Sustainability Roadmap 2018-2019:

Climate Change Adaptation

Progress Report and Plan for Meeting
the Governor's Sustainability Goals
for California State Agencies

Department of Water Resources

Edmund G. Brown Jr., Governor

December 2017

Department of Water Resources Sustainability Road Map 2018-2019: Climate Change Adaptation

Primary Authors

Robb Tibstra
Michelle Selmon
Andrew Schwarz
John Andrew

Karla Nemeth
Director

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Acronyms & Abbreviations

AB	Assembly Bill
AP	Adaptation Plan
ADA	Americans with Disabilities Act
Bay	San Francisco Bay
CDFW	California Department of Fish and Wildlife
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
DAC	Disadvantaged Communities
Delta	Sacramento-San Joaquin Delta
DLIS	Delta Levees Investment Strategy
Draft VA	Draft DWR Climate Change Vulnerability Assessment
DWR	California Department of Water Resources
EHT	Extreme Heat Threshold
EO	Executive Order
GCM	Global Circulation Model
GGERP	Greenhouse Gas Emissions Reduction Plan
ºF	Degrees Fahrenheit
GHG	Greenhouse Gas
IRWM	Integrated Regional Water Management
OPC	Ocean Protection Council
RCP	Representative Concentration Pathway
SB	Senate Bill
SWP	State Water Project
VA	Climate Change Vulnerability Assessment
VA/AP	Climate Change Vulnerability Assessment/Adaptation Plan

EXECUTIVE SUMMARY

In addition to DWR's award winning work in reducing greenhouse gas emissions (GHGe), DWR has prepared the first state agency's Climate Change Vulnerability Assessment (VA). A three-year task, the VA covers the potential climate-driven hazards to all DWR facilities, managed lands, operations, and staff activities. In preparing its VA, DWR uses a standardized approach to extract relevant information from an extensive existing body of knowledge about climate change. The VA evaluates, describes, and quantifies - where possible - DWR's vulnerabilities to increases in wildfire, extreme heat, and sea level rise. Further, DWR reviews how changes in hydrology and ecosystems will impact DWR's facilities, operations, and other activities.

The greatest risk DWR faces from climate change will be from increasing heat impacting DWR employees' health in the field and no employee location will be unaffected. However, DWR has investigated the heat risk to all DWR employees and has determined that DWR has adequate flexibility in operations and staffing as well as heat risk procedures already in place to mitigate the risk to the end of the century.

Existing DWR facilities have been engineered and constructed to withstand a broad range of temperature fluctuations that is encompassed within the expected increases due to climate change. It is not anticipated that structures themselves will be impacted. For all DWR's new facilities and buildings, DWR has required the integration of climate change into department planning. All new construction projects must include climate change into the planning and construction process.

DWR has also included climate change in its engagement and planning process with DWR's Integrated Regional Water Management (IRWM)program working extensively with local communities and providing guidance documents. Additionally, DWR's California Water Plan, updated every five years, contains climate change guidance for the California water community.

DWR has fourteen funding programs that include climate change considerations in their funding criteria. Thirteen have specific criteria and one incorporates climate change through the California Environmental Quality Act (CEQA) which is required for grant application process.

After heat health risks to DWR employees, the second challenge is hydrologic changes caused by climate change, particularly in the operation of the SWP. Climate change brings both changes in temperature and precipitation, both of which are critical operational factors. Higher temperatures act to increase evapotranspiration, sublimation, and snowmelt rates, while decreasing soil moisture and snowpack. This, in turn, leads to reduced water storage, and changed water runoff patterns.

Changes in precipitation may affect average annual precipitation rates or the frequency, magnitude, and duration of extreme events. These changes can affect water quantity and quality and, in turn, the ecosystems and water systems dependent on the watersheds. Loss of snowpack is another concern for DWR operations. Snowmelt provides an annual average of 15

million acre-feet of water, slowly released by melting from about April to July each year. The SWP was designed to capture and store winter and spring runoff and to deliver the water during the drier summer and fall months. However, by the end of this century, the Sierra snowpack may diminish by 48-65 percent from 1961-1990 levels (Pierce and Cayan 2012). This loss of snowpack, due to precipitation falling as rain instead of snow and the remaining snow melting faster, will result in larger volumes of runoff entering reservoirs during the winter and early spring and less runoff arriving in late spring and early summer This could lead to higher downstream flow during flood events and reduced late summer storage levels.

Another consideration for DWR operations is the impact to ecosystems. DWR does not rely just on man-made infrastructure, but DWR also relies on natural or green infrastructure. (*Natural infrastructure is the "preservation or restoration of ecological systems or the utilization of engineered systems that use ecological processes to increase resiliency to climate change, manage other environmental hazards, or both*). Unfortunately, climate change is already affecting and will continue to affect ecosystems and ecosystem services in California (PRBO 2011). Wildlife and plant species distributions are shifting in response to changing environmental conditions, impacts to important life-cycle events have been observed (e.g., changes in reproduction and migration patterns), and some species populations are declining (OEHHA/CalEPA 2013). In addition to these direct impacts, climate change is indirectly affecting ecosystems by exacerbating existing stressors, such as urbanization, habitat fragmentation, and invasive species.

Although the focus of this report is the impact on state facilities and operations, it is important to note that for some state agencies, climate change impacts their mission as well. DWR's mission statement declares that "*DWR is responsible for managing and protecting California's water resources. DWR works with other agencies to benefit the State's people and to protect, restore and enhance the natural and human environments*." This mission will be severely challenged by climate change impacts and DWR's mission will become much more difficult. Despite these challenges, DWR is committed to its mission and will continue to meet the new trials that climate change will bring.

Executive Director Signature

Karla Nemeth

Director

SUSTAINABILITY GOALS

The Governor has directed California State Agencies to demonstrate sustainable operations and to lead the way by implementing sustainability policies set by the state. Sustainability includes the following general initiatives:

- Greenhouse Gas Emissions Reductions
- Climate Change Adaptation
- Building Energy Efficiency and Conservation
- Indoor Environmental Quality (IEQ)
- Water Efficiency and Conservation
- Monitoring Based Building Commissioning (MBCx)
- Environmentally Preferable Purchasing (EPP)
- Financing for Sustainability
- Zero Emission Vehicle (ZEV) Fleet Purchases
- Electric Vehicle Charging Infrastructure
- Monitoring and Executive Oversight

The Governor has issued numerous executive orders directing sustainable state operations. The order relevant to climate adaptation is:

Executive Order B-30-15

EO B-30-15 declared climate change to be a threat to the well-being, public health, natural resources, economy, and environment of California. It established a new interim statewide greenhouse gas emission reduction target of 40 percent below 1990 levels by 2030, and reaffirms California's intent to reduce greenhouse gas emissions by 80 percent below 1990 levels by 2050. To support these goals, this order requires numerous state agencies to develop plans and programs to reduce emissions. It also directs state agencies to take climate change into account in their planning and investment decisions and employ life-cycle cost accounting to evaluate and compare infrastructure investments and alternatives. State agencies are directed to prioritize investments that both build climate preparedness and reduce GHG emissions, prioritize natural infrastructure, and protect the state's most vulnerable populations.

Legislative Direction

Several pieces of legislation were signed in 2015-16 that codified several elements of the EO. These include the following:

- Assembly Bill (AB) 1482 (Gordon, 2015): Requires that the California Natural Resources Agency (CNRA) update the State's adaptation strategy, Safeguarding California, every three years. Directs State agencies to promote climate adaptation in planning decisions

and ensure that state investments consider climate change impacts, as well as the use of natural systems and natural infrastructure. (Public Resources Code Section 71153)

- Senate Bill (SB) 246 (Wieckowski, 2015): Established the Integrated Climate Adaptation and Resiliency Program within the Governor's Office of Planning and Research to coordinate regional and local efforts with state climate adaptation strategies to adapt to the impacts of climate change. (Public Resources Code Section 71354)
- SB 2800 (Quirk, 2016): Requires State agencies to take the current and future impacts of climate change into planning, designing, building, operating, maintaining, and investing in state infrastructure. CNRA will establish a Climate-Safe Infrastructure Working Group to determine how to integrate climate change impacts into state infrastructure engineering. (Public Resources Code Section 71155)

State Resources and Guidance Documents

California has invested significant resources in understanding the risks of climate change to the State and actions available to respond to and reduce these risks. These include the following:

- **Safeguarding California**: The State's climate adaptation strategy organized by sector. Each sector identifies risks from climate change and actions to reduce those risks.
- **Safeguarding California Implementation Action Plans**: Directed under EO B-30-15, the Implementation Action Plans outline the steps that will be taken in each sector to reduce risks from climate change.
- **Building a Resilient California**: Prepared under direction of EO B-30-15, this document provides a framework for State agencies to integrate climate change into planning and investment, including guidance on data selection and analytical approach.
- **California's Climate Change Assessments**: California has completed three comprehensive assessments of climate change impacts on California. Each assessment has included development of projections of climate impacts on scale that is relevant to State planning (i.e., downscaled climate projections). These data are available through Cal-Adapt, an online data visualization and access tool.

CLIMATE CHANGE ADAPTATION

Executive Order B-30-15 directs State Agencies to integrate climate change into all planning and investment. Planning and investment can include the following:

- Infrastructure and capital outlay projects
- Grants,
- Development of strategic and functional plans,
- Permitting,
- Purchasing and procurement,
- Guidance development,
- Regulatory activity,
- Outreach, and education.

This template will focus on the first three of these activities, and follows the guidance created by the Technical Advisory Group developed under EO B-30-15 to assist State Agencies to complete this task.

Climate Change Risks to Facilities

For all infrastructure, it is important to assess the risk that changing climate poses to an asset or project (e.g., sea level rise or increasing daily temperatures). It is also important to recognize the impact that an infrastructure project has on the surrounding community and the impacts on individual and community resilience (e.g., heat island impacts).

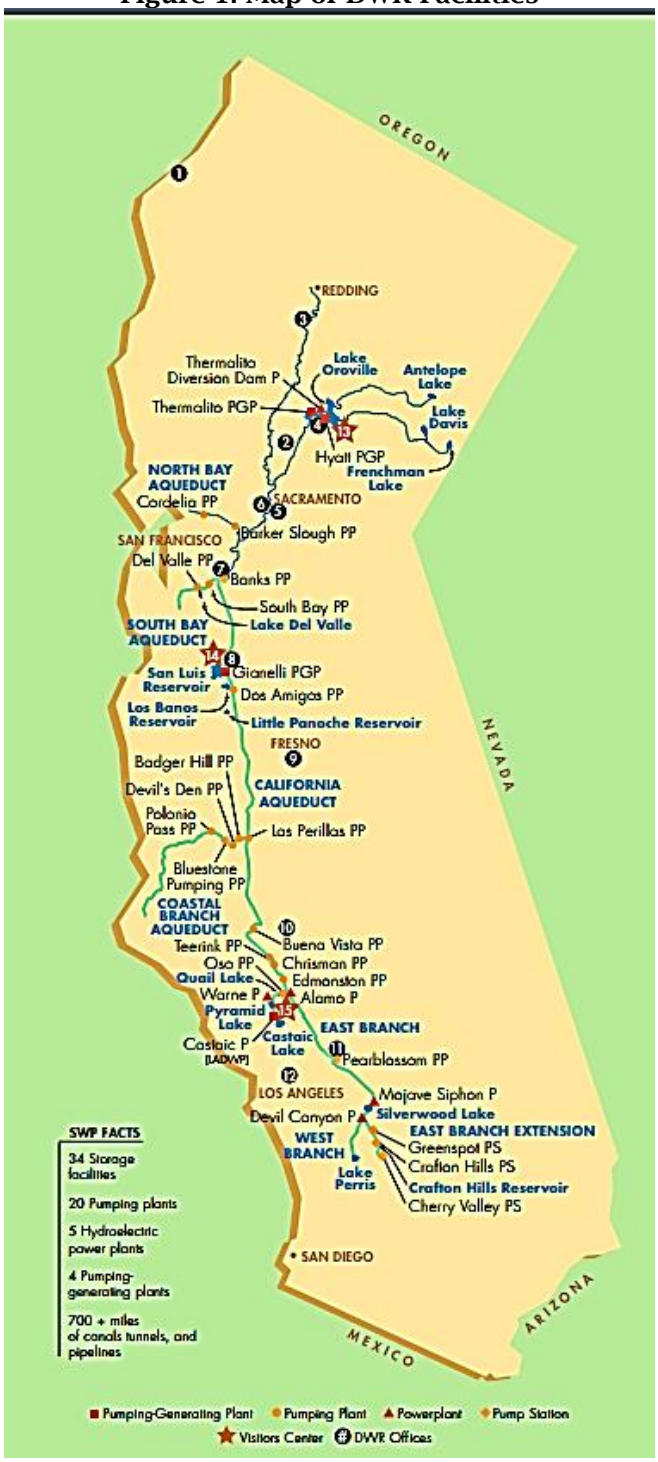
To determine how to consider climate change for a given project, plan, or existing infrastructure, the Department of Water Resources (DWR) considers the following screening questions:

1. What is the lifetime of the facility, planned project, or plan?
2. Could it be affected by changing average climate conditions or increases in extreme events over its lifetime?
3. What is the consequence of that disruption?
4. Will that disruption affect vulnerable populations, critical natural systems, critical infrastructure, or other assets?
5. Will that disruption cause irreversible effects or pose an unacceptable risk to public health and safety?

DWR's "Draft DWR Climate Change Vulnerability Assessment" (Draft VA), assesses the numerous climate-driven hazards that represent potential threats to DWR facilities, managed lands, operations, and staff activities. The analysis draws from the extensive existing body of knowledge about climate change and attempts to evaluate, describe, and quantify - where possible - DWR's vulnerabilities to expected increases in wildfire, extreme heat, and sea level rise, as well as expected changes in hydrology and ecosystems that will impact DWR's facilities, operations, and other activities. Through a standardized approach, DWR assessed various climate-driven hazards that examined exposure, sensitivity, and adaptive capacity to determine overall vulnerability from wildfire, extreme heat, sea level rise, long-term and persistent hydrologic changes, and habitat and ecosystem services degradation.

This report focuses on the risks to DWR-owned and privately leased facilities, while the Draft VA can be referred to for more in-depth analysis of DWR's activities and vulnerabilities. As a follow-up to the Draft VA, a DWR Adaptation Plan is currently under development and will specify priority actions to be implemented that will address the most vulnerable facilities and activities, ensuring that DWR adapts to the changes expected from climate change.

Figure 1: Map of DWR Facilities



Understanding Climate Risk to Existing Facilities

Risk from Increasing Temperatures

Under a changing climate, temperatures are expected to increase – both at the high and low end. As a result, facilities will experience higher maximum temperatures and increased minimum temperatures. And while both minimum and maximum annual temperatures have and will continue to increase, the minimum temperatures have increased more (1.6 to 2.5°F) than the maximums (0.4 to 1.4°F) (DWR 2014). A recent study by Scripps Institution of Oceanography projected future temperatures across California. The results indicate that by 2060-2069 mean temperatures may be 3.4 to 4.9°F higher across the state compared to the period 1985-1994 (Pierce et al. 2012, DWR 2014). Seasonal trends indicate a greater increase in the summer months (4.1 to 6.5°F) than in the winter months (2.7 to 3.6°F) by 2060-2069. While these changes in mean temperatures may contribute to many water management changes, it is the projected increase in maximum summertime temperatures and extreme heat events that poses the highest risk to the health and safety of DWR staff working outdoors. Tables 1 and 2 show the facilities expected to be most affected by increasing mean temperatures and increased number of extreme heat events.

Table 1: Top 5 Facilities Most Affected by Changing Temperature (°F)

Facility Name	Annual Mean Maximum Temperature (1961 – 1990)	Annual Mean Maximum Temperature (2031 – 2060)	Annual Mean Max T (2070-2099)	Annual Mean Minimum Temperature (1961 – 1990)	Annual Mean Minimum Temperature (2031 – 2060)	Annual Mean Min T (2070-2099)
Northern Region Office	75.89	80.41	84.31	50.62	55.02	58.89
Delta Field Division	74.21	78.26	82.50	49.02	53.56	57.37
San Luis Field Division	72.80	79.16	82.23	48.93	53.16	57.08
San Joaquin Field Division	77.38	81.20	85.47	50.14	54.13	57.95

Southern Region Office	76.02	80.40	84.14	52.80	57.42	61.42

Table 2: Top Five Facilities that Will Experience the Largest Increase in Extreme Heat Events (ºF)

Facility Name	Extreme heat threshold (EHT)	Average number of days above EHT (1961-1990)	Average number of days above EHT (2031-2060)	Increase in number of days above EHT by mid-century	Avg. # days above EHT (2070-2099)	Increase in Avg. # days above EHT by end of century
Northern Region Office	108.6	4.3	14	9.7	36	31.7
Delta Field Division	103.8	4.3	20	15.7	38	33.7
San Luis Field Division	102.4	4.3	30	25.7	58	53.7
San Joaquin Field Division	105.7	4.3	28	23.7	54	49.7
Southern Region Office	98.6	4.3	13	8.7	30	25.7

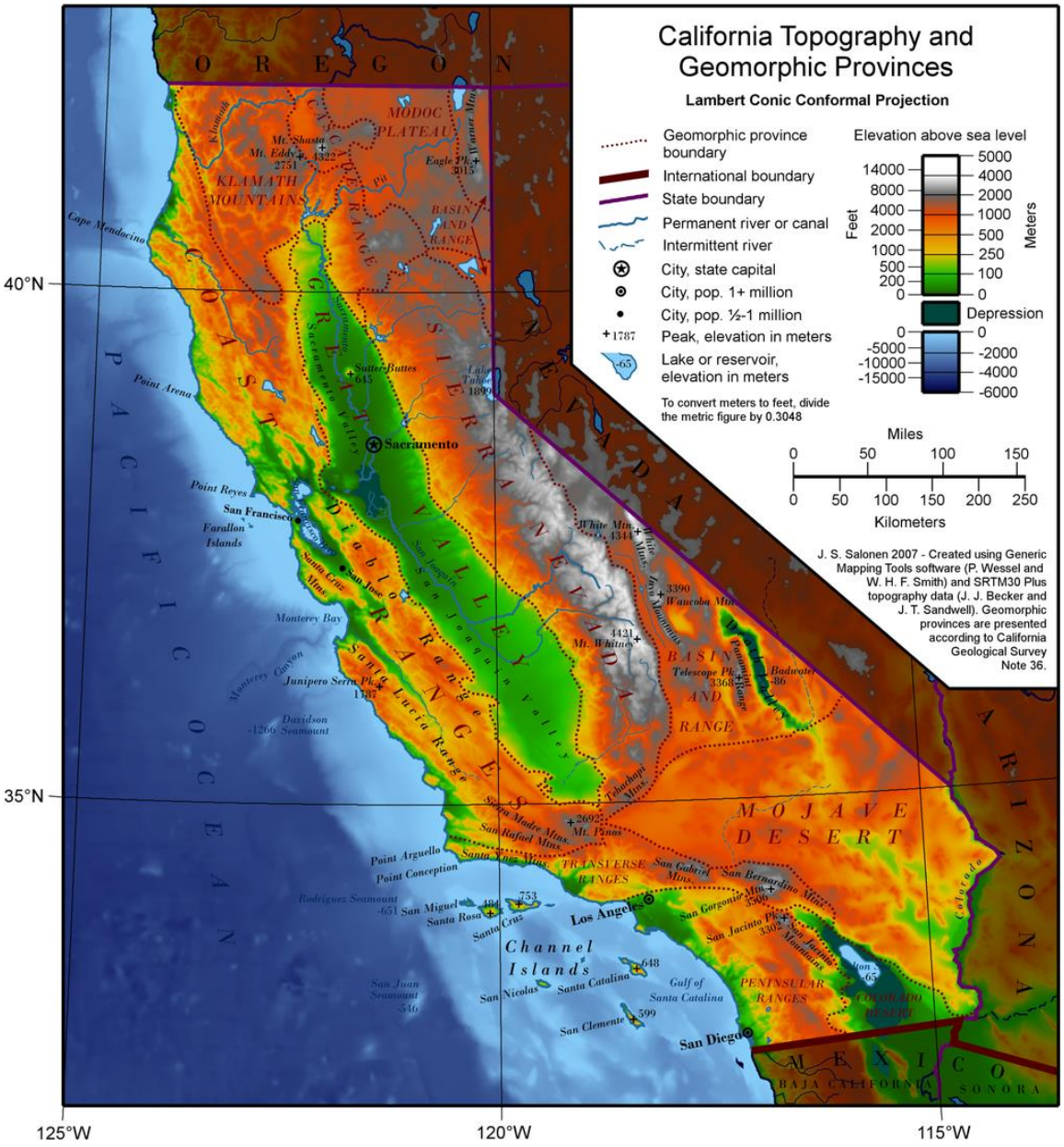
Increasing temperatures pose operational challenges associated with hydrological changes (type of precipitation and runoff timing) as well as potential health impacts to DWR staff, especially those working in the field. DWR performs numerous activities that require staff to work outside for extended periods, such as repairing or maintaining equipment and conducting biological surveys and monitoring; extreme heat events can be disruptive to these activities. Sensitivity to warming temperatures will vary depending on the individual. Staff with existing health complications will be more sensitive to increases in temperature. In addition, staff currently working in cooler areas may be less acclimated to extreme heat events and may not have access to air conditioning to cool off if overheated. Therefore, staff working outdoors in the Delta or near the Southern Region Office may be more sensitive to the projected increases in

temperature, although the San Luis and San Joaquin Field Division offices are expected to have the most dramatic increases in extreme heat days.

In this analysis, the focus of temperature affects to DWR is placed on operations and individuals, rather than on the facilities themselves, because the facilities were built to withstand a broad range of temperature fluctuations that is encompassed within the expected increases due to climate change. To assess human exposure to extreme heat events, DWR's Climate Change Program staff interviewed Regional Office staff and managers to obtain initial data and refine a screening survey on heat exposure. An "Extreme Heat Screening Questionnaire" was then sent to all DWR Branch Chiefs to identify which branches have staff in the field between May and October. A more detailed survey was conducted to gather information on the types of activities occurring between May and October and how summer temperatures currently affect staff activities. The survey targeted supervisors, and in a few cases staff, identified in the initial questionnaire. The purpose of the survey was to help assess staff's current exposure to extreme heat and identify where DWR has flexibility, along with potential constraints, to reducing that exposure. (*The questionnaire and relevant portions of the survey results are available in Appendix C of the Draft VA.*)

Most DWR outdoor work occurs in the Central Valley and the Southern Interior and Mojave Desert regions as shown in Figure 2.

Figure 2: California Map Showing the Central Valley, the Southern Interior and the Mojave Desert



While all staff working outdoors will be exposed to warming temperatures, projections for mid-century indicate that the increases will either be within the range or slightly above the range to which they are currently exposed. As temperatures increase, outdoor staff activities may need to shift (i.e. either to a different time of day or to another work window), and implement the buddy system more frequently, and project delays associated with the need for more on-site cool down rest periods, schedule shifts, and longer acclimation periods for new staff may occur.

For construction as well as operations and maintenance activities, there may be delays in completing scheduled work activities, heat-related disruptions to the power grid that impact

ability to operate (i.e. pumps go offline), short term increases in workload as scheduled activities get moved into shorter work windows, and increased costs associated with higher staffing levels to offset the need for more on-site rest periods, increases in staff sick days for existing health conditions exacerbated by heat, and heat illness. Another set of activities that may be vulnerable are conducting sampling, monitoring, and various surveys, which could be especially problematic for real-time compliance monitoring

Fortunately, DWR already has a fair amount of adaptive capacity to address the risk to staff from warming temperatures and extreme heat events. Based on the survey results presented in the Draft VA, supervisors do have some ability to shift work schedules to the cooler portions of the day and nearly half indicated that they can reschedule certain work activities. In addition, DWR has protective measures for staff in place via the implementation of the Heat Illness Prevention Plan.

Risks from Changes in Precipitation

Table 3: Top Seven Facilities that will be Most Impacted by Projected Changes in Precipitation

Facility Name	Annual Mean Maximum Precipitation (1961 – 1990)	Annual Mean Precipitation (2031 – 2060)	Percent Change by mid-century	Annual Mean Precipitation (2070 – 2099)	Percent change by end of century
San Luis Field Division Headquarters	10.35	11.76	13.62	12.91	24.73
Delta Field Division Headquarters	11.5	13.41	16.61	14.28	24.17
Northern Region Office	21.99	25.95	18.01	27.19	23.65
Oroville Field Division Office	35.21	38.86	10.37	41.1	16.73
Southern Region Office	18.11	18.75	3.54	20.86	15.18
Southern Field Division Headquarters	32.62	33.77	3.53	36.5	11.89

Facility Name	Annual Mean Maximum Precipitation (1961 – 1990)	Annual Mean Precipitation (2031 – 2060)	Percent Change by mid-century	Annual Mean Precipitation (2070 – 2099)	Percent change by end of century
San Joaquin Field Division Headquarters	5.89	6.07	3.06	6.42	8.99

DWR's individual facilities, including those in Table 3, have been built to withstand a wide range of precipitation events, and are expected to withstand these changes in precipitation. For DWR, risks caused by changes in precipitation are most evident in the challenge of the State Water Project (SWP) to continue to manage streamflow and provide flood protection and water supply to the people of California.

Hydrologic changes caused by climate change pose serious challenges to DWR assets, particularly operation of the SWP. Climate change vulnerability throughout the water sector stems from both changes in temperature and precipitation. Higher temperatures act to increase evapotranspiration, sublimation, and snowmelt rates, and decrease soil moisture and snow accumulation. These effects combine to reduce snowpack, water storage, and change runoff patterns. Changes in precipitation may affect average annual precipitation rates or the frequency, magnitude, and duration of extreme events. These changes can affect water quantity and quality and, in turn, the ecosystems supported by the watershed and water systems dependent on the watersheds.

Loss of snowpack because of higher temperatures and reduced precipitation is of concern in California. Snowmelt provides an annual average of 15 million acre-feet of water, slowly released by melting from about April to July each year. Much of the state's water infrastructure, including the SWP, was designed to capture and store winter and spring runoff to reduce streamflows that cause flooding and to deliver the water during the drier summer and fall months when it is needed for water supply.

Projections now indicate that by the end of this century the Sierra snowpack may diminish by 48-65 percent from 1961-1990 levels (Pierce and Cayan 2012). This loss of snowpack, due to precipitation falling as rain instead of snow and the remaining snow melting faster, will result in larger volumes of runoff entering reservoirs during the winter and early spring and less runoff arriving in late spring and early summer, which could overwhelm the flood storage capacity of reservoirs during winter. This could lead to higher downstream flow during flood events and reduced late summer storage levels.

Climate change may also affect water demand for both agricultural and urban use. Warmer temperatures are likely to extend growing seasons, increase evapotranspiration, and reduce soil

moisture—all of which will increase the amount of water needed for irrigation, urban landscaping, and environmental needs (US Global Change Research Program 2014).

DWR's Draft VA assessed climate vulnerability across a wide range of potential future climate conditions and found that operation of the SWP has high exposure to changing climate conditions. In the watersheds from which SWP water supplies originate, higher temperatures and changes in precipitation are expected to change inflows to SWP reservoirs—increasing winter runoff and decreasing spring and summer runoff. In the Sacramento-San Joaquin Delta (Delta), water supplies interact with the Delta's complex hydrology which is influenced by sea level, tides, and flows from several rivers.

It is still unclear to what extent SWP facilities and operations can be adapted to ameliorate losses in performance due to climate change. Several structural improvements, such as the California Water Fix, non-structural improvements, such as upper meadow restoration in the Upper Feather River Watershed, and operational improvements, such as forecast-based operations of reservoirs, have been suggested. While a full analysis of the efficacy of these types of adaptation strategies has yet to be completed, initial assessments of some strategies appear promising. Suggested adaptation strategies, such as those evaluated in the California Water Plan Update 2013 and US Bureau of Reclamation's Sacramento-San Joaquin Basin Study, range in cost from a few million dollars to billions of dollars and range in social acceptability from highly acceptable with nearly no social resistance to highly contentious. If effective adaptation strategies can be identified, historical experience suggests that political and financial resources to implement such strategies could be mobilized. These issues will be evaluated further in DWR's Climate Change Adaptation Plan.

Risks from Sea Level Rise

Increasing global temperatures are contributing to rising sea levels. Rising sea levels will result in inundation of coastal areas and increased flooding due to storm surges. The California Ocean Protection Council (OPC) has issued guidance for State agencies on what level of sea level rise to consider. The Guidance document provides the following estimates of sea level rise for the California Coast, which are based on a study by the National Academy of Sciences:

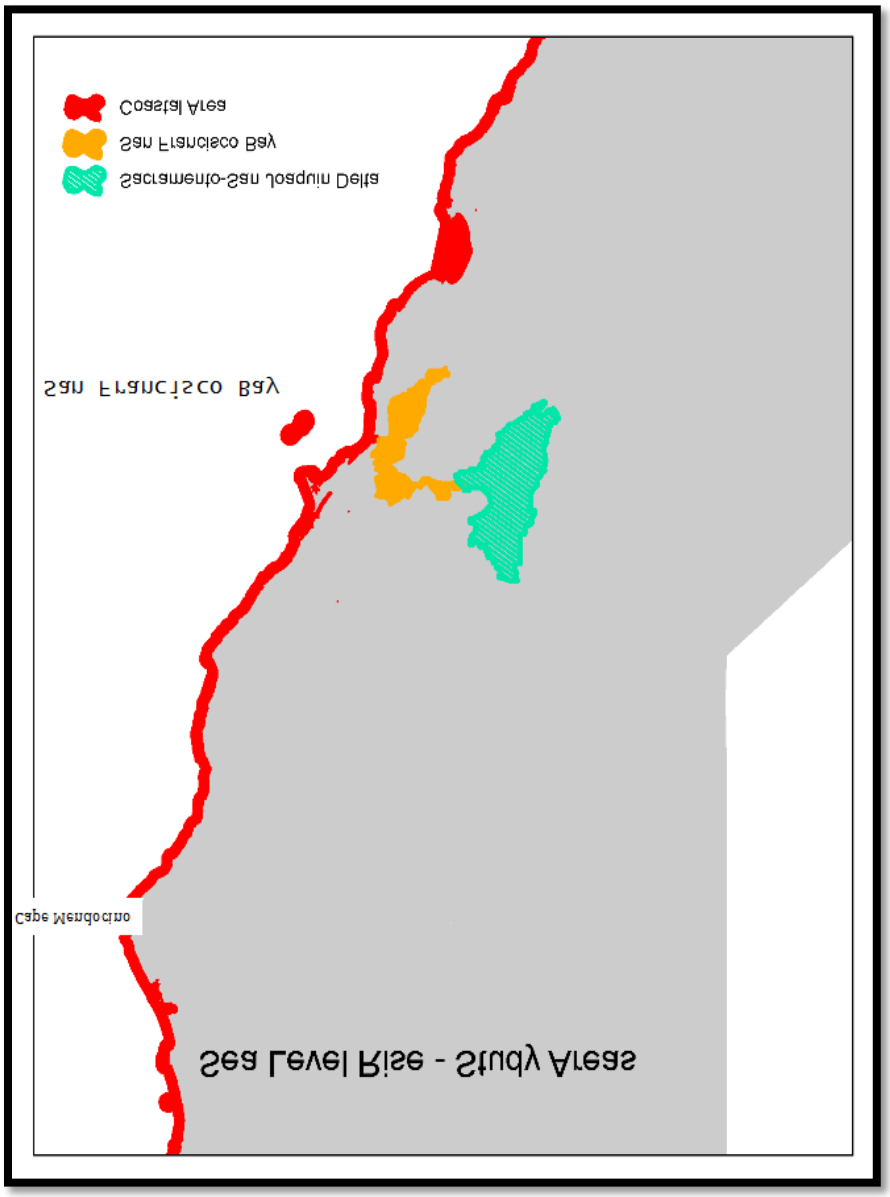
Table 3a: OPC Sea Level Rise Guidance

Date	North of Cape Mendocino	South of Cape Mendocino
2000 - 2030	-4 to 23 cm (-0.13 to 0.75 ft.)	4 to 30 cm (0.13 to 0.98 ft.)
2000 – 2050	-3 to 48 cm (-0.1 to 1.57 ft.)	12 to 61 cm (0.39 to 2.0 ft.)
2000 – 2100	10 to 143 cm (0.3 to 4.69 ft.)	42 to 167 cm (1.38 to 5.48 ft.)

An accompanying OPC resolution recommends that departments base analyses on estimates of sea level rise in the upper two-thirds of the range. Sea level rise is a key climate change vulnerability that must be incorporated into planning and decision-making wherever DWR owns

or manages facilities or conducts operations of the SWP. DWR facilities that have potential exposure to sea level rise are classified into the San Francisco Bay (Bay) and the Sacramento-San Joaquin Delta (Delta) regions and are discussed separately below (Figure 1). Because hazards and available data differ in these two areas, the methodologies for calculating exposure to sea level rise hazards are likewise different for each area. In all cases, exposure was assessed as the probability of inundation or other damage due to rising seas or storm surges. Note that sea level rise is one contribution of many to the actual water surface level at any given location and time; other factors include tides, storm surge, and atmospheric pressure (OPC 2013). River outflows are more important in the Delta than in the Bay. The majority of DWR facilities identified as potentially vulnerable are located in the Delta area.

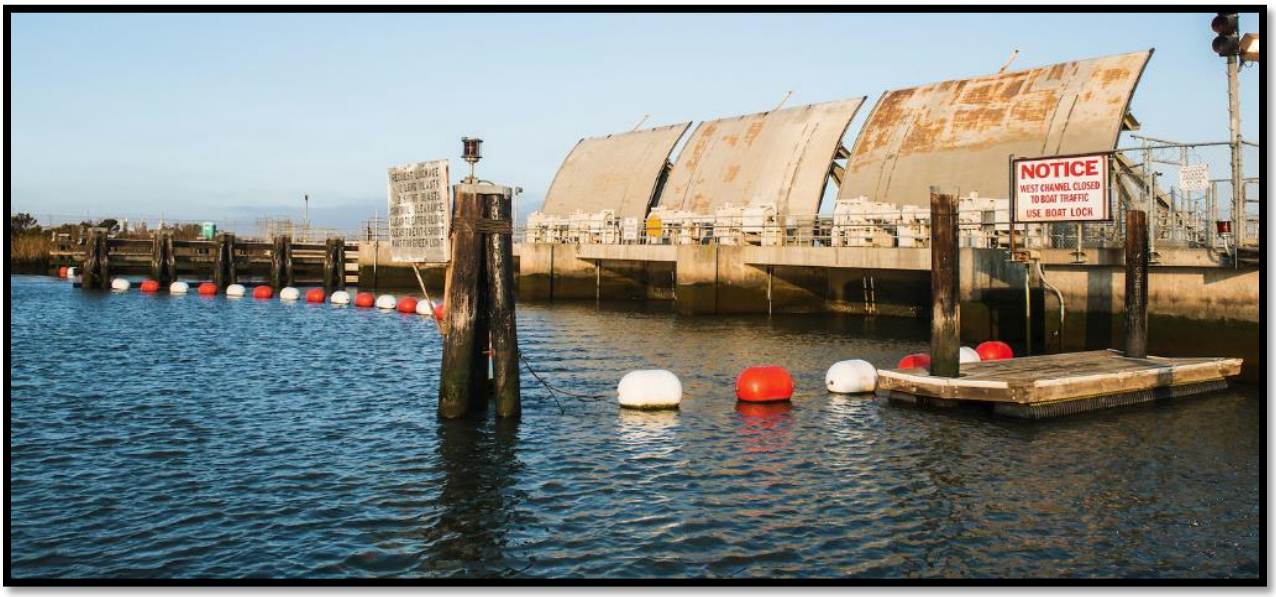
Figure 3: Study Areas for DWR Sea-level Rise Exposure Analysis



This region includes the San Francisco Bay inland to the confluence of the Sacramento and San Joaquin Rivers (at approximately the town of Antioch). DWR has very little infrastructure within the Bay itself. The facilities identified for inclusion in this study are all within the Suisun Marsh area.

In the Suisun Marsh, there are salinity control gates that have high exposure to sea level rise, but because they are already in frequent contact with saltwater and were designed to maintain their ability to function under those conditions, sensitivity was determined to be low. However, natural lands such as upland marsh habitat may be impacted depending on elevation. In addition, DWR owns and maintains several facilities within San Francisco Bay/Suisun Marsh that will be exposed to sea level rise; however, these facilities have low sensitivity (due to existing frequent contact with water) and thus overall risk from increasing sea level is low.

Figure 4:Suisun Marsh Salinity Gates



In summary, DWR owns and maintains several facilities within San Francisco Bay/Suisun Marsh that will be exposed to sea level rise, however, these facilities have low sensitivity (due to existing frequent contact with water) and thus overall risk from increasing sea level is low. However, the Suisun Marsh is already being impacted by changes due to human activities, and will be impacted in the future by increasing inundation of mud flats and low-lying areas, levee and dike failures, and greater variation in environmental conditions (Moyle et al. 2014). Sensitivity to these changes is high, and adaptive capacity is complicated by a variety of factors such as multiple ownership and joint management entities, therefore Suisun Marsh itself is considered to have high risk.

Delta

The Delta is especially sensitive to the combined effects of multiple aspects of climate change. Areas within the Delta have water surface elevations that are affected by a variety of factors

including mean sea level, tidal fluxes and freshwater inflows, barometric pressure, and temporary water fluxes due to wind and storm surge. Because climate change can increase mean sea level, alter freshwater flows, and intensify wind and storm surge, the facilities in the Delta may be particularly vulnerable to the synergistic effects of multiple aspects of climate change.

A detailed modeling analysis of the combined effects of mean sea level, tidal fluxes, freshwater inflows, barometric pressure, and temporary water fluxes due to wind and storm surge was beyond the scope of the analysis conducted for the VA. Furthermore, much of this analysis is already being undertaken as part of the Central Valley Flood Protection Plan (CVFPP) 2017 Update. The CVFPP 2017 includes technical analyses of reservoir, riverine and estuary simulations, hydrologic and economic analysis and ecological assessments. One technical component of the plan is to evaluate the impact of hydrologic changes driven by climate change and sea level rise during large flood events on the State Plan of Flood Control Levees. While most of the State Plan of Flood Control Levees are outside of the Delta, flood protection facilities throughout the Central Valley have important implications for the amount and timing of flood flows entering the Delta.

The Draft VA did, however, include analysis to evaluate additional climate change exposure to DWR facilities in the Delta based on modeling and interpretation completed for the CVFPP 2017. The three major facilities in the Delta owned by DWR include the West Sacramento DWR Office, the North Bay Aqueduct, and the Clifton Court Forebay.

For each location, the effect of increased stream flows resulting from climate change, increased mean sea level, and storm surge were calculated at the closest available analysis point. The analysis was conducted to view the change in water surface elevation from approximately 40 cm of mean sea level rise plus flows from a 100-year flood event (a flood event that has a 1% probability of occurring in any given year) and the residual storm surge[1]. In these conditions, the West Sacramento DWR Office experiences an increase of approximately 0.6 feet, expected from the Yolo Bypass and 1.1 feet in the Sacramento River. The North Bay Aqueduct intake is expected to experience an increase in water surface elevation of 1 foot during a 100-year flood, mostly caused by the backwater effect of the Yolo Bypass.

On the south side of the Delta, a much larger increase of 2.6 to 3.6 feet is expected near the Clifton Court Forebay. This increase is the result of two reinforcing effects:

1. The San Joaquin River watershed is generally higher in elevation compared to the rest of the Sierra and has historically received more snow and less rain at higher elevations, temperature increases will result in increased direct runoff as more of the watershed receives rain and less snow falls at mid-century conditions.
2. In this location of the Delta, the Sacramento River creates a backwater effect on Middle River, Old River, and Grantline Canal, as flows from the San Joaquin River reach the

[1] Residual storm surge in this analysis is the amount of storm surge existing when the flood waters from a storm arrive in the Delta, several hours after the storm would have made landfall at the Delta causing the greatest storm surge.

Delta, the backwater effects on Middle and Old River, and Grantline Canal create a hydraulic dam which results in the San Joaquin flows backing up and raising water surface elevations even higher.

Facility exposures to sea level rise were evaluated based on the analysis above and based on their proximity to Delta waters and their elevation above mean sea level. Assets on Delta islands and assets in direct contact with Delta waters (e.g. control gates, pumping plants) were assumed to have high exposure during all time periods. For these facilities, elevation is not included, and exposure is automatically listed as high for all time periods. All other facilities within the Delta were analyzed based on their elevation and location (Table 4).

Table 4. Facility Exposure Rating – Delta Area

Facility/Program	Asset Name	Approx. Elevation (AMSL)	Exposure Rating	
			2030	2050
SWP - Barker Slough Pumping Plant	Control Building	23	Low	Low
	Compressor Building	23	Low	Low
SWP - Clifton Court	Clifton Court Check Structure	N/A	High	High
	Clifton Court Accessory Buildings	16	Low	Low
SWP - Banks Pumping Plant	Pumping Plant	N/A	High	High
	Switchyard Control Building	144	Low	Low
	Area Control Center (Visitor's Center)	16	Low	Low
Delta O&M Center	Administration Center	143	Low	Low
	Plant Maintenance Shop	138	Low	Low
	Civil Maintenance HQ	137	Low	Low
	Vehicle Storage Building	136	Low	Low
	Mobile Equipment Repair	136	Low	Low
	Civil Maintenance Warehouse	136	Low	Low

Facility/Program	Asset Name	Approx. Elevation (AMSL)	Exposure Rating	
	Heavy Equipment Storage	136	Low	Low
	Plant Maintenance Vehicle Storage	136	Low	Low
	Water Treatment Plant	144	Low	Low
	Guard Station Building	124	Low	Low
	Warehouse and Welding Shop	137	Low	Low
SWP - John Skinner Fish Protection Facility	Fish Holding Tank 1	11	Low	Low
	Fish Holding Tank 2	10	Low	Low
	Control Building	11	Low	Low
	Vehicle Storage Building	10	Low	Low
	Skinner Fish Facility Screens	N/A	High	High
Bay-Delta Office - Other	Aeration Facility (South Delta Branch)	N/A	High	High
Flood Control Materials Depots	Brennan Island Warehouse	21	Low	Low
	Twitchell Island Warehouse	-5	High	High
NCRO IRWM/DOE/DES	Office @ 3500 Industrial Blvd. West Sacramento	19	Low	Low

Facilities within the Delta that were determined to have high exposure were the Banks Pumping Plant, Skinner Fish Facility, numerous temporary barriers (Old River at Tracy, Head of Old River, Middle River, Grant Line Canal), and the Bay-Delta Office/South Delta Branch Aeration Facility (Table 4). As with structures in the Suisun Marsh, these facilities have been designed and are operated with the presumption of frequent contact with brackish water and therefore were determined to have low sensitivity to sea level rise.

Although Delta facilities themselves were determined to have low risk from sea level rise directly, failure of levees within the Delta might jeopardize those structures. Several efforts are underway that are likely to increase the resilience of the Suisun Marsh and the Delta to future climate change impacts, either by planning for increased stresses on levees or by increasing habitat and 'natural infrastructure' to sustain species and provide other critical ecosystem services. Key efforts are the Delta Levees Investment Strategy (DLIS) and projects being undertaken by DWR through its Delta Levees Programs and EcoRestore efforts.

Following passage of the Delta Reform Act of 2009, the Delta Stewardship Council launched the DLIS to update priorities for State investments in the Delta levee system, with the purpose of reducing the likelihood and consequences of levee failures and to protect people, property and State interests. The DLIS is also intended to support and advance the coequal goals of improving water supply reliability, restoring the Delta ecosystem, and protecting and enhancing the values of the Delta as an evolving place.

California EcoRestore is another initiative that will help increase Delta resilience and increase the adaptive capacity of the Delta area. California EcoRestore will help coordinate and advance at least 30,000 acres of critical habitat restoration in the Delta and Suisun Marsh over the next four years. A broad range of habitat restoration projects will be pursued, including projects to address aquatic, sub-tidal, tidal, riparian, floodplain, and upland ecosystem needs.

California EcoRestore's initial goal is to initiate 30,000 acres of Delta habitat restoration, including 25,000 acres associated with existing mandates for habitat restoration, pursuant to federal biological opinions. California Waterfix would allow construction of tunnels to transport water from the Sacramento River upstream of the Delta to the existing pumping plants near Clifton Court Forebay, relieving pressure on the aging levees in the face of sea level rise. These projects will be funded exclusively by the state and federal water contractors that benefit from the SWP and the Central Valley Project (CVP) systems. Additionally, 5,000 acres of habitat enhancements will be funded through Proposition 1 grants to local governments, non-profit organizations, and other entities who will support these habitat enhancements throughout the Delta. Funding will come primarily from the Delta Conservancy, the California Department of Fish and Wildlife (CDFW), and DWR.

In summary, overall vulnerability of DWR's facilities to direct sea level rise is low and will continue to be low through mid-century, except for Suisun Marsh. However, failure of levees could change the vulnerability determinations.

Vulnerability of operations is not known now, and due to other ongoing efforts, such as the CVFPP process, which is seeking to address that question, this was not analyzed in the Draft VA.

Natural Infrastructure to Protect Existing Facilities

EO B-30-15 directs State agencies to prioritize the use of natural and green infrastructure solutions. Natural infrastructure is the "preservation or restoration of ecological systems or the utilization of engineered systems that use ecological processes to increase resiliency to climate change, manage other environmental hazards, or both. This may include, but need not be

limited to, flood plain and wetlands restoration or preservation, combining levees with restored natural systems to reduce flood risk, and urban tree planting to mitigate high heat days" (Public Resource Code Section 71154(c)(3)).

Healthy, functioning ecosystems provide multiple benefits related to water management including sustaining aquatic fisheries, flood risk reduction, and water quality protection. They also provide multiple benefits that sustain, mitigate for and restore listed and non-listed species.

Climate change is already affecting and will continue to affect ecosystems and ecosystem services in California (PRBO 2011). Wildlife and plant species distributions are shifting in response to changing environmental conditions, impacts to important life-cycle events have been observed (e.g., changes in reproduction and migration patterns), and some species populations are declining (OEHHA/CalEPA 2013). Negative impacts to species populations may result in adoption of additional regulations with which DWR will be required to comply. In addition to these direct impacts, climate change is indirectly affecting ecosystems by exacerbating existing stressors, such as urbanization, habitat fragmentation, and invasive species.

Many natural areas in California have been highly modified for urban and agricultural purposes, which has resulted in a large and prosperous economy, yet has left only remnants of certain habitat types in the state - riparian corridors and wetlands in particular (CDFW 2015). These land use changes have created stress on many ecosystems and species and contributed to the increases in number of listed and sensitive species and at-risk habitat types. These changes directly affect DWR's ability to operate the SWP. Climate change will likely exacerbate stresses on certain species and habitat types and therefore may require additional action by DWR to help mitigate potential impacts on species and habitats and, if appropriate, restore the affected habitats.

The benefits provided by ecosystem services are embodied within the broader concept of environmental stewardship, which is one of the three foundational actions in the *California Water Plan Update 2013* (DWR 2014) and is a key component within the *California Water Action Plan*[2], the *Central Valley Flood System Conservation Strategy*[3], and the *Safeguarding California Plan*[4]. Environmental stewardship, as defined in DWR's Environmental Stewardship Policy[5], is a concept and commitment to manage and protect the natural resources (water, air, land, plants and animals) and ecosystems in a sustainable manner to ensure that they are available for future generations as DWR carries out its planning activities and facilitates meeting future

---

2 CA Water Action Plan: http://resources.ca.gov/california_water_action_plan/

3 CVFPP Conservation Strategy: http://www.water.ca.gov/conservationstrategy/cs_new.cfm

4 Safeguarding California: http://www.water.ca.gov/conservationstrategy/cs_new.cfm

5 http://www.water.ca.gov/cvfmp/docs/WhitePaperEnvironmentalStewardship03250%20Finalv2.pdf

water supply, flood risk reduction, and environmental protection needs of the population of California.

There are thousands of acres of land throughout California for which DWR is charged with management. Habitat types on those parcels include wetland, riparian, grassland, marsh, oak woodland, saltbush scrub, and others. Habitat quality varies widely, but much of the acreage is either occupied by or potential habitat for sensitive species, migratory birds, and pollinators, and provides important ecosystem services such as carbon sequestration, flood attenuation, water purification, and aesthetic benefits. In addition to providing existing key ecosystem services, there may be opportunities for DWR-owned or managed land to be a part of a landscape-level approach to resource conservation and climate change adaptation in California by serving as wildlife refugia and/or movement corridors.

Types of land holdings owned and/or managed by DWR include: mitigation property, restoration projects and right-of-way easements. Mitigation land is managed to offset project impacts, and typically has strict criteria that must be met for it to provide mitigation of impacts for a long term, often in perpetuity. Therefore, DWR's management is often required to maintain the desired ecological balance (e.g. minimize invasive species or habitat degradation), and climate change effects could impact the conditions on site such that it no longer meets the mitigation criteria. Restoration projects represent a substantial financial investment for DWR, and likewise need to be protected from factors that could degrade the area. DWR right-of-way lands, such as acreage surrounding certain lakes and flood control basins and along the California Aqueduct and other infrastructure facilities, also contain important habitat that must be managed appropriately to control invasive species and protect against damage from encroachment of neighboring activities such as farming.

The majority of DWR-owned and managed habitat and ecosystem properties are found within the Sacramento-San Joaquin Delta Ecoregion. However, habitat and ecosystem properties connected with Oroville and other reservoirs and right of way holdings along the California Aqueduct are also at-risk due to changes in temperature and precipitation. There are many flood-related properties that support habitat and ecosystem services but it was not possible to identify all of them for this report or in the Draft VA.

DWR has several established programs, projects, directives, and procedures that can help increase the resiliency of our managed lands in the face of a changing climate. The CVFPP seeks to provide a comprehensive, long-term approach to improving riverine habitat and floodplains as part of an integrated flood management plan. The *North Delta Flood Control and Ecosystem Restoration Project*[6] is another example of a project that is designed to support flood control improvements while also providing benefits to aquatic and terrestrial habitats, species, and ecological processes.

---

6 http://www.water.ca.gov/floodsafe/fessro/levees/north_delta/docs/

Ongoing and proposed habitat restoration projects in the Delta to meet DWR's obligations under the *Fish Restoration Program Agreement*[7], the Delta Levees Programs, the *Operations Criteria and Plan*[8], the *Suisun Marsh Habitat Management, Preservation, and Restoration Plan*[9], and other habitat restoration projects in the Delta - such as Dutch Slough and Prospect Island - also improve the resiliency of our managed lands while contributing to the adaptive capacity of the Delta region. More in-depth analysis of DWR lands is included in the VA.

In summary, climate change is expected to exacerbate stresses on certain species and habitat types that may require additional action by DWR to help mitigate potential impacts to those species and habitats and, if appropriate, restore those habitats. In other cases, degradation of species and habitat types may result in additional regulations within which DWR will be required to operate. Therefore, DWR-managed lands as well as operations are vulnerable to additional degradation of habitat and ecosystem services resulting from climate change.

Understanding the Potential Impacts of Facilities on Communities

Vulnerable Populations

Certain populations are more susceptible to the effects of changing climate conditions, and will have less capacity to recover from changing average conditions and more frequent and severe extreme events. Many factors contribute to vulnerability, often in overlapping and synergistic ways. These can include many social and economic factors, and be determined by existing environmental, cultural, and institutional arrangements. Vulnerable populations can include, but are not limited to, people living in poverty; people with underlying health conditions; incarnated populations; linguistically or socially isolated individuals; communities with less access to healthcare or educational resources; or communities that have suffered historic exclusion or neglect.

DWR facilities serve local populations in several ways. Directly, they provide local employment opportunities, in the form of working for DWR and working for independent employers that provide support for maintenance and operation of those facilities. Indirectly, DWR facilities such as reservoirs and the California aqueduct provide recreational and fishing opportunities, which may be highly valued in vulnerable populations. Also, many service industries depend upon DWR employees in local communities. Most significantly, DWR facilities and operations provide water as a resource to vulnerable populations throughout the state, and disruptions to water deliveries because of climate change have the potential to greatly affect vulnerable populations.

Disadvantaged Communities

---

7 http://www.water.ca.gov/environmentalservices/frpa.cfm

8 http://www.water.ca.gov/OCAPstudies/

9 https://www.wildlife.ca.gov/Regions/3/Suisun-Marsh

California is required to invest resources in disadvantaged communities (DACs). DACs are identified using CalEnviroScreen, a tool that ranks census tracts based on a combination social, economic, and environmental factor. While it does not capture all aspects of climate vulnerability, it is one tool that is available, and does include several relevant characteristics. In many cases, disadvantaged communities are more likely to suffer damage under changing climate conditions, including extreme events. The department's facilities located in these communities can contribute or alleviate the vulnerability of these communities.

Table 5: Facilities located in disadvantaged communities

Facility Name	CalEnviroScreen Score	Is it located in a disadvantaged community? Yes/No
Southern Region Office	91-95%	Yes
San Luis Field Division Headquarters	91-95%	Yes
San Joaquin Field Division Headquarters	76-80%	Yes
Cedar Springs Dam Office (Silverwood Reservoir—Southern Field Division)	76-80%	Yes

The primary purpose of the facilities located in DACs in Table 5 are to support the operation of the SWP and do not provide immediate, critical services to the surrounding populations.

Urban Heat Islands

Urban heat islands are areas with localized spikes in temperature, which impact human health, increase pollution, and increase energy demand. Urban heat islands occur during the hot summer months in areas with higher percentages of impervious surface and less vegetation. This is likely in areas with large parking lots, dense development, and lower tree density and shading. Urban heat islands can be mitigated (i.e., reduced) through tree planting and other greening measures, cool roofs (e.g., lighter roofing materials that reflect light), cooler pavements, and other measures.

Table 6: Five Facilities Located in Urban Heat Islands

Facility Name	Located in an urban heat island (yes/no)
Southern Region Office	Yes
Delta Field Division Headquarters	Yes
Southern Field Division Headquarters	Yes

Perris Reservoir Visitors Center	Yes
Cedar Springs Dam Office	Yes

The area occupied by these buildings is relatively small, but does include the buildings and associated parking lots, which are paved. Landscaping is generally a part of all facilities, but varies with region and climate. Furthermore, only the Southern Region Office is located within an exclusively urban area. Due to meeting requirements for reduced water consumption at state facilities during the most recent drought, few efforts have focused on attempting to reduce the heat island impact through increased plantings. In some areas, such as the Delta Field Division Headquarters, water was discontinued on grass landscape for conservation, which resulted in the conversion of a small field to dirt, which may contribute to additional warming to the urban heat island. Conversely, a new building was added to the Southern Field Division Headquarters in an area previously consisting of a dirt field. The building and associated parking lot included a “cool” roof coating and permeable concrete, which may lessen some impacts of the urban heat island index.

Figure 5: Urban Heat Islands and the Southern Field Division

Understanding Climate Risk to Planned Facilities

Table 7: Climate Risks to New Facilities

Facility Name	Annual Mean Maximum Temperature (1961 – 1990)	Annual Mean Maximum Temperature (2031 – 2060)	Annual Mean Minimum Temperature (1961 – 1990)	Annual Mean Minimum Temperature (2031 – 2060)	Annual Mean Maximum Precipitation (1961 – 1990)	Annual Mean Precipitation (2031 – 2060)
Dutch Slough Tidal Marsh Restoration Project	73.47	79.75	48.55	52.97	13.51	15.64
Clifton Court Forebay Fishing Facility	74.21	78.26	49.02	53.56	11.50	13.41
Pearblossom Solar Project	75.85	81.70	46.53	51.99	7.04	7.57
Rio Vista Estuarine Research Station	73.02	77.63	49.04	53.21	12.93	15.40

Table 8: Extreme Heat Events and New Facilities

Facility Name	Extreme heat threshold (EHT)	Average number of days above EHT (1961-1990)	Average number of days above EHT (2031-2060)	Increase in number of days above EHT
Dutch Slough Tidal Marsh Restoration Project	101.8	4.3	16	11.7
Clifton Court Forebay Fishing Facility	103.8	4.3	20	15.7

Facility Name	Extreme heat threshold (EHT)	Average number of days above EHT (1961-1990)	Average number of days above EHT (2031-2060)	Increase in number of days above EHT
Pearblossom Solar Project	102.1	4.3	23	18.7
Rio Vista Estuarine Research Station	101.3	4.3	16	11.7

The facilities listed in Tables 7 and 8 are briefly discussed below in the context of how DWR is accounting for changing conditions in the facility siting, design, construction, and operation. All DWR projects are analyzed for their contributions to greenhouse gas emissions and comply with Phase I of our Climate Action Plan, which guides projects and sets limits to emissions to meet reduction goals.

Dutch Slough Tidal Marsh Restoration Project

This project includes revegetation of a 1,178-acre tidal marsh area with riparian and wetland native plant species. As such, there are no buildings being constructed and thus planning for changing climate conditions is not applicable in the siting, construction, and operation. The restoration of the tidal marsh is expected to benefit the environment by increasing carbon sequestration, improving water quality, and benefitting sensitive Delta species such as Sacramento splittail and California black rail.

Clifton Court Forebay Fishing Facility

This project consists of installing an ADA-compliant fishing pier extending approximately 500 feet over the water. Associated facilities will include a public restroom and equipment shed. The site was selected with constraints regarding available sites and while impacts from climate change did not guide construction, they are not expected to significantly affect the facility.

Pearblossom Solar Project

This project consists of installing a solar panel array and supporting facilities on approximately 70 acres near the Southern Field Division headquarters. Siting, design, and construction were constrained by available land and the need to maximize energy production. The project will result in fewer greenhouse gas emissions by producing cleaner energy than that produced by fossil fuel consumption.

Rio Vista Estuarine Research Station

This project includes building new facilities to support scientific programs within the Interagency Ecological Program. The project will include office and work space for up to 160 employees, wet and dry laboratories, lab chemical storage, warehouse storage for lab samples and field equipment, boat and vehicle storage, and wet slips with docks and boat ramp. It is

located at the decommissioned Army base at Rio Vista. Planning for this project has included climate change analysis to ensure that it is protected from the effects of sea level rise and expected localized flooding from 100-year storms. It is also being designed as an energy-efficient building to minimize greenhouse gas emissions and water consumption.

Table 9: New Facilities and Disadvantaged Communities and Urban Heat Islands

Facility Name	Located in a Disadvantaged Community (yes/no)	Located in an urban heat island (yes/no)
Dutch Slough Tidal Marsh Restoration Project	No	No
Clifton Court Forebay Fishing Facility	No	No
Pearblossom Solar Project	No	No
Rio Vista Estuarine Research Station	No	No

None of the planned facilities in Table 9 are located within disadvantaged communities or urban heat islands. The Dutch Slough project will help to reduce future heat island impacts by increasing vegetation in the area, and the Rio Vista Estuarine Research Station will be energy – efficient and include drought-tolerant and native plantings. The projects are being designed to withstand future increases in temperatures and the expected variability in precipitation.

Natural Infrastructure

EO B-30-15 also directs agencies to prioritize natural and green infrastructure solutions. Natural infrastructure is the "preservation or restoration of ecological systems or the utilization of engineered systems that use ecological processes to increase resiliency to climate change, manage other environmental hazards, or both. This may include, but need not be limited to, flood plain and wetlands restoration or preservation, combining levees with restored natural systems to reduce flood risk, and urban tree planting to mitigate high heat days" (Public Resource Code Section 71154(c)(3)).

DWR has identified the preservation and restoration of ecological systems as an important component in adapting to the vulnerabilities presented by climate change. The Draft VA includes a detailed analysis of those vulnerabilities, and DWR is currently developing an Adaptation Plan. Please also refer to the section above, "Natural Infrastructure to Protect Existing Facilities" for a discussion of natural infrastructure.

Full Life Cycle Cost Accounting

EO B-30-15 directs State agencies to employ full life cycle cost accounting in all infrastructure investment. Lifecycle cost accounting includes:

- Considering initial investment costs, as well as lifetime operation and maintenance costs under changing climate conditions, including changing average conditions and increases in extreme events.
- Applying non-market evaluation methods such as travel cost, avoided costs or contingent valuation to capture hard to quantify benefits and costs

New facilities are being designed with analysis of appropriate local conditions, including those areas where localized flooding and/or sea level rise is expected to play a role. DWR has participated with the California Office of Planning and Research to plan for the challenge of incorporating life-cycle analysis to our facility planning process. DWR's Economic Analysis Section is currently updating the DWR Economic Analysis Guidebook to include a Life-Cycle Benefit-Cost Analysis of facilities. This process will help guide and inform project teams and decision-makers whether the social benefits of the facility outweigh its social costs.

Integrating Climate Change into Department Planning and Funding Programs

Table 10: Integration of Climate Change into Department Planning

Plan	Have you integrated climate?	If no, when will it be integrated?	If yes, how has it been integrated?
California Water Plan Update 2013	Y		Extensively
DWR Strategic Business Plan	Y		Climate Change objectives included
DWR Climate Action Plan Phases I, II, III	Y		GHG reduction targets, climate analysis guidance, VA/AP

Table 11: Engagement and Planning Processes

Plan	Does this plan consider impacts on vulnerable populations?	Does this plan include coordination with local and regional agencies?	Does this plan prioritize natural and green infrastructure?
IRWM	Y	Y	N
CA Water Plan Update 2013	Y	Y	N/A

Table 12: Climate Change in Funding Programs

Grant or funding program	Have you integrated climate change into program guidelines?	If no, when will it be integrated?	Does this plan consider impacts on vulnerable populations?	Does this program include coordination with local and regional agencies?
Water Storage Investment Program (Prop 1, Ch 8, CA Water Commission)	WSIP has regulations instead of guidelines. Climate Change has been incorporated into the regulations governing the Program, specifically within the quantification of benefits and impacts and uncertainty analysis.	Regulations are effective as of March 7, 2017.	The Program does not specifically call out or define vulnerable populations in relation to project impacts. The WSIP requires applicants to analyze the effects of climate change on water operations and benefits. It also requires applicants to disclose and quantify impacts or negative effects the proposed water storage project would have on ecosystem, water quality, uses and storage of water, or other resources. Also, State Water Board's Water Quality Priorities include a priority to provide water for basic human needs	Yes
California Safe Drinking Water Bond Law of 1988 (Prop 81)	No	Date – unsure since program is continually funded to primarily leak detection or water conservation projects.	Disadvantaged community and severely disadvantaged community are qualified for funding consideration	Yes

Grant or funding program	Have you integrated climate change into program guidelines?	If no, when will it be integrated?	Does this plan consider impacts on vulnerable populations?	Does this program include coordination with local and regional agencies?
Safe Drinking Water Containment Removal (Prop 50)	No	Date – unsure since program is continually funded to primarily pilot projects to remove drinking water contaminants.	Disadvantaged community and severely disadvantaged community are qualified for funding consideration	Yes
Flood Control Subventions (Proposition 1E)	No	Program does not anticipate including Climate Change guidelines.		
Flood Corridor Program (Propositions 1E, 84 & 13)	No	Program does not anticipate including Climate Change the guidelines.		
Local Levee Assistance (Proposition 84)	No	Program does not anticipate including Climate Change the guidelines.		
Yuba Feather Flood Protection	No	Program does not anticipate including Climate Change the guidelines.		

Grant or funding program	Have you integrated climate change into program guidelines?	If no, when will it be integrated?	Does this plan consider impacts on vulnerable populations?	Does this program include coordination with local and regional agencies?
Small Communities Flood Risk Reduction (Prop 1E)	No	Considered for Phase 2 PSP in FY 18/19	Unknown	Yes
Urban Flood Risk Reduction	Yes	N/A Guidelines were released January 2015	Yes	Yes
Water Desalination Grant Program	Yes	Not applicable	This program does not have any specific requirements about impacts on vulnerable populations.	This program relies upon CEQA documents for climate change analysis and does not have any specific requirements for coordination with local and regional agencies.
Water Use Efficiency Grants	No. Currently, we have no new or pending guidelines. In previous guidelines, we required GHG emission calculations.	In future guidelines, when funding becomes available for new PSPs.	DWR's Grant committee "FAIR" develops standard language to be included in all funding program guidelines. These need to be developed.	Yes.
Sustainable Groundwater Planning Grant Program	Yes. CA code of Regulations, Title 23, Division 2, Chapter 1.5, requires all Groundwater Sustainability		Yes. 10% of funding is reserved for severely disadvantaged communities and SDAC Projects are prioritized for funding.	Yes

Grant or funding program	Have you integrated climate change into program guidelines?	If no, when will it be integrated?	Does this plan consider impacts on vulnerable populations?	Does this program include coordination with local and regional agencies?
	Plans to include a climate change scenario evaluation.			
Proposition 1 Integrated Regional Water Management (Disadvantaged Community Involvement, Planning, and Implementation)	Yes. Climate change in 2016 IRWM Guidelines.		Yes. Providing funding for vulnerable communities is a statewide priority.	Yes

Measuring and Tracking Progress

DWR performs a wide range of activities to help support climate change analysis and adaptation planning by local and regional water managers, fund climate monitoring and research, and develop water sector policies and management practices to support California's comprehensive approach to addressing the challenges posed by climate change. DWR is also leading by example in developing its own comprehensive Climate Action Plan to guide how DWR is and will continue to address climate change for programs, projects, and activities over which it has authority. DWR's Climate Action Plan is divided into three phases:

Phase I is DWR's Greenhouse Gas Emissions Reduction Plan (GGERP), which covers how DWR will help mitigate the future impacts of climate change by reducing the GHG emissions from its activities. Phase I was completed in June 2012 when DWR Director Mark Cowin signed the adoption of the GGERP. DWR is currently implementing the GGERP and is ahead of schedule to achieve the major GHG reductions described.

Phase II is DWR's framework and guidance for consistent incorporation and alignment of analysis for climate change impacts in its project and program planning activities. Climate change analysis can be extremely complex, including accounting for large uncertainties about the future climate and other important future conditions. This phase of the DWR Climate Action Plan ensures that all DWR planning activities meet standards for quality, scientific rigor,

and consistency. Phase II work began in 2012 with the empaneling of DWR's expert Climate Change Technical Advisory Group and recently completed in early 2017. This phase will also include guidance for conducting a climate resiliency analysis as part of major projects, consistent with EO B-30-15 and AB 1482.

Phase III is DWR's Climate Change Vulnerability Assessment and Adaptation Plan (VA/AP). This phase of the Climate Action Plan evaluates, describes, and where possible, quantifies the vulnerabilities of DWR's assets and business activities to projected changes in temperature, wildfire, sea level rise, hydrology (including precipitation, snowpack runoff, and flooding), and ecosystem services. These vulnerabilities were identified and prioritized in the Draft VA and appropriate adaptation strategies are being developed to address them. Work on DWR's VA/AP began in 2014. The Draft VA portion of Phase III is complete and being prepared for publication, and the Adaptation Plan (AP) in progress. When adopted, the AP will guide various programs to implement the recommended strategies and will provide detailed procedures for measuring and tracking progress.

Literature Cited

California Department of Fish and Wildlife (CDFW). 2015. California State Wildlife Action Plan. Retrieved from https://www.wildlife.ca.gov/SWAP/Final

Central Valley Flood Protection Plan (CVFPP) 2017 Update. 2016. Retrieved from http://www.water.ca.gov/cvfmp/2017-cvfpp-docs.cfm

California Department of Water Resources (DWR). 2014. California Water Plan 2013. Retrieved from http://www.waterplan.water.ca.gov/cwpu2013/

Moyle, P., A. Manfree, and P. Fiedler. 2014. Suisun Marsh: Ecological History and Possible Futures. UC Press. Retrieved from http://www.jstor.org/stable/10.1525/j.ctt5vjz9n

OEHHA/CalEPA. 2013. Indicators of Climate Change in California. Retrieved from http://oehha.ca.gov/multimedia/epic/2013EnvIndicatorReport.html

Ocean Protection Council (OPC). 2013. State of California sea-level rise guidance document. Retrieved from http://www.opc.ca.gov/2013/04/update-to-the-sea-level-rise-guidance-document

Pierce, D., D. Tapash, D. Cayan, E. Maurer, N. Miller, Y. Bao, and M. Tyree. 2012. Probalistic estimates of future changes in California temperature and precipitation using statistical and dynamical downscaling. Climate Dynamics. Retrieved from http://tenaya.ucsd.edu/~cayan/New_Pubs/D30_Pierce_etal_2012_CD.pdf

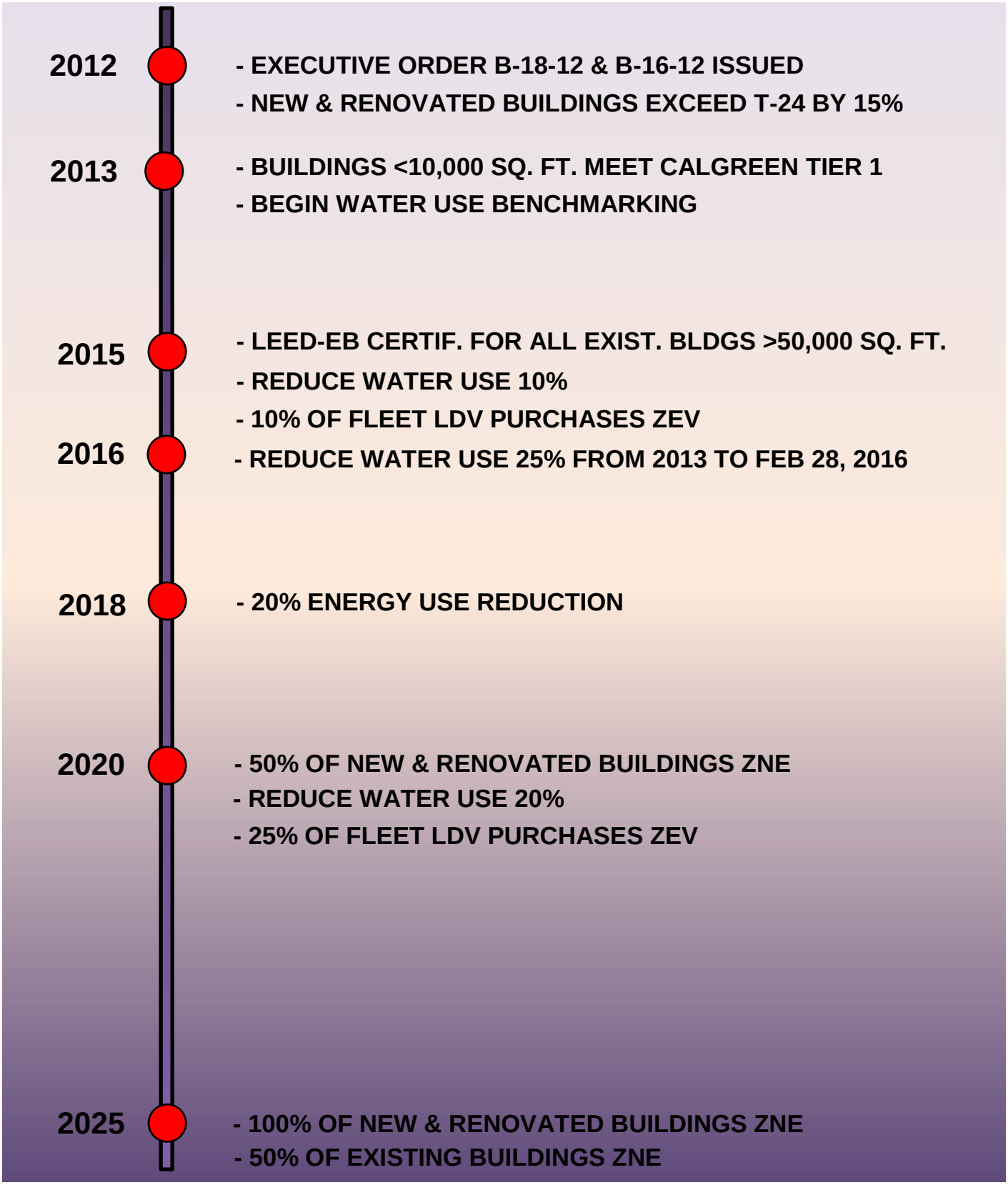
Pierce, D., and D. Cayan. 2013. The uneven response of different snow measures to human-induced climate warming. American Meterological Society, 4148-4167. Retrieved from http://journals.ametsoc.org/doi/pdf/10.1175/JCLI-D-12-00534.1

Point Reyes Bird Observatory (PRBO). 2011. Projected effects of climate change in California: ecoregional summaries emphasizing consequences for wildlife. Retrieved from http://climate.calcommons.org/bib/projected-effects-climate-change-california-ecoregional-summaries-emphasizing-consequences

US Bureau of Reclamation (USBR). 2016. Sacramento and San Joaquin Rivers basin study. Retrieved from http://www.usbr.gov/watersmart/bsp/completed.html

US Global Change Research Program. 2014. Nation climate assessment. Washington, DC: US Global Change Research Program, United States Government. Retrieved 5/3/2016 from http://nca2014.globalchange.gov/report/sectors/water#statement-16598

SUSTAINABILITY MILESTONES & TIMELINE



DEPARTMENT STAKEHOLDERS

List individuals, offices, and divisions responsible for leading efforts related to each initiative identified in this report. Include their respective titles, roles, responsibilities.

Understanding Climate Risk at Existing Facilities	
John Andrew	Assistant Deputy Director, Climate Change

Understanding Climate Risk at Planned Facilities	
John Andrew	Assistant Deputy Director, Climate Change

Integrating Climate Change into Department Planning and Funding Programs	
John Andrew	Assistant Deputy Director, Climate Change

Measuring and Tracking Progress	
John Andrew	Assistant Deputy Director, Climate Change