, and entrainment of juveniles at pumping plants (NMFS 2014b). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: loss of juvenile rearing habitat, flow fluctuations, water pollution, passage impediments and barriers, warm water temperatures, predation, and entrainment.

1.9 Central Valley Spring-Run Chinook Salmon

1.9.1 Status and Distribution

The Central Valley spring-run (CV SR) Chinook salmon ESU is a special-status species listed as threatened under the federal ESA and the California ESA (CDFW 2017b). The CV SR Chinook salmon ESU contains naturally spawning populations in the Sacramento River watershed, and also includes the Feather River Hatchery Spring-run Chinook Program (Figure 5). Historically, CV SR Chinook salmon populations also occurred in the San Joaquin River watershed; however, CV SR Chinook salmon have been extirpated from all tributaries in the San Joaquin River watershed. (SWRCB 2010; NMFS 1998)

1.9.2 Life History

In general, CV SR Chinook salmon rear in freshwater for up to 16 months, migrate to the ocean, spend one to four years maturing in the marine environment, and return to freshwater to spawn. CV SR Chinook salmon adult migration into the Delta typically begins in late January and early February, when the fish are sexually immature. Between March and October, adult CV SR Chinook salmon typically continue to migrate upstream into the freshwater of the Sacramento River watershed, peaking between April and July. CV SR Chinook salmon then hold in freshwater for several months in cold, deep pools to complete maturation prior to spawning. CV SR Chinook salmon spawning in the Sacramento River watershed typically occurs between mid-August and early October, with a peak in September. As with all salmon, CV SR Chinook salmon spawn only once, and die shortly after spawning. (CDFS 2015; NMFS 2014b)

CV SR Chinook salmon eggs tend to incubate in redds for 40 to 60 days, typically between August and December, before hatching. CV SR Chinook salmon egg incubation typically occurs between August and December, and fry emergence typically occurs between November and March. Upon emergence, the newly hatched alevins remain in redds for an additional four to six weeks before emerging into the water column as fry, with emergence typical between November and March. In the winter or spring and within eight months of hatching, CV SR Chinook salmon fry may either migrate to the ocean as young-of-the-year, or may rear in freshwater for 12 to 16 months and then migrate to the ocean as yearlings. The specific timing of young-of-the-year and yearling outmigration varies by stream system; outmigration typically occurs between November and May. Following outmigration, CV SR Chinook salmon generally spend one to four years maturing in the marine environment before migrating back to freshwater to spawn, typically as three year olds. (CDFW 2015; NMFS 2014b)

1.9.3 Threats to Viability

CV SR Chinook salmon are subject to a number of population viability threats. These stressors collectively affect all CV SR Chinook salmon life history stages. Major stressors on the CV SR Chinook salmon populations include passage impediments and barriers, ocean harvest, warm water temperatures during holding and rearing periods, limited quantity and quality of rearing habitat (e.g., loss of floodplain habitat, loss of natural river morphology and function, and loss of riparian habitat and instream cover), predation, and entrainment. Other important stressors on CV SR Chinook salmon populations include hatchery effects, warm water temperatures affecting adult immigration and spawning, low-flow conditions, excessive channel braiding, limited spawning habitat availability and instream gravel supply, sedimentation, loss of channel connectivity, and flow fluctuations from hydropower operations (NMFS 2014b). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: limitation to the quantity and quality of rearing habitat, sedimentation, flow fluctuations, low-flow conditions, loss of channel connectivity, warm water temperatures, predation, and entrainment.

1.10 Central Valley Fall-Run Chinook Salmon

1.10.1 Status and Distribution

The Central Valley fall-run (CV FR) Chinook salmon DTE is listed as a species of special concern by CDFW (Moyle et al. 2015). In addition, NMFS lists CV FR Chinook salmon in conjunction with the Central Valley late fall-run Chinook salmon as a species of concern[6,7] (NMFS 2017).

The CV FR Chinook salmon ESU includes populations in the Sacramento River watershed and the San Joaquin River watershed (Figure 6). Historically, CV FR Chinook salmon spawned in the low elevation reaches of all major Central Valley rivers. Today, impassable dams prevent CV FR Chinook salmon from reaching over seventy percent of their historic spawning habitat. In some Central Valley rivers, however, cold water releases from dams allow CV FR Chinook salmon to spawn in areas where stream temperatures conditions were historically unsuitable to support CV FR Chinook salmon. In addition, CV FR Chinook salmon populations have not been as substantially impacted by dam construction as SRWR Chinook salmon and CV SR Chinook salmon populations, which typically spawn at higher elevations in the Central Valley. (Moyle et al 2015)

1.10.2 Life History

In general, CV FR Chinook salmon rear in freshwater for one to seven months, migrate to the ocean, spend two to five years maturing in the marine environment, and return to freshwater to spawn. CV FR Chinook salmon adult spawning migration typically begins in June and lasts through December, with peak migration occurring between September and October. CV FR Chinook salmon exhibit an ocean-type life-history strategy, are sexually mature when adult upstream migration begins, and move relatively quickly to their spawning grounds. CV FR Chinook salmon spawning typically occurs between late September and December and peaks in October and November. As with all salmon, CV FR Chinook salmon spawn only once, and die shortly after spawning. (Moyle et al. 2015)

CV FR Chinook salmon eggs incubate in redds for 40 to 60 days under optimal egg incubation conditions. Upon hatching, the alevins remain in the redds for an additional four to six weeks before emerging into the water column as fry. CV FR Chinook salmon fry typically emerge between December and March and move downstream into large rivers within a few weeks of emergence. CV FR Chinook salmon fry often rear in freshwater for one to seven months, although they may remain as long as one year before out-migrating. Juvenile CV FR Chinook salmon out-migrate to the ocean during the spring, before water temperatures exceed thermal tolerances during the hot summer and early fall months. Following outmigration, CV FR Chinook salmon typically spend two to five years maturing in the marine environment before migrating back to freshwater to spawn. (Moyle et al. 2015)

Historically, juvenile CV FR Chinook salmon likely foraged extensively on floodplains prior to entering the San Francisco Estuary. This floodplain rearing life history component represented an important growth opportunity for CV FR Chinook salmon, which usually enter the ocean at a relatively small size and young age compared to out-migrating smolts from other Central Valley Chinook salmon runs. Today, less than 10 percent of this historic floodplain habitat remains. Moyle et al 2015)

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[6] NMFS designates populations as species of concern if the organization has "concern regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act" (NMFS 2017).

[7] NMFS currently considers the Central Valley fall-run Chinook salmon and the Central Valley late fall-run Chinook salmon to be two races under a single ESU. To contrast, CDFW regards the CV FR Chinook salmon and CV LFR Chinook salmon runs as separate taxonomic entities, and thus separate species of special concern on the statewide Species of Special Concern list, based upon their distinct life-history strategies and in consideration of the unique management concerns of each run. (Moyle et al. 2015).

1.10.3 Threats to Viability

CV FR Chinook salmon are subject to a number of population viability threats. Overall, CV FR Chinook salmon population viability threats are considered to be of high concern. Estuary alteration is recognized as the anthropogenic factor of greatest concern related to CV FR Chinook salmon population viability. Additional anthropogenic factors that are considered major concerns on the continued viability of CV FR Chinook salmon populations include: major dams; agriculture; urbanization; instream mining; ocean and inland harvest; and hatcheries. CV FR Chinook salmon are particularly dependent on hatchery production to augment low numbers of naturally-spawning CV FR Chinook salmon, which may result in a loss of CV FR Chinook salmon life history variability due to homogenization. CV FR Chinook salmon viability is also threatened by climate change, which may result in Central Valley stream temperature increases and changes in precipitation patterns. Factors of lesser concern on the continued viability of CV FR Chinook salmon populations include grazing, rural residential development, legacy effects of hydraulic and hard rock gold mining, transportation, logging, fire, recreation, and alien species (Moyle et al 2015). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, rural development, logging, and existing roads and road development.

1.11 Central Valley Late Fall-Run Chinook Salmon

1.11.1 Status and Distribution

The Central Valley late fall-run (CV LFR) Chinook salmon DTE is listed as a species of special concern by CDFW (Moyle et al. 2015). In addition, NMFS lists CV LFR Chinook salmon in conjunction with the Central Valley fall-run Chinook salmon as a species of concern[8]. (NMFS 2017)

The CV LFR Chinook salmon ESU includes populations in the Sacramento River watershed (Figure 6). CV LFR Chinook salmon likely historically spawned in the upper Sacramento and McCloud Rivers, in portions of major tributaries that naturally provided adequate cold water temperatures during summer, and possibly in the Friant region and in other large tributaries to the San Joaquin River. Today, impassible dams prevent CV LFR Chinook salmon from reaching much of this historic spawning habitat. As a result, CV LFR Chinook salmon now primarily spawn and rear in the Sacramento River between the Red Bluff Diversion Dam and Redding, and are reliant on cold water releases from Shasta Dam to maintain suitable spawning habitat conditions. (Moyle et al 2015)

1.11.2 Life History

In general, CV LFR Chinook salmon rear in freshwater for 7 to 13 months, migrate to the ocean, spend one to four years maturing in the marine environment, and return to freshwater to spawn. CV LFR Chinook salmon adult migration typically occurs during December and January, but may begin as early as October and continue into April. CV LFR Chinook salmon are sexually mature when upstream migration begins, move relatively quickly to their spawning grounds, and typically spawn shortly after arrival at spawning grounds. CV LFR Chinook salmon spawning occurs between late December and April and peaks between February and March. As with all

[8] NMFS currently considers the Central Valley fall-run Chinook salmon and the Central Valley late fall-run Chinook salmon to be two races under a single ESU. In contrast, CDFW regards the runs as separate taxonomic entities, and thus separate species of special concern on the statewide Species of Special Concern list, based upon their distinct life-history strategies and in consideration of the unique management concerns of each run. (Moyle et al. 2015).

salmon, CV LFR Chinook salmon spawn only once, and die shortly after spawning. (CDFW 2015; Moyle et al 2015)

CV LFR Chinook salmon life history details are less extensively documented compared to other Central Valley Chinook salmon populations because CV LFR Chinook salmon were recognized relatively recently as a unique run[9] and because CV LFR Chinook salmon migration and spawning activities are difficult to observe and tend to coincide with high, cold, and turbid streamflows. It is presumed that CV LFR Chinook salmon have similar egg and alevin incubation lengths compared to other Central Valley Chinook salmon populations; it is presumed that CV LFR Chinook salmon egg incubation lasts for, 40 to 60 days and CV LFR Chinook salmon alevin incubation lasts 4-6 weeks. Alevins typically emerge into the water column as fry from April to early June. Juvenile CV LFR Chinook salmon usually hold in freshwater for 7 to 13 months before out-migrating, and peak CV LFR Chinook salmon outmigration appears to occur in October. Juvenile CV LFR Chinook salmon may, however, out-migrate at younger ages and smaller sizes during most months of the year. Following outmigration, CV LFR Chinook salmon may spend between one and four years maturing in the marine environment before migrating back to freshwater to spawn. Historically, spawning CV LFR Chinook salmon adults consisted of a mix of age classes ranging from two to five years of age; however, currently, most adults return to freshwater to spawn as three-year-olds. (Moyle et al. 2015)

1.11.3 Threats to Viability

CV LFR Chinook salmon are subject to a number of population viability threats. Overall, threats to the viability of CV LFR Chinook salmon population are considered to be of high concern. Major anthropogenic factors limiting or potentially limiting CV LFR Chinook salmon population viability include major dams, estuary alteration, agriculture, ocean and inland harvest, and hatcheries. In addition, while the current proportion of the spawning population of hatchery origin is small, the influence of hatcheries is still of concern due to the associated potential ecological and genetic impacts to the sustainability of the run. CV LFR Chinook salmon face additional risks posed by climate change, which is expected to increase instream temperatures while simultaneously limiting the ability to maintain a cool water pool behind Shasta Dam; these factors may result in a lack of cold water habitat sufficient to support CVLFR Chinook salmon year-round. CV LFR Chinook salmon population viability threats of lesser concern include grazing, rural residential development, instream mining, mining (particularly from Iron Mountain Mine), transportation, logging, fire, recreation, and alien species (Moyle et al. 2015). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, rural development, logging, and existing roads and road development.

1.12 California Central Valley Steelhead

1.12.1 Status and Distribution

The California Central Valley (CCV) steelhead DPS is a special-status species listed as threatened under the federal ESA. The CCV steelhead DPS includes naturally spawned steelhead populations in the Sacramento and San Joaquin Rivers and their tributaries, but does not include steelhead populations in tributaries to the San Francisco and San Pablo Bays (Figure 3). The CCV steelhead DPS also includes steelhead from two artificial propagation programs. (CDFW 2017b)

[9] Central Valley late-fall run Chinook salmon were recognized as a distinct Chinook salmon run in 1966, after the construction of the Red Bluff Diversion Dam allowed for easier observation of fish passage through this area (Moyle et al. 2015).

1.12.2 Life History

In general, CCV steelhead rear in freshwater for one to three years, migrate to the ocean, spend one to four years maturing in the marine environment, and return to freshwater to spawn. At this time, CCV steelhead follow an ocean-maturing, or winter run life history strategy, but CCV steelhead may have also historically included a summer steelhead life history strategy prior to the construction of large Central Valley dams. CCV steelhead adults typically begin migrating from the ocean in December when tributary streamflows are high, with peak CCV steelhead adult migration occurring in January and February. However, adult CCV steelhead freshwater migration may begin as early as August and extend until as late as April. CCV steelhead spawn in small streams and tributaries in the Sacramento and San Joaquin River watersheds where cool, well-oxygenated water is available year-round, including every major tributary downstream of major storage dams. CCV steelhead spawning usually occurs between January and March and peaks in February. CCV steelhead are capable of spawning more than once, but rarely spawn more than twice. Those individuals that do not die after spawning typically migrate back to the ocean between April and June, with a peak observed in May. (CDFW 2015; NMFS 2014b)

CCV steelhead eggs incubate in redds for three to four weeks or more, depending on water temperature. Upon hatching, the alevins remain in redds for an additional four to six weeks before emerging into the water column as fry. Fry and juvenile CCV steelhead spend up to three years rearing in freshwater and most commonly rear in freshwater for two years. Typically, juvenile CCV steelhead out-migrate to the ocean between November and May. However, in the Sacramento River watershed, juvenile CCV steelhead may migrate downstream during most months of the year, with peak outmigration occurring in spring, and a smaller peak occurring in fall. During outmigration, juvenile CCV steelhead may rear for short periods in the Delta’s tidal marshes, non-tidal freshwater marshes, and other shallow water habitat. Peak outmigration through the Delta typically occurs in March and April. Following outmigration, CCV steelhead typically spend two or three years maturing in the marine environment before migrating back to freshwater to spawn as four- or five-year-olds. (NMFS 2014b; CDFW 2015)

1.12.3 Threats to Viability

CCV steelhead are subject to a number of population viability threats. Overall, stressors on CCV steelhead collectively affect all life history stages. Major stressors on CCV steelhead include passage impediments and barriers, warm water temperatures for rearing, hatchery effects, limited quantity and quality of rearing habitat (e.g., loss of floodplain habitat, loss of natural river morphology and function, and loss of riparian habitat and instream cover), predation, and entrainment. Other important stressors on CCV steelhead include warm water temperatures affecting adult immigration and holding and embryo incubation, limited spawning habitat availability, limited instream gravel supply, sedimentation, the potential for hazardous spills, flow fluctuations, low-flow conditions, and poor water quality (NMFS 2014b). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: limitations to the quantity and quality of rearing habitat, poor water quality, entrainment, sedimentation, flow fluctuations, passage impediments and barriers, predation, warm water temperatures for rearing, and low-flow conditions.

1.13 Central California Coast Steelhead

1.13.1 Status and Distribution

The Central California Coast (CCC) steelhead DPS is a special-status species listed as threatened under the federal ESA. The CCC steelhead DPS includes all steelhead populations from the winter-run populations in the Russian River basin south to Aptos Creek in Santa Cruz County, and the drainages of San Francisco, San Pablo, and Suisun Bays, including the tributary streams to Suisun Marsh, but excluding the Sacramento-San Joaquin River system (Figure 3; CDFW 2017b, NMFS 1996).

1.13.2 Life History

The CCC steelhead DPS exhibits a similar life history to the ocean-maturing, or winter-run, NC steelhead. (NMFS 2011, 2007a) Please refer to the NC steelhead description in this appendix for general life history information that applies to the CCC steelhead DPS.

1.13.3 Threats to Viability

CCC steelhead are subject to a number of population viability is threats. All CCC steelhead life stages are affected by CCC steelhead population viability threats, but the greatest impact of these threats fall on winter-rearing juvenile CCC steelhead, followed by egg incubation and summer-rearing juvenile life history stages. The highest severity and most extensive CCC steelhead population viability threats, inclusive of all life stages, include channel modifications, residential and commercial development, roads and railroads, and water diversions and impoundments. CCC steelhead population viability threats of lesser severity or extent include: severe weather patterns; agriculture; mining; livestock farming and ranching; fire, fuel management, and fire suppression; recreational areas and activities; logging and wood harvesting; disease, predation, and competition; fishing and collecting; and hatcheries and aquaculture (NMFS 2015). The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, water diversions and impoundments, channel modifications, land development, logging and wood harvesting, and existing roads and road development.

1.14 Central California Coast Coho Salmon

1.14.1 Status and Distribution

The Central California Coast (CCC) coho salmon ESU is a special-status species listed as endangered under the federal ESA and the California ESA (CDFW 2017b). The CCC coho salmon ESU includes all coho salmon populations in California found in coastal watersheds between Punta Gorda in Humboldt County and Aptos Creek in Santa Cruz County (Figure 4; NMFS 2012a).

1.14.2 Life History

CCC coho salmon predominantly adhere to a three-year life cycle. CCC coho salmon typically rear in freshwater for one year, migrate to the ocean, spend two years maturing in the marine environment, and return to freshwater to spawn. Adult CCC coho salmon typically migrate from the ocean to freshwater spawning grounds between September and January and spawn shortly thereafter, typically between November and January. In more southern portions of the CCC coho salmon range, such as Scott and Waddell Creeks in Santa Cruz County, CCC coho salmon tend to migrate and spawn later in the year. This southern-range spawning migration typically occurs from November through January, with spawning occurring into February and early March. CCC coho salmon adult migration into freshwater coincides with large increases in streamflows that are sufficient to breach sandbars at the mouths of coastal streams and allow salmon access to upstream spawning areas. After spawning, female coho salmon will guard their redds from predators until they become too weak to hold their position. Both male and female coho salmon die shortly after spawning. (Moyle 2002, NMFS 2012a)

CCC coho salmon eggs incubate in redds for approximately 35 to 50 days, between November and April. Upon hatching, the alevins remain in redds for an additional 2 to 10 weeks before emerging into the water column as fry. Juvenile CCC coho salmon emergence typically occurs between February and June and peaks between March and May. Almost all juvenile CCC coho salmon rear in freshwater for one year prior to outmigration. During winter months, juvenile CCC coho salmon may seek refuge from higher flows in off-channel habitat, backwater pools, or small, clear tributaries. Juvenile CCC coho salmon outmigration typically begins in March and peaks from April to July. Most CCC coho salmon spend two years in the marine environment and then migrate to freshwater to spawn as three-year olds. (NMFS 2012a)

Compared to other anadromous salmonid populations in California, CCC coho salmon use the broadest diversity of freshwater/estuarine habitats. These freshwater habitat types include small tributaries of coastal streams, lakes, inland tributaries of major rivers, and estuarine environments. CCC coho salmon may utilize estuarine environments for seasonal juvenile rearing, to transition to or from the more saline ocean environment, or simply as a migratory corridor. (NMFS 2012a)

The dominance of the three-year life cycle amongst CCC coho salmon results in a strong demographic separation of the three-year classes. Exceptions to the dominant life cycle include smolts that remain in freshwater for two years instead of one year and jack males, which may return to freshwater at two years of age after spending only six months spent maturing in the ocean. However, essentially all wild female coho salmon spawn as three-year olds, creating three distinct, separate maternal brood year lineages for each CCC coho salmon stream. The lack of overlapping maternal generations places brood year lineages at high long-term risk from adverse effects of stochastic (random) events. In streams south of San Francisco Bay, loss of year classes appears to have already taken place due to poor ocean conditions and a fire that degraded both riparian and instream habitat. (NMFS 2012a)

1.14.3 Threats to Viability

CCC coho salmon are subject to a number of population viability threats. The most impacted CCC coho salmon life stage is winter-rearing juveniles, but all other life history stages are also impacted by anthropogenic stressors. The highest severity and most extensive CCC coho salmon population viability threats, inclusive of all life stages, include: roads and railroads; water diversions and impoundments; residential and commercial development; and severe weather patterns. CCC coho salmon population viability threats of lesser severity or extent include: channel modification; livestock farming and ranching; agriculture; logging and wood harvesting; fire, fuel management, and fire suppression; disease, predation, and competition; fishing and collecting; recreational areas and activities; mining; and hatcheries and aquaculture. Other emerging CCC coho salmon population viability threats include: water toxins, such as nutrients, pesticides, and pharmaceuticals; climate change; urbanization; adverse effects associated with the actual size of a population (e.g., small population dynamics); and increasing adverse impacts due to water diversions. (NMFS 2012a) The most significant threats discussed above that may be exacerbated by cannabis cultivation include: agriculture, water diversions and impoundments, channel modifications, land development, logging and wood harvesting, and existing roads and road development.

1.15 South-Central California Coast Steelhead

1.15.1 Status and Distribution

The South-Central California Coast (SCCC) steelhead DPS is a special-status species listed as threatened under the federal ESA (CDFW 2017b). The SCCC steelhead DPS includes steelhead populations in watersheds from the Pajaro River, located at the boundary between Santa Cruz and Monterey Counties, south to Arroyo Grande Greek, located in San Luis Obispo County (Figure 3).

1.15.2 Life History

In general, SCCC steelhead rear in freshwater for one to three years, migrate to the ocean to spend one to four years maturing in the marine environment, and return to freshwater to spawn. SCCC steelhead adult migration and spawning typically occurs during winter and early spring, and is cued by factors such as higher runoff and breaching of sandbars that form at the mouths of rivers during periods of low streamflows. SCCC steelhead may migrate back to the marine environment after spawning and return to freshwater to spawn again in subsequent years. Some large SCCC steelhead adults, however, may remain in freshwater after spawning and become trapped in deep residual pools in the summer. (NMFS 2013)

SCCC steelhead eggs incubate in redds for three weeks up to two months, depending on water temperature and dissolved oxygen conditions. Upon hatching, the alevins remain in redds for an additional two to six weeks before emerging into the water column as fry. Fry and juvenile SCCC steelhead typically spend a total of one to three years rearing in freshwater before out-migrating to the ocean in late winter and spring, cued by photoperiod, streamflow, temperature, and breaching of the sandbar. During their first rearing summer, juvenile SCC steelhead retreat to the cooler temperatures of headwaters or lagoons/estuaries[10]. At age one, juvenile SCCC steelhead that have grown rapidly, usually due to lagoon rearing, undergo smoltification and migrate out to the ocean. However, the majority of age one SCCC steelhead will stay in the river system and, in summer, again seek thermal refugia (primarily in headwaters), before finally out-migrating to the ocean at age two or three. In some watersheds, juvenile SCCC steelhead may rear in a lagoon or estuary for several weeks or months prior to entering the ocean. Following outmigration, SCCC steelhead spend between one and four years in the marine environment before migrating back to freshwater to spawn. (NMFS 2013)

1.15.3 Threats to Viability

SCCC steelhead are subject to a number of population viability is threats. The highest severity and most extensive SCCC steelhead threats include dams and surface water diversions, groundwater extraction, levees and channelization, recreational facilities, urban development, roads and culverts (and other passage barriers), agricultural development, non-point source pollution, and mining. SCCC steelhead population viability threats of low and medium severity include agricultural effluent, flood control/maintenance, non-native species, roads, upslope/upstream activities, urban effluents, and wildfires. (NMFS 2013) The most significant threats discussed above that may be exacerbated by cannabis cultivation include: dams and surface water diversions, groundwater extraction, agricultural development, passage barriers including culverts and road crossings, non-point source pollution, and agricultural effluent.

[10] Those steelhead that primarily rear over summer in lagoons or estuaries are termed lagoon-anadromous steelhead, while those primarily over-summering in freshwater rivers and streams are termed fluvial-anadromous steelhead. Finer-scale habitat switching, such as multiple movements between lagoon and freshwater habitats, is also possible. (NMFS 2013).

1.16 Southern California Coast Steelhead

1.16.1 Status and Distribution

The Southern California Coast (SCC) steelhead DPS is a special-status species listed as endangered under the federal ESA and not listed under the California ESA (CDFW 2017b). The SCC steelhead DPS includes Southern California coastal steelhead populations, including coastal steelhead populations between the Santa Maria River watershed and the Tijuana River watershed (Figure 3).

1.16.2 Life History

The SCC steelhead DPS exhibits a very similar life history to the SCCC steelhead DPS described above, under the South-Central California Coast Steelhead section. The only notable distinction in the life history description of the SCC steelhead as compared with SCCC steelhead is that SCC steelhead typically mature in the marine environment for two to four years, whereas SCCC steelhead reside in the marine environment for one to four years. (NMFS 2012b)

1.16.3 Threats to Viability

SCC steelhead face a number of population viability threats. The highest severity and most extensive SCC steelhead population viability threats include dams and surface water diversions, wildfires, groundwater extraction, urban development, levees and channelization, passage barriers (including culverts and road crossings), flood control maintenance, roads, agricultural development, recreational facilities, and non-native species. SCC steelhead population viability threats of low and medium severity include agricultural effluent, passage barriers associated with culverts and road crossings, urban effluents, mining and quarrying (including historical mining and quarrying), and upslope/upstream activities. (NMFS 2012b) The most significant threats discussed above that may be exacerbated by cannabis cultivation include: dams and surface water diversions, groundwater extraction, agricultural development, passage barriers including culverts and road crossings, existing roads and road development, and agricultural effluent.

2.0 Other Salmonids of Interest

Not included in Section 1.0 of this appendix are two anadromous salmonid populations considered by CDFW as likely to warrant designation as species of special concern, pink and chum salmon, and one special-status amphidromous salmonid, the coastal cutthroat trout. The Cannabis Cultivation Policy (Policy) is anticipated to be protective of pink salmon, chum salmon, and coastal cutthroat trout due to the similar means by which cannabis cultivation is expected to impact these populations and those that were reviewed in greater detail in Section 1.0 of this appendix.

2.1 Pink and Chum Salmon

Pink salmon and chum salmon are not listed as species of special concern by CDFW due to the insufficient information available to determine their status. However, both species' persistence in California is likely at risk due to their naturally small populations in the state and the fact that California represents the southern extreme of both of their ranges. Pink salmon have been observed in small numbers in the Klamath River, Russian River, Garcia River, Ten Mile River, Sacramento River and tributaries, and San Lorenzo River; they are currently extremely rare in California. Chum salmon are also rare; they seem to maintain small runs in northern California rivers (Smith, Klamath, and Trinity) and have been observed in freshwater as far south as the San Lorenzo River. Both species venture no further than 200 km inland from the ocean, have short freshwater residencies, and are heavily dependent on estuaries during the juvenile life stage. Impacts to estuaries and spawning areas from logging, road building, mining and other factors likely contribute to the species decline. (Moyle et al. 2015, 1995; Moyle 2002) These impacts may be exacerbated by cannabis cultivation.

2.2 Coastal Cutthroat Trout

Coastal cutthroat trout do not exhibit a strictly anadromous life history. Instead, individuals of this subspecies of cutthroat trout exhibit one of four life history variants: the amphidromous life history, the riverine (potadromous) life history, the stream-resident life history, and the lacustrine life history. Individuals exhibiting the amphidromous life history (the variant most similar to an anadromous life history) move back and forth between fresh and salt water multiple times to feed and then migrate to freshwater to spawn. Individuals exhibiting the potadromous life history strategy live in rivers and make seasonal migrations upstream and downstream. Stream-resident populations remain in streams and are often present in headwaters above natural barriers. Lacustrine coastal cutthroat trout dwell in large lakes but may migrate into streams to spawn. (Moyle et al. 2015)

Coastal cutthroat trout are distributed in California from the Salt River, tributary to the Eel River estuary, north to the California-Oregon border. They typically spawn and rear in small streams until one year of age. After year one, juveniles may move extensively throughout the watershed but prefer small, low gradient coastal streams and estuaries/lagoons where they may spend months at a time, moving in and out of freshwater. Those individuals that migrate to salt water typically stay near shore, venturing no more than 7 kilometers from the coastline and often remaining close to the plume of the river in which they reared. (Moyle et al. 2015)

Like many of special-status anadromous salmonids discussed in detail in this Policy (Appendix B, section 1.0), coastal cutthroat trout experience impacts from land-use activities, including agriculture, grazing, logging, water diversion, rural and urban development, estuary alteration, and road construction; fish passage issues, such as major dams; and competition and hybridization with hatchery steelhead. Climate change is expected to further stress the population of coastal cutthroat trout in California. (Moyle et al. 2015) These impacts may be exacerbated by cannabis cultivation.

Figure 1. Life-Stage Timing of California Special-Status Anadromous Salmonids

Shading indicates the relative abundance of “survivors” (i.e., individuals who persist through the conclusion of that life stage category) present in freshwater, unless otherwise specified, by life stage category and ESU/DPS/DTE. Life stage categories are consecutive (e.g., when a juvenile salmonid commences outmigration, it is represented by an addition to the “Juvenile outmigration” category and a loss from the “Incubation/rearing” category). The darkest shading indicates the highest abundance of survivors within a life stage category by ESU/DPS/DTE. No shading indications that no individuals within the life stage category are expected to be present under most circumstances.

These graphics are approximations of the timing of salmonid life stages by ESU/DPS/DTE and are subject to the constraints of the various source materials. These graphics should not be relied upon as independent sources; instead, the in-text life history summaries, and the sources provided therein, should be referenced.

Southern Oregon/Northern California Coastal Chinook Salmon

Adult upstream migration/spawning
Incubation/rearing
Juvenile outmigration
Source: Moyle et al. 2015

California Coastal Chinook Salmon (Ocean Type)

Adult upstream migration/spawning
Incubation/rearing
Juvenile outmigration
Source: NMFS 2015

Klamath Mountains Province Steelhead

Winter run: Adult upstream migration/spawning

Summer run: Adult upstream migration/holding/spawning

Fall run: Adult upstream migration/holding/spawning

Adult outmigration (and holding due to fragmented habitat)^
Incubation/rearing
Juvenile outmigration
Half-pounder freshwater residency
Source: Moyle et al. 2015 KMPS, CDFW 2015, USFWS 2001

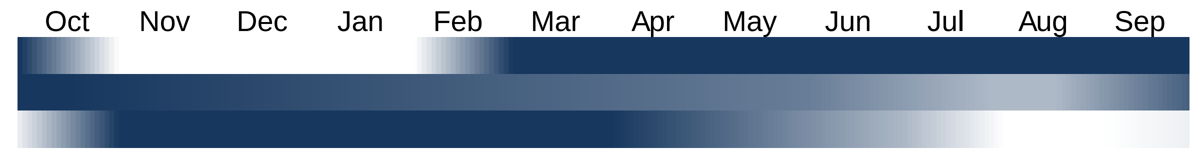
^ The timing of adult outmigration is infrequently described in the source materials, therefore, graphical representations of adult outmigration frequently show best estimates of the timing of this life stage based on the timing of spawning, the local hydrologic regime, and extrapolations from similar populations.

Figure 1. Continued

^ The timing of adult outmigration is infrequently described in the source materials, therefore, graphical representations of adult outmigration frequently show best estimates of the timing of this life stage based on the timing of spawning, the local hydrologic regime, and extrapolations from similar populations.

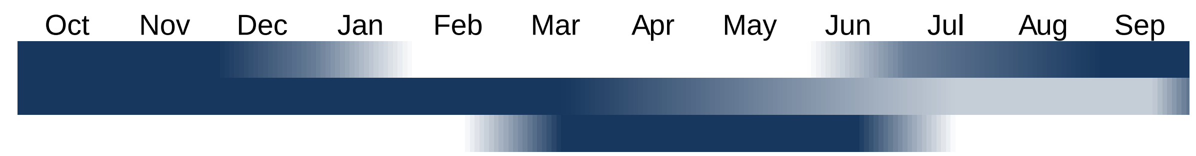
Figure B-1 Continued

Central Valley Spring-Run Chinook Salmon



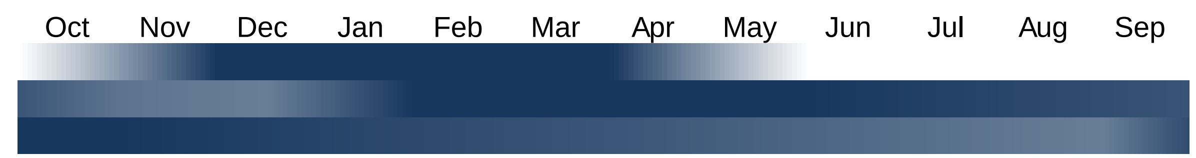
Adult upstream migration/holding/spawning
Incubation/rearing
Juvenile outmigration
Source: CDFW 2015, NMFS 2014b

Central Valley Fall-Run Chinook Salmon



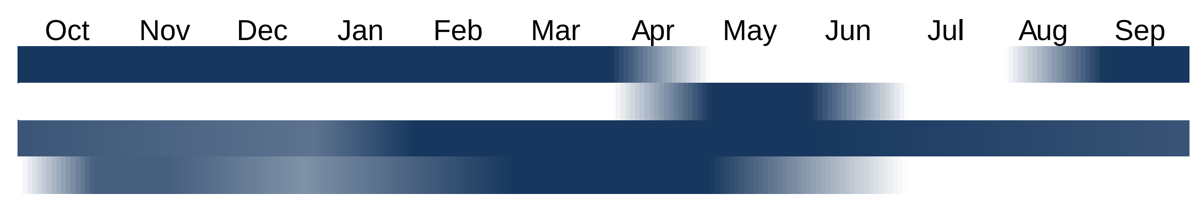
Adult upstream migration/spawning*
Incubation/rearing
Juvenile outmigration*
Source: Moyle et al. 2015

Central Valley Late Fall-Run Chinook Salmon



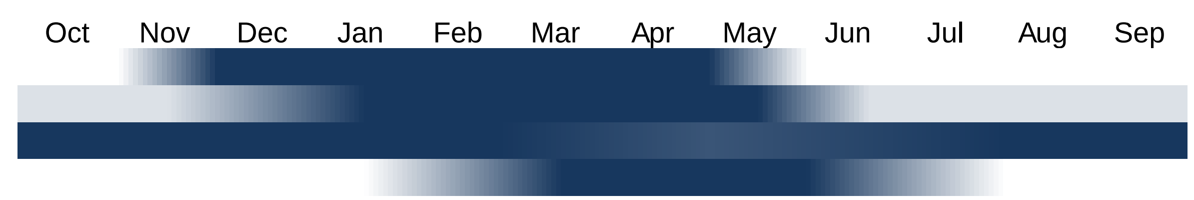
Adult upstream migration/spawning*
Incubation/rearing
Juvenile outmigration*
Source: Moyle et al. 2015

California Central Valley Steelhead



Adult upstream migration/spawning
Adult outmigration
Incubation/rearing
Juvenile outmigration
Source: CDFW 2015, NMFS 2014b

Central California Coast Steelhead



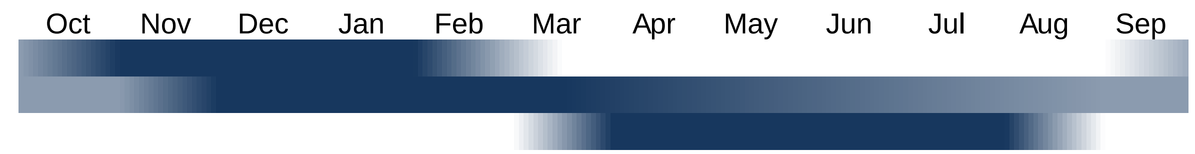
Adult upstream migration/spawning
Adult outmigration (and holding due to fragmented habitat)^
Incubation/rearing
Juvenile outmigration
Source: NMFS 2007a, 2015

^ The timing of adult outmigration is infrequently described in the source materials, therefore, graphical representations of adult outmigration frequently show best estimates of the timing of this life stage based on the timing of spawning, the local hydrologic regime, and extrapolations from similar populations.

* Representation of life stage timing includes presence in freshwater and brackish water (i.e., the San Francisco Bay/Sacramento-San Joaquin Delta).

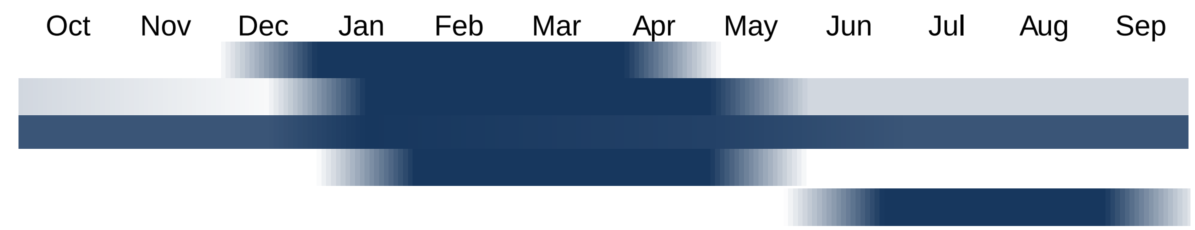
Figure B-1 Continued

Central California Coast Coho Salmon



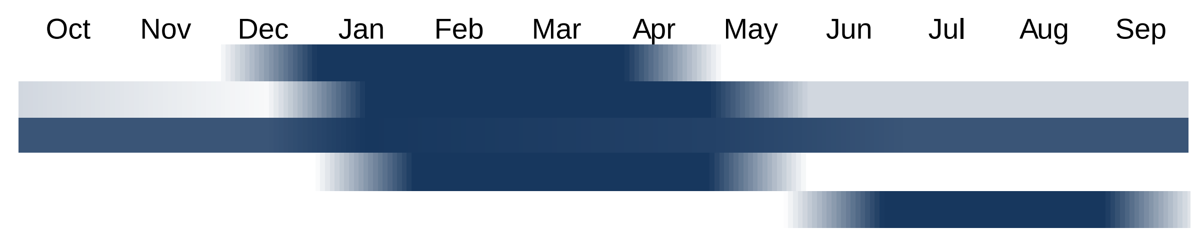
Adult upstream migration/spawning
Incubation/rearing
Juvenile outmigration
Source: NMFS 2012a

South-Central California Coast Steelhead



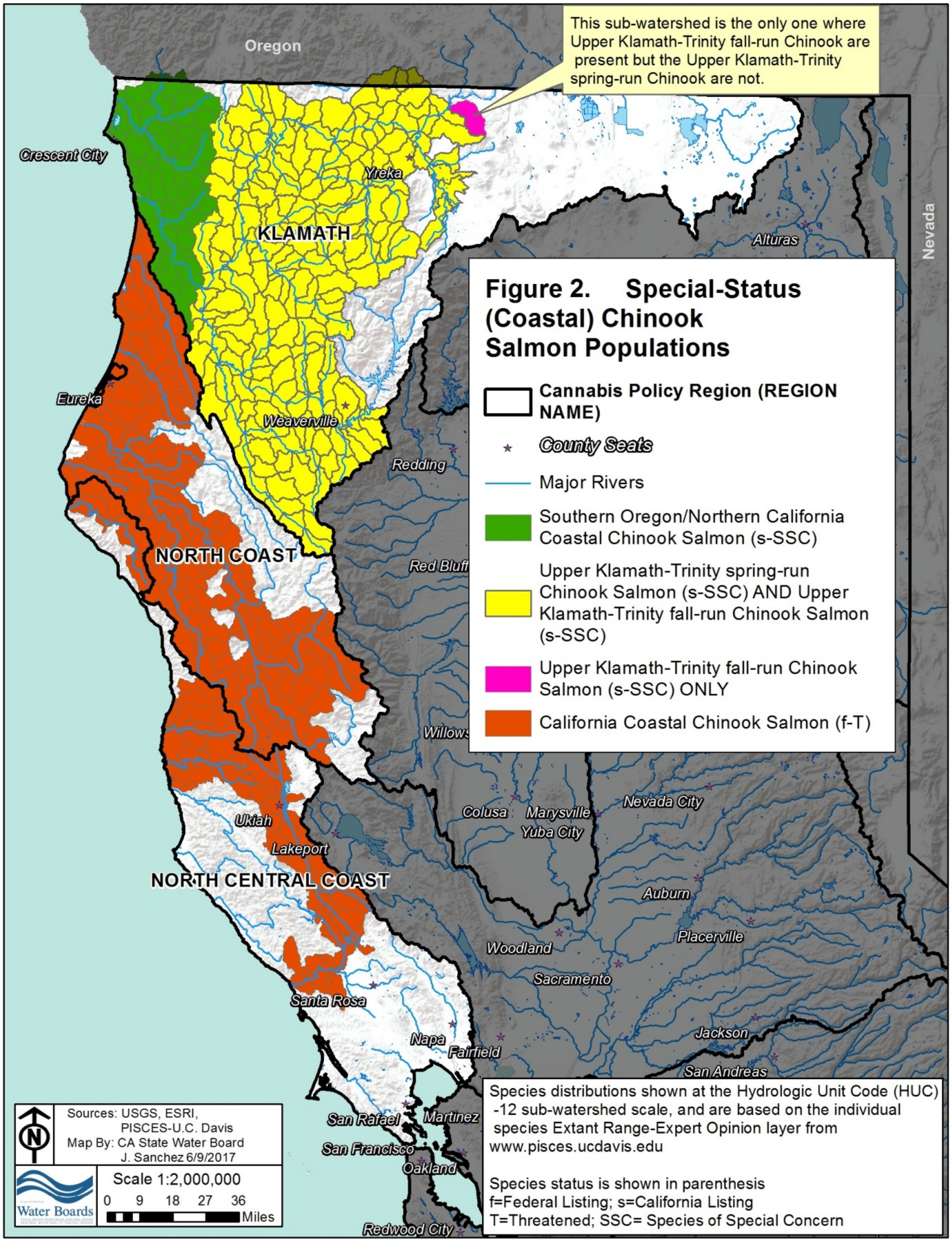
Adult upstream migration/spawning
Adult outmigration (and holding due to fragmented habitat)^
Incubation/rearing
Juvenile outmigration
Lagoon rearing
Source: NMFS 2013

Southern California Coast Steelhead



Adult upstream migration/spawning
Adult outmigration (and holding due to fragmented habitat)^
Incubation/rearing
Juvenile outmigration
Lagoon rearing
Source: NMFS 2012b

^ The timing of adult outmigration is infrequently described in the source materials, therefore, graphical representations of adult outmigration frequently show best estimates of the timing of this life stage based on the timing of spawning, the local hydrologic regime, and extrapolations from similar populations.


This sub-watershed is the only one where Upper Klamath-Trinity fall-run Chinook are present but the Upper Klamath-Trinity spring-run Chinook are not.
Oregon
Nevada
Crescent City
Yreka
KLAMATH
Alturas
Eureka
Weaverville
Redding
NORTH COAST
Red Bluff
Willows
Colusa
Marysville
Yuba City
Nevada City
Ukiah
Lakeport
NORTH CENTRAL COAST
Auburn
Placerville
Woodland
Sacramento
Santa Rosa
Jackson
Napa
Fairfield
San Andreas
San Rafael
Martinez
San Francisco
Oakland
Redwood City
Figure 2. Special-Status (Coastal) Chinook Salmon Populations
Cannabis Policy Region (REGION NAME)
County Seats
Major Rivers
Southern Oregon/Northern California Coastal Chinook Salmon (s-SSC)
Upper Klamath-Trinity spring-run Chinook Salmon (s-SSC) AND Upper Klamath-Trinity fall-run Chinook Salmon (s-SSC)
Upper Klamath-Trinity fall-run Chinook Salmon (s-SSC) ONLY
California Coastal Chinook Salmon (f-T)
Sources: USGS, ESRI, PISCES-U.C. Davis
Map By: CA State Water Board J. Sanchez 6/9/2017
Water Boards
Scale 1:2,000,000
0 9 18 27 36 Miles
Species distributions shown at the Hydrologic Unit Code (HUC) -12 sub-watershed scale, and are based on the individual species Extant Range-Expert Opinion layer from www.pisces.ucdavis.edu
Species status is shown in parenthesis
f=Federal Listing; s=California Listing
T=Threatened; SSC= Species of Special Concern

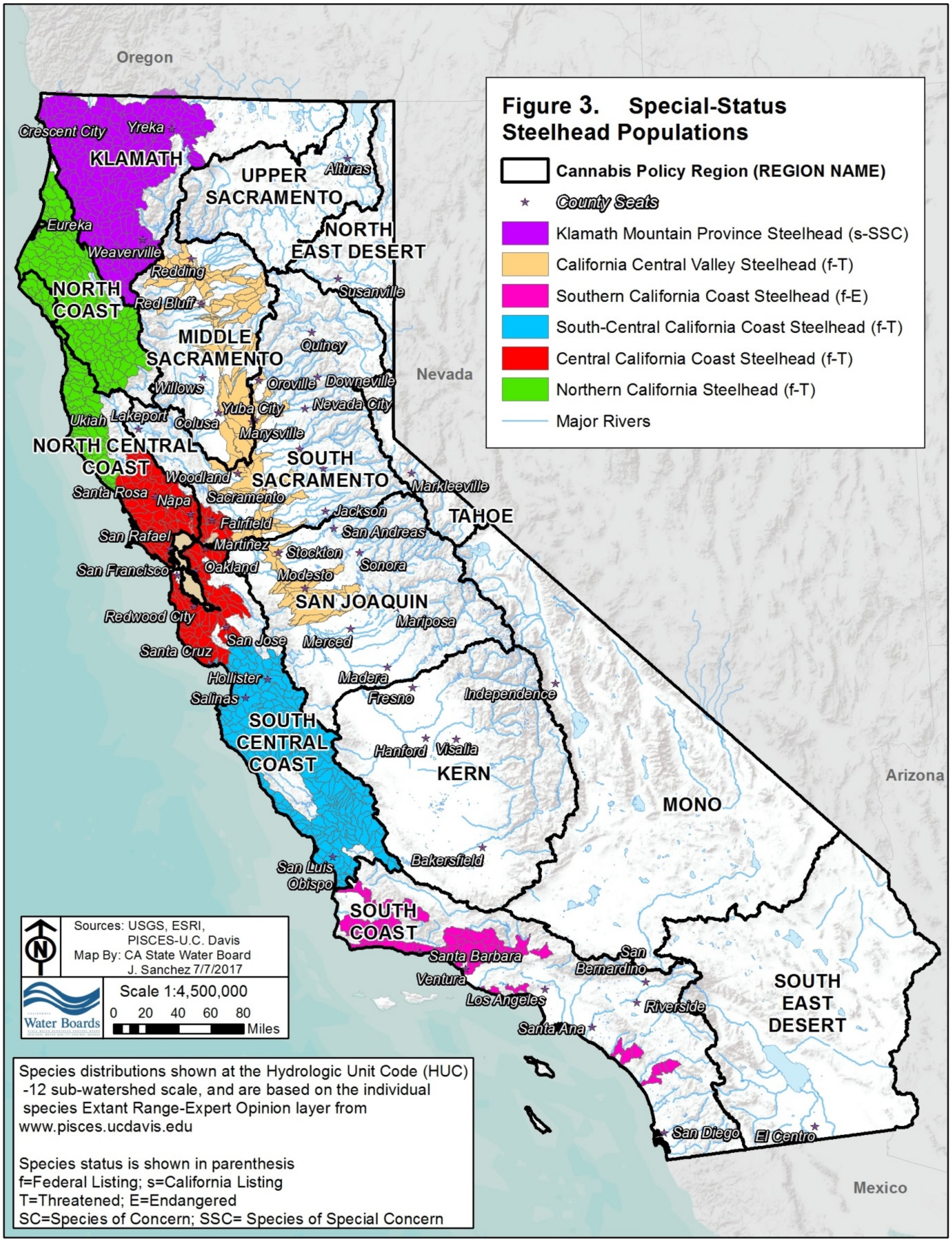


Figure 3. Special-Status Steelhead Populations
Cannabis Policy Region (REGION NAME)
County Seats
Klamath Mountain Province Steelhead (s-SSC)
California Central Valley Steelhead (f-T)
Southern California Coast Steelhead (f-E)
South-Central California Coast Steelhead (f-T)
Central California Coast Steelhead (f-T)
Northern California Steelhead (f-T)
Major Rivers
Oregon
Nevada
Arizona
Mexico
KLAMATH
UPPER SACRAMENTO
NORTH EAST DESERT
NORTH COAST
MIDDLE SACRAMENTO
NORTH CENTRAL COAST
SOUTH SACRAMENTO
TAHOE
SAN JOAQUIN
SOUTH CENTRAL COAST
KERN
MONO
SOUTH COAST
SOUTH EAST DESERT
Crescent City
Yreka
Alturas
Eureka
Weaverville
Redding
Susanville
Red Bluff
Quincy
Willows
Oroville
Downieville
Yuba City
Nevada City
Ukiah
Lakeport
Colusa
Marysville
Woodland
Markleeville
Santa Rosa
Napa
Sacramento
Jackson
Fairfield
San Andreas
San Rafael
Martinez
Stockton
Sonora
San Francisco
Oakland
Modesto
Redwood City
Mariposa
San Jose
Merced
Santa Cruz
Hollister
Madera
Salinas
Fresno
Independence
Hanford
Visalia
Bakersfield
San Luis Obispo
Santa Barbara
Ventura
San Bernardino
Los Angeles
Riverside
Santa Ana
San Diego
El Centro
Sources: USGS, ESRI, PISCES-U.C. Davis
Map By: CA State Water Board J. Sanchez 7/7/2017
Water Boards
Scale 1:4,500,000
0 20 40 60 80 Miles
Species distributions shown at the Hydrologic Unit Code (HUC) -12 sub-watershed scale, and are based on the individual species Extant Range-Expert Opinion layer from www.pisces.ucdavis.edu
Species status is shown in parenthesis
f=Federal Listing; s=California Listing
T=Threatened; E=Endangered
SC=Species of Concern; SSC= Species of Special Concern

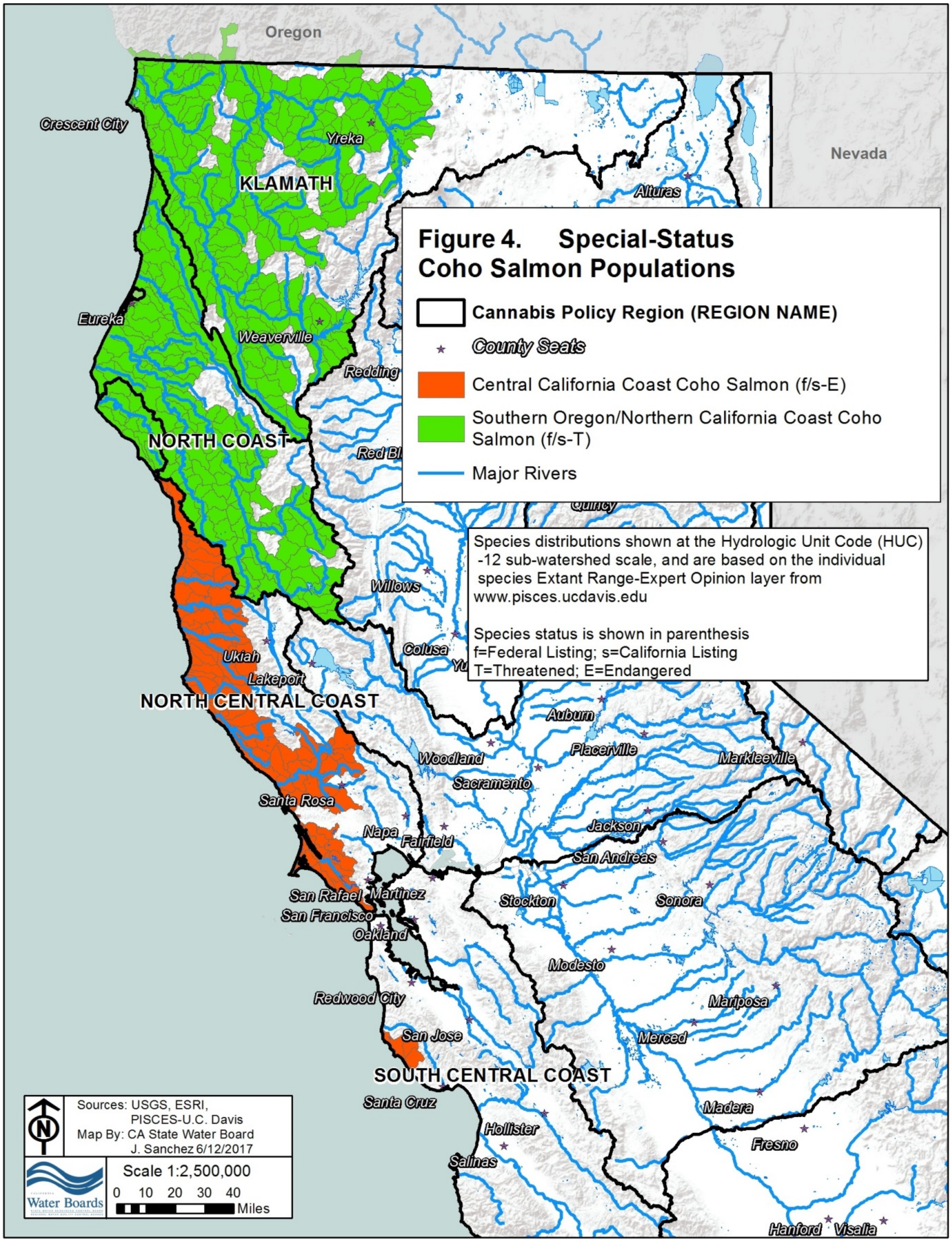


Figure 4. Special-Status Coho Salmon Populations
Cannabis Policy Region (REGION NAME)
County Seats
Central California Coast Coho Salmon (f/s-E)
Southern Oregon/Northern California Coast Coho Salmon (f/s-T)
Major Rivers
Species distributions shown at the Hydrologic Unit Code (HUC) -12 sub-watershed scale, and are based on the individual species Extant Range-Expert Opinion layer from www.pisces.ucdavis.edu
Species status is shown in parenthesis
f=Federal Listing; s=California Listing
T=Threatened; E=Endangered
Oregon
Nevada
KLAMATH
NORTH COAST
NORTH CENTRAL COAST
SOUTH CENTRAL COAST
Crescent City
Yreka
Alturas
Eureka
Weaverville
Redding
Quincy
Willows
Colusa
Ukiah
Lakeport
Auburn
Placerville
Markleeville
Woodland
Sacramento
Santa Rosa
Jackson
Napa
Fairfield
San Andreas
San Rafael
Martinez
Stockton
Sonora
San Francisco
Oakland
Modesto
Redwood City
Mariposa
San Jose
Merced
Santa Cruz
Madera
Hollister
Fresno
Salinas
Hanford
Visalia
Sources: USGS, ESRI, PISCES-U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/12/2017
Scale 1:2,500,000
0 10 20 30 40
Miles
Water Boards

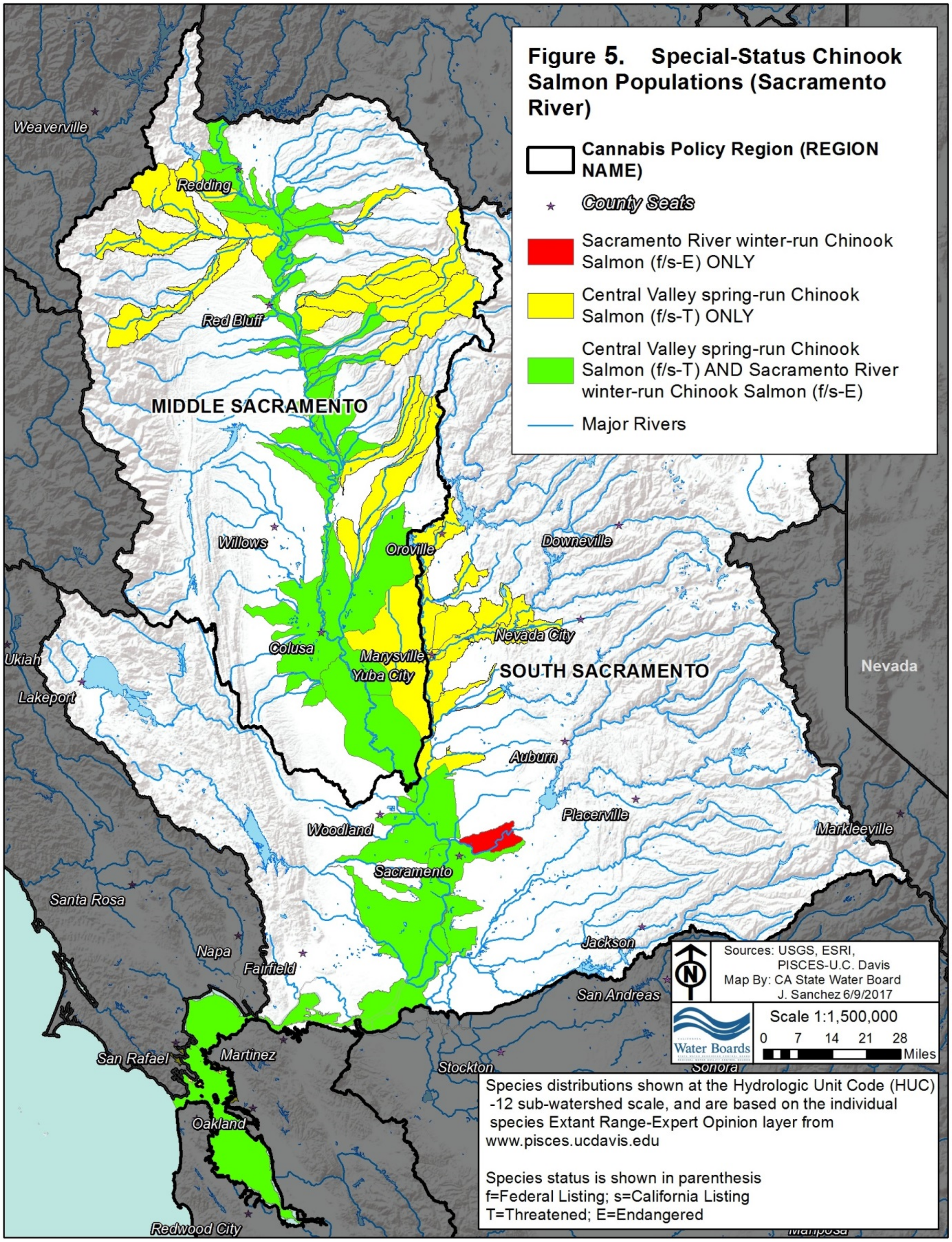


Figure 5. Special-Status Chinook Salmon Populations (Sacramento River)
Cannabis Policy Region (REGION NAME)
County Seats
Sacramento River winter-run Chinook Salmon (f/s-E) ONLY
Central Valley spring-run Chinook Salmon (f/s-T) ONLY
Central Valley spring-run Chinook Salmon (f/s-T) AND Sacramento River winter-run Chinook Salmon (f/s-E)
Major Rivers
Weaverville
Redding
Red Bluff
MIDDLE SACRAMENTO
Willows
Oroville
Downieville
Nevada City
Colusa
Marysville
Yuba City
SOUTH SACRAMENTO
Nevada
Ukiah
Lakeport
Auburn
Placerville
Woodland
Markleeville
Sacramento
Santa Rosa
Jackson
Napa
Fairfield
San Andreas
Sources: USGS, ESRI, PISCES-U.C. Davis
Map By: CA State Water Board J. Sanchez 6/9/2017
Water Boards
Scale 1:1,500,000
0 7 14 21 28
Miles
San Rafael
Martinez
Stockton
Sonora
Oakland
Redwood City
Mariposa
Species distributions shown at the Hydrologic Unit Code (HUC) -12 sub-watershed scale, and are based on the individual species Extant Range-Expert Opinion layer from www.pisces.ucdavis.edu
Species status is shown in parenthesis
f=Federal Listing; s=California Listing
T=Threatened; E=Endangered

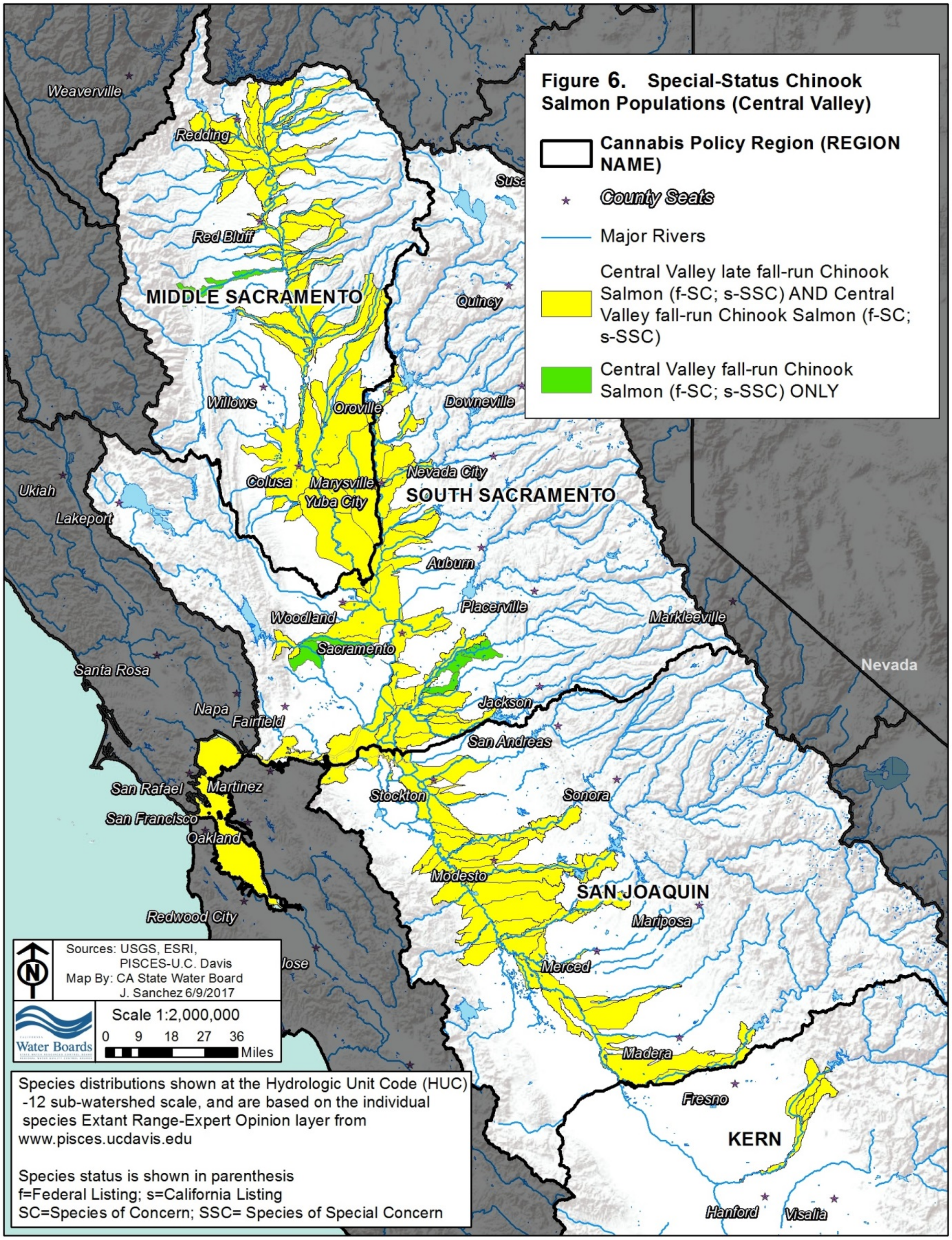


Figure 6. Special-Status Chinook Salmon Populations (Central Valley)
Cannabis Policy Region (REGION NAME)
County Seats
Major Rivers
Central Valley late fall-run Chinook Salmon (f-SC; s-SSC) AND Central Valley fall-run Chinook Salmon (f-SC; s-SSC)
Central Valley fall-run Chinook Salmon (f-SC; s-SSC) ONLY
MIDDLE SACRAMENTO
SOUTH SACRAMENTO
SAN JOAQUIN
KERN
Nevada
Weaverville
Redding
Red Bluff
Quincy
Willows
Oroville
Downieville
Colusa
Marysville
Yuba City
Nevada City
Ukiah
Lakeport
Auburn
Woodland
Placerville
Markleeville
Sacramento
Santa Rosa
Jackson
Napa
Fairfield
San Andreas
San Rafael
Martinez
Stockton
Sonora
San Francisco
Oakland
Modesto
Mariposa
Redwood City
Merced
Madera
Fresno
Hanford
Visalia
Sources: USGS, ESRI, PISCES-U.C. Davis
Map By: CA State Water Board
J. Sanchez 6/9/2017
Scale 1:2,000,000
0 9 18 27 36 Miles
Water Boards
Species distributions shown at the Hydrologic Unit Code (HUC) -12 sub-watershed scale, and are based on the individual species Extant Range-Expert Opinion layer from www.pisces.ucdavis.edu
Species status is shown in parenthesis
f=Federal Listing; s=California Listing
SC=Species of Concern; SSC= Species of Special Concern