Local Hazard Mitigation Plan

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Table of Contents

List of Exhibits

List of Figures

List of Tables

Appendices

Section One - Introduction

Natural hazards and extreme weather events are an ongoing part of the cycle of weather and seasons. However, when natural hazards such as earthquakes, fires, or winter storms are at their height, they pose a severe risk to people and property. They can cause death or leave people injured or displaced, cause significant damage to our communities, businesses, public infrastructure, and environment. In addition, they cost tremendous amounts in terms of response and recovery dollars and can contribute to economic loss.

Throughout history, governmental agencies in the Antelope Valley area of Los Angeles County and the eastern portion of Kern County have dealt with the region's various hazards. In the past, the area has dealt with earthquakes, flooding from severe storms, and wildfire.

Although there were fewer people in the area, the hazards adversely affected the lives of those who depended on the land and climate conditions for food and welfare. As the area's population increases, exposure to hazards creates an even higher risk than previously experienced.

The Antelope Valley has a high desert type of climate. The area is characterized by the unique and attractive landscape that makes the area popular. However, the potential impacts of natural hazards associated with the terrain make the environment and population vulnerable to natural disaster situations.

A successful hazard mitigation strategy enables the implementation and sustaining of local actions that reduce vulnerability and risk from hazards or reduce the severity of the effects of hazards on people and property. Historically, in many local jurisdictions, disasters are followed by repairs and reconstruction, which restore the area to pre-disaster conditions.

1.1 The Antelope Valley - East Kern Water Agency

AVEK is a special district governmental agency within the State of California. Special districts are local governments created by the people of a community to deliver specialized services essential to their health, safety, economy, and well-being. A community forms a special district, which are political subdivisions authorized through a state's statutes, to provide specialized services the local city or county does not provide.

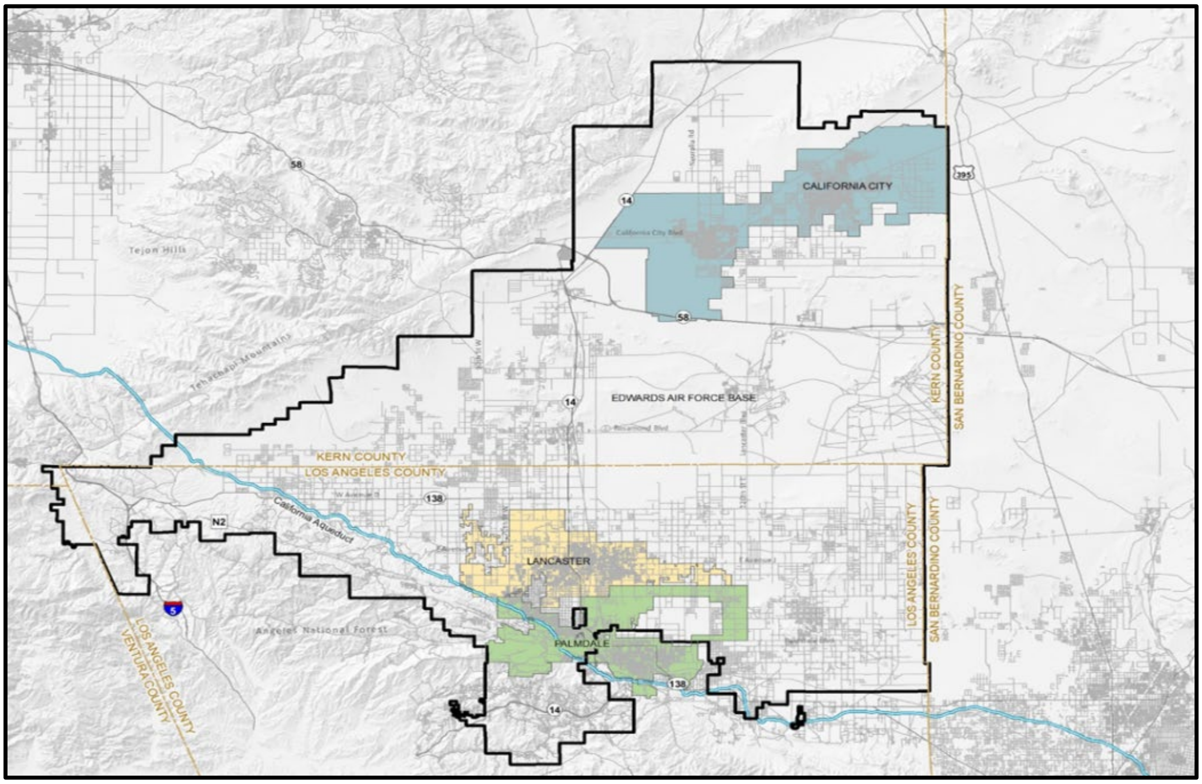
The Antelope Valley - East Kern Water Agency's Service area includes the areas of Acton, Palmdale, and Lancaster in Los Angeles County; Rosamond, California City; and Edwards Air Force Base in Kern County; and a small portion of northeast Ventura County.

Serving over 20 municipal users along with Edwards Air Force Base, Plant 42, and U.S. Borax, AVEK's more than 2400 square mile territory includes portions of Los Angeles, Kern, and Ventura Counties.

The Agency serves a growing population of over 500,000 people.

Refer to **Exhibit 1**, a map of the AVEK service area.

Exhibit 1 - Map of AVEK Service Area



Source - AVEK

History

Figure 1 - AVEK Charter Signing
Source - AVEK

In 1959, AVEK received its charter as a regional water Agency from the State Legislature, which followed the 1953 formation of the Antelope Valley-Feather River Association. The concept was to import surface water supplies from the Feather River. In 1962 AVEK's Board of Directors signed a contract with the state to secure the delivery of water supplies intended to supplement the local groundwater. As a result, AVEK became the 3rd largest State Water Contractor with an entitlement of 144,844 acre-feet (the average household uses one acre-foot per year (AFY).

AVEK is a wholesale water provider that treats, delivers, and stores water, providing treated water to retail agencies and untreated water to agricultural customers within its 2,400 square mile service area, including parts of Los Angeles, Kern, and Ventura Counties. The Agency's current demand is approximately 50,000 AFY.

State Water Project Water Contractors

The Department of Water Resources administers long-term water supply contracts to 29 local water agencies for water service from the State Water Project (SWP). These water supply contracts are central to the SWP's construction and operation. In return for State financing, construction, operation, and maintenance of Project facilities, the agencies contractually agree to repay all associated SWP capital and operating costs. Original contracts and their amendments for all water contractors are available in PDF format, on request.

The bulk of the water imported by AVEK is treated and distributed to customers throughout its service area through Domestic-Agricultural Water Network (DAWN) Project facilities. The Agency's entitlement also provides for the delivery of untreated irrigation water from the Aqueduct and AVEK turnouts to Antelope Valley farmers. See **Exhibit 3 - AVEK Distribution System Map.**

In 1999, AVEK joined forces with Palmdale Water District and Littlerock Creek Irrigation District to form the Antelope Valley State Water Contractor's Association, a joint powers authority. Together, the agencies optimize the use of water resources, protect surface water and groundwater storage.

In December 2016, AVEK and the California Municipal Finance Authority entered into a Joint Exercise of Powers Agreement, creating the Antelope Valley-East Kern Water Agency Financing Authority. This was done for AVEK to take advantage of lower interest rates that could be achieved through establishing a separate government agency. Both AVEK and the Financing Authority have the same Board of Directors.

1.2 Purpose of the Plan

As the cost of damages from natural disasters continues to increase, the Antelope Valley - East Kern Water Agency understands the importance of identifying effective ways to reduce vulnerability to disasters. This Plan assists the Agency in reducing vulnerability to disasters by identifying critical facilities **(Table 13 - AVEK Critical Facilities List)**, resources, information, and strategies for risk reduction while helping to guide and coordinate mitigation actions.

The Plan provides a set of strategies intended to do the following: reduce risk from natural hazards through education and outreach programs, foster the development of partnerships, and implement risk reduction activities. The resources and information within the Plan are (or include):

- Establish a basis for coordination and collaboration among participating agencies and public entities;
- Identify and prioritize future mitigation projects; and
- Assist in meeting the requirements of federal assistance programs. As outlined in **Section Five**, the Antelope Valley - East Kern Water Agency's Local Hazard Mitigation Plan works in conjunction with other Agency plans.

1.3 AUTHORITY

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d) requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identifies and prioritizes mitigation actions, encourages the development of local mitigation and provides technical support for those efforts. This mitigation plan serves to meet these requirements.

1.4 PLAN ADOPTION

The Antelope Valley - East Kern Water Agency approved the LHMP on February 8, 2022. After review by the California Office of Emergency Services (Cal OES), it was approved by FEMA on Date. The Agency's Board of Directors adopted the Final LHMP on Date.

1.5 PLAN USE

Each section of the mitigation plan provides information and resources to assist the public in understanding the hazard-related issues facing residents, businesses, and the environment. The plan's structure enables the public to use a section of interest and allows the AVEK to review and update sections when new data is available. The ability to update individual sections of the mitigation plan places less of a financial burden on the Agency. Decision-makers can allocate funding and staff resources to selected pieces in need of review, thereby avoiding a full update, which can be costly and time-consuming. In addition, the ease of incorporating new data into the plan will result in a hazard mitigation plan that remains current and relevant to the Agency.

The Local Hazard Mitigation Plan is comprised of the following sections:

Section One: Introduction
The Introduction describes the background and purpose of developing the mitigation plan in addition to introducing the mitigation priorities and summarizing the planning process.

Section Two: Community Profile
The Community Profile presents the history, geography, demographics, and socioeconomics of the Antelope Valley. It serves as a tool to provide a historical perspective of natural hazards in the city.

Section Three: Risk Assessment and Hazard Identification
This section provides information on hazard identification, hazard profiles, vulnerability and risk associated with natural hazards, and a vulnerability assessment of critical facilities concerning the identified hazards.

Section Four: Hazards Affecting the Agency
This section documents in-depth profiles of each of the hazards that have been identified as having a potential impact on the Agency.

Section Five: Mitigation Actions
This section provides strategies and mitigation actions to reduce potential risks to AVEK's facilities.

Section Six: Plan Maintenance Process
This section provides information on plan implementation, monitoring, and evaluation of the assets and capabilities available to achieve the proposed mitigation actions outlined in **Section Five** and opportunities for continued public involvement.

Section Seven: Glossary of Acronyms
Listing of commonly used Acronyms in Emergency Management and Hazard Mitigation planning.

1.6 MITIGATION PRIORITIES AND GOALS

The mission of the Antelope Valley - East Kern Water Agency's Hazard Mitigation Plan is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss prevention, and identifying activities to guide the Agency toward participating in a safer, more sustainable community.

The Agency's Technical Advisory Committee (TAC) has adopted the five primary goals for reducing disaster risk in the Antelope Valley - East Kern Water Agency's Hazard Mitigation Plan, which includes:

1. Avoid or reduce the potential for loss of life, injury, and economic damage to the public and Agency employees from earthquakes, floods, drought, landslides, and other hazards.
2. Provide a level of regional water reliability that supports customers' water needs.
3. Increase the ability of the Agency to serve the community during and after hazard events.
4. Protect Antelope Valley's unique character, scenic beauty, and values from being compromised by hazard events.
5. Encourage mitigation activities to increase the disaster resilience of institutions, private companies, and systems essential to the Agency.

1.7 HAZARD MITIGATION PLANNING PROCESS

This Plan was developed according to the Disaster Mitigation Act of 2000 for the Antelope Valley - East Kern Water Agency. The Agency staff responsible for developing and maintaining this plan are known as the Technical Advisory Committee (TAC). Members of this team included:

Table 1 - Technical Advisory Team Members

Name	Title
Matthew Knudson	Assistant General Manager
Jon Bozigian	Manager of Operations
Joe Goulet	Assistant Manager of Operations (Water Treatment and Production)
Doug Holmes	Assistant Manager of Operations (Water Banking and Maintenance)
Justin Livesay	Engineering Manager
Tom Barnes	Water Resources Manager
Ben Melendez	Engineering Technician

The TAC is responsible for the development, implementation, and maintenance of this plan. A Public Advisory Committee (PAC) was formed to advise the Agency during the development of this plan. Coordination with the PAC enables ongoing risk reduction coordination throughout the area. **Table 2** lists PAC representatives from the following local agencies:

Table 2 - Public Advisory Committee Participants

Government Entities		
Name	**Public Agency**	**E-Mail**
Lynn Glidden	City of Palmdale Public Works	lglidden@cityofpalmdale.org
Sutida Bergquist	State Water Resources Control Board	sutida.bergquist@waterboards.ca.gov
Jesse Dhaliwal	State Water Resources Control Board	jesse.dhaliwal@waterboards.ca.gov
Yun Hui Park	State Water Resources Control Board	YunHui.Park@waterboards.ca.gov
Jose Lopez	California Dept. of Water Resources	jose.lopez@water.ca.gov
Wendy Benson	Kern County OES	wbenson@kerncountyfire.org
Barbara Lods	AV Air Quality Management District	blods@avagmd.ca.gov
Vickie Rausch	AV Resource Conservation District	vickieravrcd@gmail.com
Customers		
Name	**Organization or Company**	**E-Mail**
Evelyn Ballesteros	Los Angeles County Waterworks Districts	eballesteros@dpw.lacounty.gov
Greg Even	Los Angeles County Waterworks Districts	geven@dpw.lacounty.gov
Chad Reed	Quartz Hill Water District	creed@qhwd.org
Jose Ojeda	California Water Service Co.	jojeda@calwater.com
Bill Cole	U.S. Borax (Rio Tinto Borates and Lithium)	Bill.cole@riotinto.com
John Ukkestad	White Fence Farms Mutual Water Co.	johnnyu40@yahoo.com
Bee Coy	Mojave PUD	beepud@sbcglobal.net
Brach Smith	Rosamond CSD	bsmith@rosamondcsd.com
Joshua Vasquez	Edwards AFB	joshua.vasquez.5@us.af.mil
Mark Edwards	Edwards AFB	mark.edwards@us.af.mil
Paul Hernandez	Edwards AFB	paul.hernandez.8@us.af.mil
Jillian Marroquin	Edwards AFB	jillian.marroquin@us.af.mil
Stacey Stuart	Edwards AFB	stacey.stuart@us.af.mil

Since the Agency does not directly serve residential or business customers, the TAC identified public stakeholder organizations that serve the public and provide feedback on the Plan. These organizations were sent a copy of the draft LHMP to review and submit comments. **Table Three** lists those organizations.

Table 3 - Public Stakeholder Organizations

Organization	Website
AV EDGE	https://avedgeca.org
Palmdale Chamber of Commerce	https://www.palmdalechamber.org/
Antelope Valley Chambers of Commerce	https://www.avchambers.org/
California City Chamber of Commerce	https://www.californiacitychamber.com/
American Red Cross	https://www.yelp.com/biz/american-red-cross-antelope-valley-chapter-palmdale
Antelope Valley Conservancy	https://avconservancy.org/
Palmdale Water District	https://www.palmdalewater.org/

The following table summarizes the milestone TAC meetings and public outreach conducted during the hazard mitigation planning process. **Please refer to Appendix A - Technical Advisory Committee Meeting Materials** and **Appendix B - Public Outreach Meeting Materials** for detailed information from each meeting**.**

Table 4 - Meeting Summaries and Public Involvement Opportunities

Date	Purpose
March 4, 2021	**Initial TAC Meeting** - First meeting (in-person) of the Technical Advisory Committee (TAC). This meeting focused on identifying the hazards facing the Agency; a discussion on how to set goals, objectives, and mitigation actions; and the establishment of the Public Advisory Committee (PAC). The meeting minutes are included in Appendix 1.
April 20, 2021	**Second TAC Meeting** - The second TAC meeting (in-person) reviewed the hazards facing the Agency and the development of goals, objectives, and mitigation actions. The meeting minutes are included in Appendix 1.
April 29, 2021	**Initial PAC Meeting** - The first PAC meeting was held via teleconference from the AVEK Administration Conference Room. The meeting focused on a presentation regarding LHMPs and their purpose, the role of the PAC, a review of the hazards identified by the TAC, and the initial development of the Plan's goals, objectives, and mitigation actions.
August 19, 2021	**Third TAC Meeting** - The third TAC meeting was held to review the initial draft LHMP based on information developed from the first two TAC meetings and the first PAC meeting.
October 7, 2021	**Board Planning Committee Review** - The Board Planning Committee met (via Zoom) to review the LHMP process. They recommend that the LHMP be sent to the Board for the first Public Hearing and full Board review.
October 26, 2021	**First Board Meeting (Public Hearing)** - At the first Board meeting (via Zoom), the Public Hearing was convened and the Board received a presentation on the LHMP and the associated planning process. Neither the public, nor any of the Board members, had any comments on the Plan. The Board was informed that they will they will have an additional opportunity to comment on the Plan when it comes before them to recommend that it be sent to CalOES and FEMA for their approval after additional public comment.

Table 4 - Meeting Summaries and Public Involvement Opportunities (Continued)

Date	Purpose
November 9, 2021 to December 31, 2021	**Public Outreach** - Upon completion of the Draft LHMP, the Agency distributed the document to the PAC members, the listed stakeholder's group and posted the document on the Agency's website for public review and comment. Refer to **Table 5 - Summary of Public Comments**.
November 18, 2021	**Second PAC Meeting** - The PAC met for the second time to review the draft LHMP and make any final recommendations to the Agency. Refer to **Table 5 - Summary of Public Comments.**
November 18, 2021	**Fourth TAC Meeting** - Immediately following the second PAC meeting, the TAC met for the last time to review the final draft LHMP and make any last recommendations before it went to the Board for approval.
February 8, 2022	**Second Board Meeting (Public Hearing)** - Staff and the consultant presented the Local Hazard Mitigation Plan to the Board of Directors for approval. The Public Hearing was noticed on the Agency's website on Date. The Board approved the submittal of the LHMP to CalOES and FEMA.
Date	**Final Board Meeting to Approve the LHMP** - The Board approved by Resolution the final LHMP after both CalOES and FEMA sanctioned it. The Resolution will be attached to the Plan.

1.8 PUBIC REVIEW PROCESS

The Antelope Valley - East Kern Water Agency's Board of Directors held a Public Hearing on October 26, 2021. At the meeting, the Board allowed for public comment, and recommended it be placed out for additional community review.

On November 19, 2021 the Draft AVEK Local Hazard Mitigation Plan was made available to the public via the Agency's website; it was sent out to interested stakeholders, and a hard copy was made available at the Agency's headquarters front desk; for a 30-day public review.

The AVEK Board of Directors again discussed the LHMP and conducted a second Public Hearing on February 8, 2022. After approving the Plan, they recommended that it be forwarded for review to CalOES and FEMA.

1.9 PUBLIC COMMENTS

Table 5 on the following page list the comments that were received during the public review process.

Table 5 - Summary of Public Comments

Initial PAC Meeting	
Commenter	**Comments**
City of Palmdale	They are adding Covid -19 Planning into their LHMP Update
SWRCB	Suggest pipeline redundancy planning
First Board of Directors Meeting	
Commenter	**Comments**
None	There were no Public or Board Comments on the Plan
Second PAC Meeting	
Commenter	**Comments**
Wendy Benson	Last month, FEMA approved the last components of the updated Kern Multi-Jurisdiction Hazard Mitigation Plan.
Stakeholders Group	
Commenter	**Comments**
None	There we no comments on the Plan
AVEK Website Publication	
Commenter	**Comments**
None	There we no public comments on the Plan
Second Board of Directors Meeting	
Commenter	**Comments**
TBD	TBD

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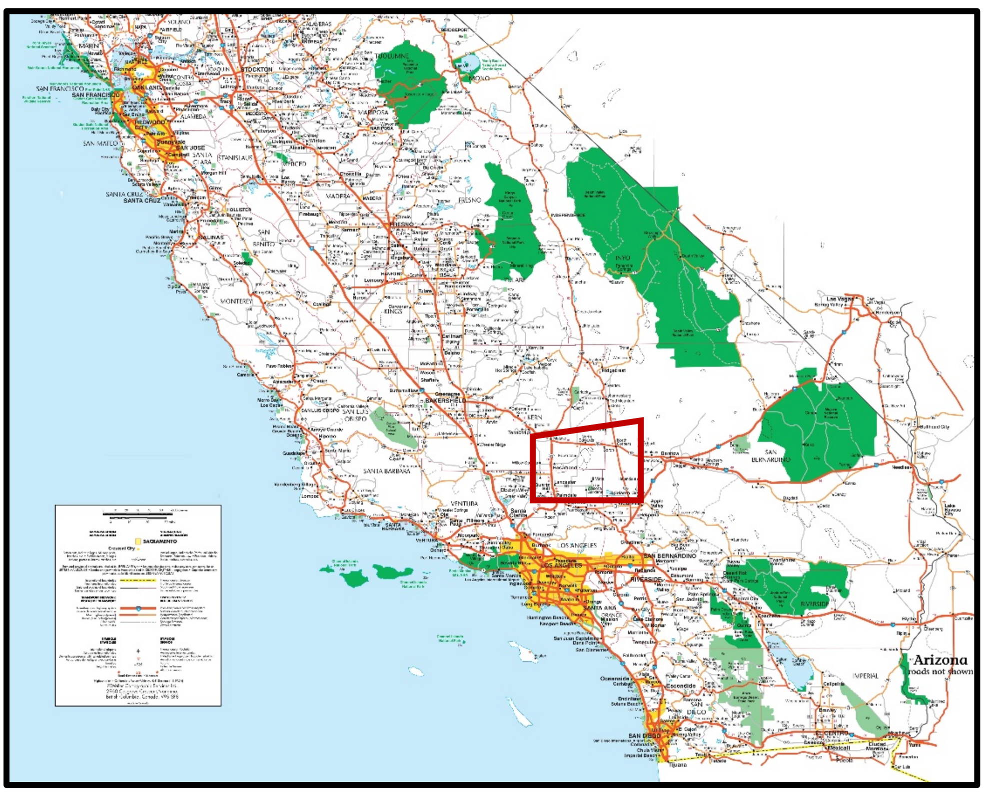
Section Two - Community Profile

2.1 Physical Setting

The Kern County border bounds the Antelope Valley planning area to the north, the Ventura County border to the west, the Angeles National Forest (inclusive) to the south, and the San Bernardino County border to the east. The area covers approximately 2,200 square miles and includes over two dozen communities. The valley comprises the western tip of the Mojave Desert, opening up to the Victor Valley and the Great Basin to the east and lying north of the San Gabriel Mountains, southeast of the Tehachapis, and east of the Sierra Pelona Mountains. The valley is bounded by the Garlock and San Andreas Fault systems.

Exhibit 2 - Location of the Antelope Valley in Southern California



Source - Mapmatrix.com

2.2 ANTELOPE VALLEY HISTORY

Populated by different cultures for an estimated 11,000 years, the Antelope Valley was a trade route for Native Americans traveling from Arizona and New Mexico to California's coast. Though the first wave of non-native exploration took place in the early 1770s, a later exploratory period starting in the 1840s led to the valley's first permanent settlement during the following decade, fueled by California's Gold Rush and new status as American territory. The 1854 establishment of the Fort Tejon military post near Castaic Lake and Grapevine Canyon created a gateway for valley traffic.

The area became known as the Antelope Valley because of the immense herds of antelope. Approximately 60,000 antelopes roamed the Antelope Valley until the herds were decimated by severe winters in the late 1800s and by hunters who slaughtered thousands of the fleet-footed animals.

Several developments were integral to the valley's growth starting in the mid-1800s, including gold mining in the Kern and Owens rivers; cattle ranching; the start of a Butterfield stagecoach route in 1858; construction of the Los Angeles-to-San Francisco telegraph line in 1860; completion of the Southern Pacific Railroad line in 1876; and ample rainfall during the 1880s and early 1890s, which attracted many farmers. Unfortunately, the decade-long drought that began in 1894-the worst in southern California's recorded history-decimated the regional economy and forced many settlers to abandon their homesteads. Still, after the turn of the twentieth century, irrigation methods and electricity brought back local farming. The 1913 completion of the Los Angeles Aqueduct spanning 233 miles between the Owens Valley and Los Angeles also revived the valley's economy. Today the Antelope Valley retains elements of its agricultural past, but its economic base is now supported by aerospace and defense industries.

Figure 2 - Mining Train from the 1800s

Source: Waste Management Los Angeles County

Besides the establishment of the railroad, mining played a significant role in the history of the Valley. Gold was first discovered in 1876 in Acton. Still, the discovery of gold at Tropico Hill in Rosamond by Ezra Hamilton and Charles Graves, the Valley's first African American postmaster, started serious mining. Miners working the Rosamond gold mines used to sail across Muroc Dry Lake, going to and from work, on a "V" shaped wagon rigged with sails. In 1898 borax was found in the surrounding mountains. The gold mining boom lasted until the beginning of World War II. At that time, gold ore deposits ran out, and prices fell. However, borax mining continues to this day at the world's largest borax mine in Boron. In the 1930s, the airplane came to the Antelope Valley. The Air Force started testing operations at Muroc Dry Lake, now Edwards Air Force Base. During World War II, many peoples arrived to work at Muroc Air Field and the Marine Auxiliary Training Base in Mojave (now Mojave Airport). The Antelope Valley came into its own by the completion of the Antelope Valley Freeway (State Route 14) in the mid-1960s. This multi-lane freeway provided fast and convenient access to and from the Los Angeles area and led to the Antelope Valley's most significant period of growth and development.

2.3 Community Profile

The Antelope Valley is a major suburban area and home to a rich and diverse base of industry, most notably some of the nation's biggest aerospace companies. It continues to be one of the fastest-growing areas of Southern California.

Currently, the planning area is home to approximately 447,000 residents. According to the current Los Angeles County LHMP, projections indicate that there will be approximately 880,000 people living in the Antelope Valley by 2035. In the past decade, there has been a significant increase in residents in the area, primarily due to the region's comparably affordable housing prices.

Table 6 - Antelope Valley Profile Data for Los Angeles County Residents

Profile	
Total Population	405,669
Males	50%
Females	50%
Median Resident Age	34
Median Household Income	$60,642
Per Capita Income	$24,260
Median House Value	$284,850
Households	63,080
Ethnicity	
White (non-Hispanic)	49.4%
Black	11.2%
American Indian	0.6%
Asian	3.3%
Some Other Race	2%
Two or More Races	2.4%
Hispanic	32.8
Education Attainment	
High school graduate or higher	79.6%
Bachelor's degree or higher	17.2%

Source: censusreporter.org 2019 - Five Year

Table 7 - Antelope Valley Profile Data for East Kern County Residents

Profile	
Total Population	81,699
Males	52%
Females	48%
Median Resident Age	34.7
Median Household Income	$59,969
Per Capita Income	$27,897
Median House Value	169,000
Households	29,052
Ethnicity	
White (non-Hispanic)	70.7%
Black	5.6%
American Indian	1%
Asian	3.1%
Some Other Race	0.2%
Two or More Races	3.2%
Hispanic	15.8%
Education Attainment	
High school graduate or higher	88.4%
Bachelor's degree or higher	21.1%

Source: censusreporter.org 2019 – Five Year

This data does not take into account Edwards Air Force Base.

2.4 Infrastructure

Two major freeways provide access to the Antelope Valley Planning Area: Interstate 5, which is located in the western portion of the planning area, and links Northern and Southern California; and State Route 14, which connects the adjacent Santa Clarita Valley just north of metropolitan Los Angeles to the eastern portion of the Antelope Valley. In addition, Metrolink's Antelope Valley Line has three station stops in the Antelope Valley, which are located in unincorporated Acton, the City of Palmdale, and the City of Lancaster. In addition, Palmdale Regional Airport, General William J. Fox Airfield, and Edwards Air Force Base are located in unincorporated Antelope Valley. Antelope Valley Transit Authority routes, serving unincorporated areas, include four local routes, two special routes, and three commuter routes connecting the Antelope Valley to other areas.

2.5 Economic Trends

The Antelope Valley has several competitive advantages that can help it become the premier destination for high-tech manufacturing firms in aerospace and other cutting-edge industries. These include the abundance of large, flat, and relatively less expensive land; availability of various transportation options such as truck, rail, and air; proximity to renewable energy sources; and other such factors. One issue facing the Antelope Valley in terms of Economic Development is its physical distance from the major urban areas of Los Angeles County. Thus, people who live in the area but work elsewhere or vice versa may have very long home-work commutes. An improved jobs-housing balance will provide a vibrant economy in the Antelope Valley.

2.6 Existing Land Use

Over the last few decades, the Antelope Valley experienced surges of development pressures. As a result, policymakers and citizens gained a greater knowledge of how new development contributes to environmental degradation, resource scarcity, and natural hazard risks. Accordingly, local governments needed to balance increased growth with obligations to protect existing natural resources. These new obligations, combined with a better understanding of the importance of balancing rural and urban areas in Los Angeles County, have created a new model for regional development. This new model, which directs new investment to areas with existing or planned services and facilities and away from areas with natural hazards and environmental resources, will shape land use in the Valley with policies that emphasize resource efficiency, economic growth, and the preservation of rural character. Over the next 20 years, this element will balance growth and economic development, the desires of residents to preserve their rural way of life, and the need for hazard avoidance and mitigation to determine the level of development that these factors can support.

2.7 Future Development

With the availability of land, easy access to transportation corridors, and proximity to renewable energy resources, the Antelope Valley is a prime destination for high-tech manufacturing to relocate to as they are more and more crowded out of their current urban locations. One of the main drivers of economic development in the Antelope Valley will be the relocation of high-tech industries to appropriate locations in the unincorporated Antelope Valley

As thousands of acres of desert lands have been subdivided over the past decade, the planning area population has skyrocketed. While much of the growth has been at urban densities in and adjacent to the cities of Palmdale and Lancaster, the desirability of rural living and the availability of affordable housing has resulted in significant growth in the many unincorporated communities. In turn, many residents have had to commute farther to access more significant employment opportunities. The opportunity areas in the Antelope Valley Planning Area are rural town centers. Rural town centers represent focal points and community centers, serve residents' daily needs and provide local employment opportunities. Rural town centers are intended to provide pedestrian-friendly environments, be accessible by a range of transportation options to reduce vehicle trips, and allow for a mix of commercial and residential uses.

As manufacturing and other industrial activities in the Antelope Valley increase, so will the demand for transportation and logistics services. With a vast expanse of relatively flat terrain and the availability of various transport options such as by truck, rail, or air, the Antelope Valley is poised to attract several companies specializing in logistics services.

The Antelope Valley has vast expanses of land that are suitable for large-scale farming and other agricultural activities. Therefore, the Antelope Valley Area Plan will encourage and continue and possibly expand such activities to ensure that agriculture continues to be one of the main economic drivers of growth in the area.

The demand for renewable energy in California is expected to increase dramatically in the near future. The Antelope Valley has one of the most abundant areas of sunshine in the country. This, along with the availability of undeveloped open spaces, gives the Valley a significant potential for solar energy development and other forms of renewable energy sources.

Section Three - Risk Assessment and Hazard Identification

3.1 What is Risk Assessment

Conducting a risk assessment can provide information regarding the location of hazards, the value of existing land and property in hazard locations, and an analysis of risks to life, property, and the environment that may result from natural, technological, and human-caused hazard events. Specifically, the four levels of a risk assessment are:

- Hazard Identification
- Profiling Hazard Events
- Vulnerability Assessment/Inventory of Existing Assets
- Risk Analysis

3.2 Risk Assessment Methodology

During the initial meeting with the Technical Advisory Committee, the Agency's critical facilities were discussed using the Risk and Resiliency Assessment (RRA) conducted in 2020 based on the U.S. Environmental Protection Agency's American Water Infrastructure Act of 2018. This assessment focused on predetermined natural hazards and human-caused events related to hazardous materials. Because it was recently completed, the TAC used it as a starting point for the LHMP Risk Assessment.

Each hazard profile noted was determined by the methodology described above. In addition, replacement and contents values for the facilities that fall within the hazard areas are tallied in each vulnerability table to estimate the total potential losses to each hazard. It should be noted that the actual losses will depend on the type and extent of the hazard event.

3.3 Hazard Identification and Prioritization

3.3.1 Hazard Identification

The TAC reviewed the natural hazards outlined in the AWIA of 2018 RRA, as well the hazards outlined in FEMA's LHMP development workbook, and determined that Drought, Earthquake, Hazardous Materials, Landslide and Mudflow, Severe Storms and Localized Flooding, Subsidence, Water Resource (California Aqueduct), Wildland Fire, and Windstorms are the most significant threats to the Agency. Refer to **Table 9**, **AVEK Hazard Assessment**. Additional discussion on the hazards facing the Agency is covered in **Section Four** of this document.

Table 8 - AVEK Hazard Identification

List of Hazards	Identified in the AWIA Risk & Resiliency Assessment	Included in LHMP	Discussion Summary
Aircraft Accident	No	No	
Agricultural Pests	No	No	
Avalanche	No	No	
Climate Change	N/A	N/A	Climate change will be considered as a factor for all of the identified hazards.
Coastal Erosion	No	No	
Coastal Storm	No	No	
Dam Failure	No	No	
Drought	No	Yes	
Earthquake	Yes	Yes	
Erosion	No	No	
Expansive soils	No	No	
Extreme Temperature	No	No	
Flooding	No	No	
Geological Hazards	N/A	N/A	This category is included in other hazard profiles.
Hailstorms	No	No	
Hazardous Materials	Yes	Yes	
Hurricane	No	No	
Land Subsidence	No	No	
Lightning	No	No	
Landslide and Mudflow	No	Yes	

Table 8 - AVEK Hazard Identification (Continued)

List of Hazards	Identified in the AWIA Risk & Resiliency Assessment	Included in LHMP	Discussion Summary
Human-Caused Hazards	N/A	N/A	Except for Hazardous Materials Spills, this plan intends to focus on natural hazard risk.
Reservoir Failure	No	No	
Sea Level Rise	No	No	
Severe Storms and Localized Flooding	Yes	Yes	
Storm Surge	No	No	
Subsidence	No	Yes	
Tornado	No	No	
Tsunami	No	No	
Volcano	No	No	
Water Resource	Yes	Yes	California Aqueduct
Wildfire	Yes	Yes	
Windstorm	No	Yes	

3.4 Calculated Priority Risk Index and the Hazard Ranking Worksheet

This Plan used two methods for determining the Hazard and Risk Analysis for the Agency. The first one used is the Calculated Priority Risk Index, a FEMA-recommended ranking method that allows disparate hazard categories to be compared. The second is the Hazard Ranking Worksheet that was used in the AWIA Risk and Resiliency Analysis. The Worksheet calculates risk differently, giving definitive rankings as Limited, Moderate, and High. The CPRI produces the results numerically. The CPRI is obtained by assigning values to risk categories:

- Probability (45%)
- Magnitude/Severity (30%)
- Warning Time (15%)
- Duration (10%)

There are four varying degrees of risk for each of the risk categories from which to choose: 1, 2, 3, or 4. Zero (0) is the value used when an option is not assigned. Refer to **Table 9**.

Table 9 - CPRI Hazard Ranking System

CPRI Category	Degree of Risk			Assigned Weighting Factor
Probability	Unlikely	Extremely rare, with no documented history of occurrences or events. Annual probability of less than 1 in 1,000 years (<0.1%).	1	45%
	Possible	Rare occurrences. Annual probability of between 1 in 100 years and 1 in 1,000 years (0.1%-1%).	2	
	Likely	Occasional occurrences, with at least two or more documented historic events. Annual probability of between 1 in 10 years and 1 in 100 years (1%-10%).	3	
	Highly Likely	Frequent events, with a well-documented history of occurrence.Annual probability of greater than 1 every year (>10%).	4	
Magnitude or Severity	Negligible	Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). Injuries or illnesses are treatable with first aid and there are no deaths. Negligible loss of quality of life. Shutdown of critical public facilities for less than 24 hours.	1	30%
	Limited	Slight property damage (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). Injuries or illnesses do not result in permanent disability, and thereare no deaths. Moderate loss of quality of life. Shutdown of critical public facilities for more than 1 day and lessthan 1 week.	2	
	Critical	Moderate property damage (greater than 25% and less than 50% ofcritical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and at least 1death. Shutdown of critical public facilities for more than 1 week and lessthan 1 month.	3	
	Catastrophic	Severe property damage (greater than 50% of critical and non-critical facilities and infrastructure). Injuries and illnesses result in permanent disability and multipledeaths. Shutdown of critical public facilities for more than 1 month.	4	

Table 9 - CPRI Hazard Ranking System (Continued)

CPRI Category	Degree of Risk			Assigned Weighting Factor
Warning Time	More than 24 hours	Population will receive greater than 24 hours of warning.	1	15%
	12 - 24 hours	Population will receive 12 - 24 hours of warning.	2	
	6 - 12 hours	Population will receive 6 - 12 hours of warning.	3	
	Less than 6 hours	Population will receive less than 6 hours of warning.	4	
Duration	Less than 6 hours	Disaster event will last less than 6 hours.	1	10%
	Less than 24 hours	Disaster event will last 6 - -24 hours.	2	
	Less than 1 week	Disaster event will last between 24 hours and 1 week.	3	
	More than 1 week	Disaster event will last more than 1 week	4	

Refer to **Table 10** for the AVEK Service Area results based on the CPRI Hazard Ranking System.

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3.4.1 Calculated Priority Risk Index Assessment

Table 10 - CPRI Risk Assessment for AVEK Service Area

Hazard	Probability		Magnitude		Warning Time		Duration		Weighted total
	Score	Weight	Score	Weight	Score	Weight	Score	Weight	
Drought	3	1.35	1	0.3	1	0.15	4	0.4	**2.20**
Earthquake	3	1.35	4	1.2	4	0.6	4	0.4	**3.55**
Hazardous Materials	1	0.45	1	0.3	4	0.6	2	0.2	**1.55**
Landslide and Mudflow	2	0.9	3	0.9	4	0.6	3	0.3	**2.70**
Severe Storms and Localized Flooding	4	1.8	1	0.3	1	0.15	3	0.3	**2.55**
Subsidence	1	0.45	1	0.3	1	0.15	4	0.4	**1.30**
Water Resource	2	0.9	4	1.2	1	0.15	4	0.4	**2.65**
Wildland Fire	3	1.35	3	0.9	4	0.6	3	0.3	**3.15**
Windstorms	4	1.8	1	0.3	1	0.15	3	0.3	**2.55**

As noted, the other tool used in ranking risk is the **Hazard Ranking Worksheet** noted in **Table 11**. This worksheet was used successfully in the 2020 AWIA Risk Analysis for each of the AVEK facilities. Refer to **Table 21.**

It was also used to give an overall analysis of the AVEK Service Area. The results of this are noted in **Table 12**, **Descriptive Planning Analysis by Hazard**.

It should be noted that both ranking tools showed almost identical hazard rating levels for the Service Area.

Table 11 - Hazard Ranking Worksheet

Probability	**Importance**	**2.0**
Based on estimated likelihood of occurrence from historical data		
Probability		Score
Unlikely (Less than 1% probability in next 100 years or has a recurrence interval of greater than every 100 years.)		1
Somewhat Likely (Between 1 and 10% probability in next year or has a recurrence interval of 11 to 100 years.)		2
Likely (Between 10 and 100% probability in next year or has a recurrence interval of 10 years or less.)		3
Highly Likely (Near 100% probability in next year or happens every year.)		4

Affected Area	**Importance**	**0.8**
Based on the size of geographical area of community affected by hazard		
Affected Area		Score
Isolated		1
Small		2
Medium		3
Large		4

Primary Impact	**Importance**	**0.7**
Based on percentage of damage to the typical facility in the community		
Impact		Score
Negligible - less than 10% damage		1
Limited - between 10% and 25% damage		2
Critical - between 25% and 50% damage		3
Catastrophic - more than 50% damage		4

Secondary Impacts	**Importance**	**0.5**
Based on estimated secondary impacts to the community at large		
Impact		Score
Negligible - no loss of function, downtime, and/or evacuations		1
Limited - minimal loss of function, downtime, and/or evacuations		2
Moderate - some loss of function, downtime, and/or evacuations		3
High - major loss of function, downtime, and/or evacuations		4

Total Score = Probability x Impact, where:
Probability = (Probability Score x Importance)
Impact = (Affected Area + Primary Impact + Secondary Impacts), where:
Affected Area = Affected Area Score x Importance
Primary Impact = Primary Impact Score x Importance
Secondary Impacts = Secondary Impacts Score x Importance

Descriptive Hazard Planning Consideration			
Total Score	(Range)	Distribution	Hazard Level
0.0	12.0	1	**Limited**
12.1	42.0	2	**Moderate**
42.1	64.0	3	**Significant**

The probability of each hazard is determined by assigning a level, from unlikely to highly likely, based on the likelihood of occurrence from historical data. The total impact value includes the affected area, primary impact, and secondary impact levels of each hazard. Each level's score is reflected in the matrix. The total score for each hazard is the probability score multiplied by its importance factor times the sum of the impact level scores multiplied by their importance factors. Based on this total score, the hazards are separated into three categories based on the hazard level they pose to the communities: Significant, Moderate, and Limited.

3.4.2 Descriptive Planning Analysis by Hazard

Table 12 - Descriptive Planning Considerations by Hazard for the AVEK Service Area

Hazard Type	Probability	Impact			Total Score	Descriptive Planning Consideration
		Affected Area	Primary Impact	Secondary Impacts		
Drought	4	2.40	1.40	1.00	19.20	**Moderate**
Earthquake	4	3.20	2.80	2.00	32.00	**Moderate**
Hazardous Materials	1	0.08	0.70	0.20	4.00	**Limited**
Landslide and Mudflow	2	1.60	1.40	1.00	8.00	**Limited**
Severe Storms and Localized Flooding	2	0.08	0.70	0.50	4.00	**Limited**
Subsidence	2	2.40	0.70	0.50	7.20	**Limited**
Water Resource	4	3.20	4.00	2.00	36.8	**Moderate**
Wildland Fire	4	0.08	0.07	1.00	10.00	**Limited**
Windstorms	4	1.60	0.07	0.50	11.20	**Limited**

For additional information on the hazard analysis for each facility, refer to **4.10.2**, **Planning Analysis Assessments by Facility**. Hazard Analysis Worksheets for each facility are included in **Appendix Three - Hazard Ranking Worksheets by Facility**.

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3.5 Critical Facilities

The Agency's facilities and infrastructure include more than 100 miles of water distribution pipeline; four Water Treatment Plants; four 8-million gallon water storage reservoirs near Mojave, a 3-million gallon capacity reservoir at Vincent Hill Summit, four additional tanks and reservoirs, 12 pumping stations, and its headquarters facilities and laboratory. Refer to **Table 13 - AVEK Critical Facilities and Infrastructure**.

Table 13 - AVEK Critical Facilities and Infrastructure

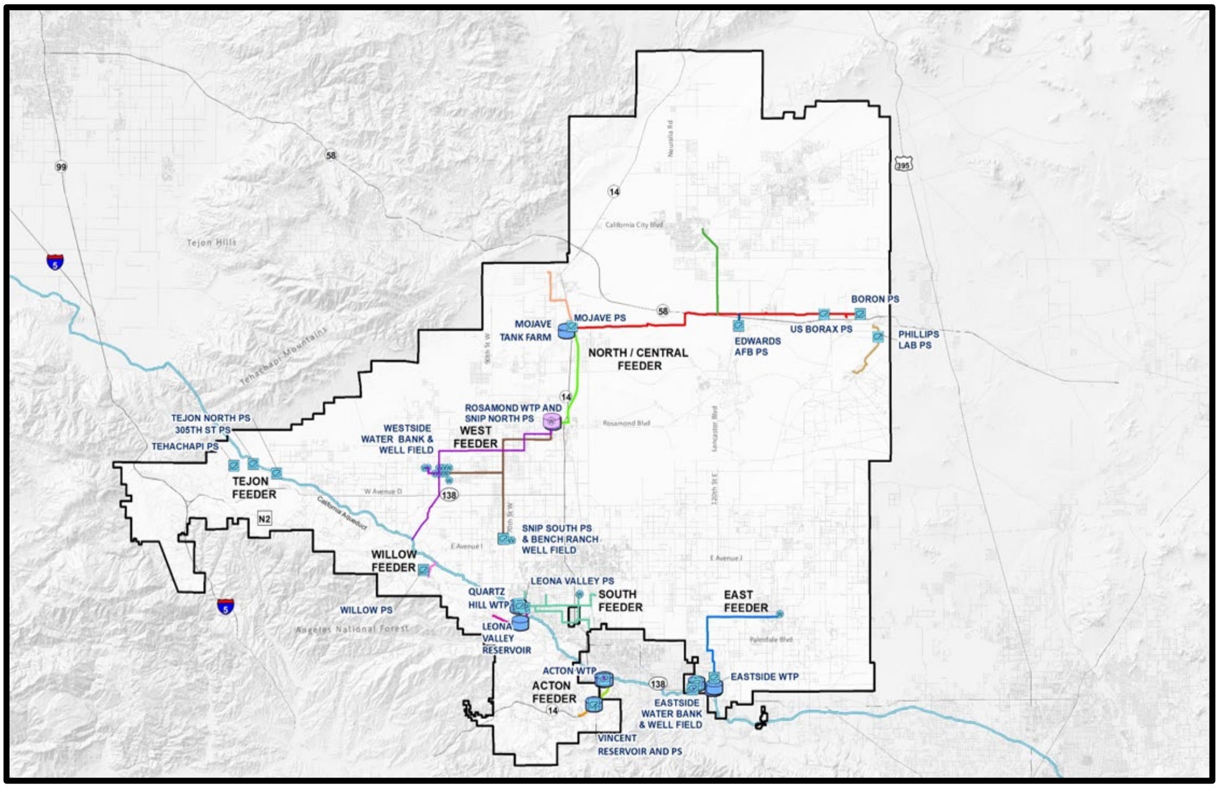
#	Facility or Infrastructure Component	Estimated Replacement Value	Estimated Contents Value	Estimated Total Value
1	Administration Building 1 and Laboratory	$9,000,000	$1,150,000	$10,150,000
2	Administration Building 2 and Emergency Operations Ctr	$7,500,000	$450,000	$7,950,000
3	Quartz Hill Water Treatment Plant and Tanks	$168,031,217	$885,629	$168,916,846
4	Rosamond Water Treatment Plant and Tanks	$49,660,481	$182,323	$49,842,804
5	Eastside Water Treatment Plant and Tanks	$38,329,879	$138,167	$38,468,046
6	Acton Water Treatment Plant and Tanks	$21,278,508	$87,969	$21,366,476
7	Tejon North Pump Station	$2,000,000	Included	$2,000,000
8	305th Street Pump Station	$5,500,000	Included	$5,500,000
9	Tehachapi Pump Station	$2,000,000	Included	$2,000,000
10	Willow Pump Station	$4,000,000	Included	$4,000,000
11	Leona Valley Pump Station	$6,500,000	Included	$6,500,000
12	Vincent Pump Station	$10,000,000	Included	$10,000,000
13	80th and H Pump Station (SNIP South Pump Station)	$10,000,000	Included	$10,000,000
14	SNIP North Pump Station	$6,000,000	Included	$6,000,000
15	Mojave Pump Station	$5,000,000	Included	$5,000,000
16	Edwards Pump Station	$6,000,000	Included	$6,000,000
17	Boron Pump Station	$5,000,000	Included	$5,000,000
18	Phillips Lab Pump Station	$5,000,000	Included	$5,000,000
19	Mojave 1 Tank	$5,515,036	Included	$5,515,036
20	Mojave 2 Tank	$5,515,036	Included	$5,515,036

Table 13 - AVEK Critical Facilities and Infrastructure (Continued)

#	Facility or Infrastructure Component	Estimated Replacement Value	Estimated Contents Value	Estimated Total Value
21	Mojave 3 Tank	$5,515,036	Included	$5,515,036
22	Mojave 4 Tank	$5,515,036	Included	$5,515,036
23	Mojave Tank Service Building	$500,000	Included	$500,000
24	Leona Valley Reservoir	$693,130	Included	$693,130
25	Vincent Reservoir	$1,512,885	Included	$1,512,885
26	Westside Water Bank and Well Field	$60,000,000	Included	$60,000,000
27	Bench Ranch Well Field	$10,000,000	Included	$10,000,000
28	Eastside Water Bank and Well Field	$20,000,000	Included	$20,000,000
29	PWD Intertie	$4,000,000	Included	$4,000,000
30	Willow Feeder	$1,900,000	Included	$1,900,000
31	East Feeder	$15,000,000	Included	$15,000,000
32	South Feeder	$40,000,000	Included	$40,000,000
33	West Feeder	$32,000,000	Included	$32,000,000
34	Central Feeder	$31,000,000	Included	$31,000,000
35	Quartz Hill WTP Intake	$2,000,000	Included	$2,000,000
36	Rosamond WTP Intake	$1,000,000	Included	$1,000,000
37	Eastside WTP Intake	$750,000	Included	$750,000
38	Action WTP Intake	$750,000	Included	$750,000

Refer to **Exhibit 3**, **Location of AVEK Facilities and Distribution System**.

Exhibit 3 - Location of AVEK Facilities and Distribution System



Source - AVEK

Table 14 - AVEK Identified Hazards and Planning Considerations

Identified Hazard	Hazard Planning Consideration
Drought	Limited
Earthquake	Moderate
Hazardous Materials	Limited
Landslide and Mudflow	Limited
Severe Storms and Localized Flooding	Limited
Subsidence	Limited
Water Resource	Moderate
Wildland Fire	Limited
Windstorms	Limited

3.6 Climate Change Considerations

Climate change is a serious issue, as it affects communities in a variety of ways. For the Antelope Valley - East Kern Water Agency, climate change can result in many impacts and potentially exacerbate existing natural and human-caused hazards or create new hazards. This Plan has identified climate change considerations within each hazard profile in the document to address potential climate change impacts. These considerations deal with changing weather patterns and precipitation regimes and other hazards that these changing conditions could exacerbate. Within each hazard profile, the plan has discussed some of the potential impacts resulting from climate change. This discussion is intended to supplement, but not replace, the **Probability of Future Occurrences** discussion.

Section Four - Hazards Affecting the Agency

4.1 Drought

Identifying Drought Hazards

A drought is a period of dry weather that persists long enough to cause crop damage and water supply shortages. Droughts can occur in short durations (single-year occurrence) or persist for several years (multi-year), impacting hydrologic cycles and biologic communities. Droughts may not be predictable, but they should be expected. They occur with some regularity and varying levels of severity. The magnitude and duration of drought can be predicted based on historical records and should be considered in water resource planning.

Profiling Drought Hazards

Droughts can occur over large regions (multiple states) or be isolated to small areas such as a city or county. For example, the Los Angeles and Kern County Hazard Mitigation Plans notes that the counties are susceptible to and at risk of drought conditions. This means that the entire Antelope Valley is susceptible to drought conditions.

Extent

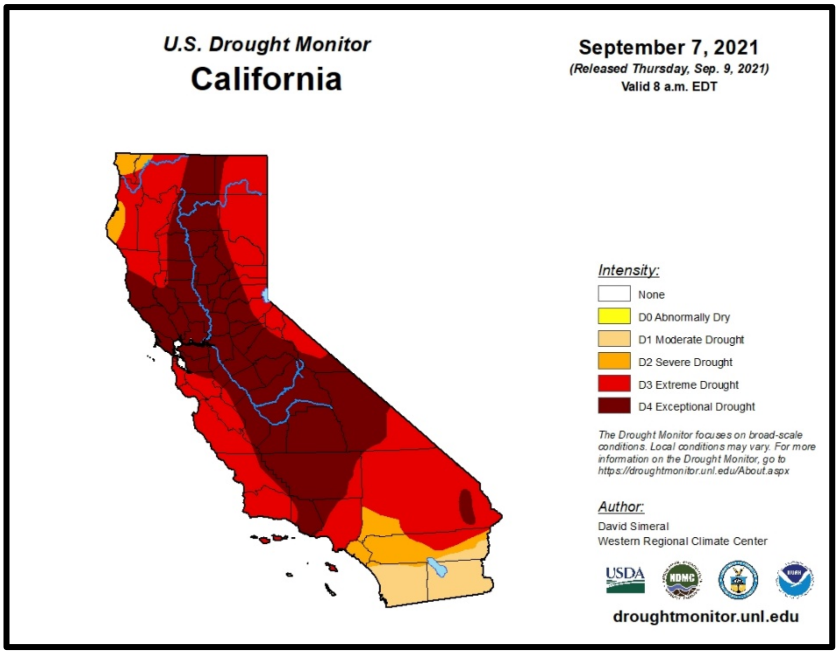
One approach to supplementing California's limited period of measured data is to reconstruct data by studying tree rings (dendrochronology) statistically. Information on the thickness of annual growth rings can be used to infer the wetness of the season. In addition, site-specific approaches to supplementing the historical record can include age-dating dryland plant remains now submerged in place by rising water levels or sediment and pollen studies. For example, a 1994 study of relict tree stumps rooted in present-day lakes, rivers, and marshes suggested that California sustained two epic drought periods, extending over three centuries. The first epic drought lasted more than two centuries before 1112; the second drought lasted more than 140 years before 1350. In this study, the researcher used drowned tree stumps rooted in Mono Lake, Tenaya Lake, West Walker River, and Osgood Swamp in the central Sierra Nevada. These investigations indicate that California has been subject to droughts more severe and more prolonged than those witnessed in the brief historical record.

Drought Monitor

The Drought Monitor was introduced as a weekly operational product in 1999 to provide an overview of conditions averaged across a broad array of time scales and impact indicators, leaning toward those that seem most relevant to observed impacts. This approach has led to an unprecedented degree of cooperation and coordination among a variety of disparate Federal, state, and local government agencies, in addition to many interested members of the academic and private research communities. The result has boiled the complex issues of drought and drought-related impact assessment down to a single, simple, visually intuitive summary of conditions that have replaced the uncoordinated, disparate, and often contradictory assortment of opinions and data that formerly characterized response requests drought information.

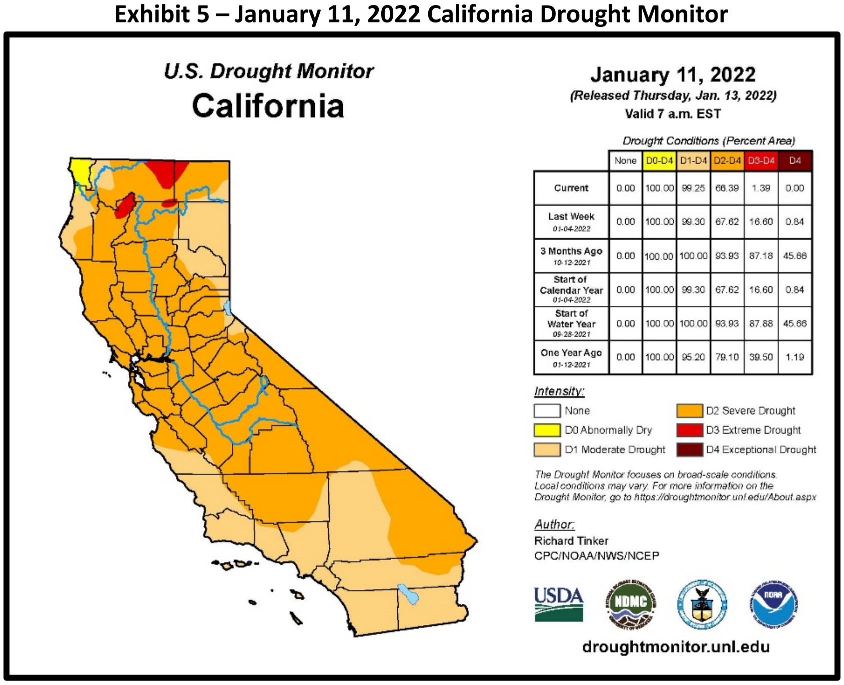
The following exhibits show how droughts are monitored throughout the Country. The first one (**Exhibit 4**) shows the level of drought in mid-2021, while the second one (**Exhibit 5**) shows the level of drought in January of 2022. These tools are helpful to agencies in planning for drought emergencies.

Exhibit 4 – September 7, 2021 California Drought Monitor



Source - Droughtmonitor.unl.edu

Exhibit 5 – January 11, 2022 California Drought Monitor



Source - Droughtmonitor.unl.edu

Drought Planning and Preparedness

The State of California has developed recommendations for small water agencies, such as many of AVEK's customers, to deal with drought conditions. These recommendations include:

Planning: Small water suppliers serving more than 1,000 customers would create an abridged version of a water shortage contingency plan. This plan would be a less stringent version of the water contingency plan that urban water suppliers must submit as part of their Urban Water Management Plans every five years. The report also calls county governments or regional entities to conduct water shortage contingency planning to cover their rural communities.

Preparedness: Small water systems should compile a list of resources needed to assist them in a drought or water shortage emergency. The list could include local community-based organizations that work with vulnerable populations, contractors for drilling wells, certified water haulers, and emergency shower vendors. In addition, DWR recommends that counties and regional entities use periodic statewide water shortage risk assessments prepared by the state to prioritize drought and water shortage assistance.

Past Occurrences

California is no stranger to drought; it is a recurring feature of our climate. We recently experienced the 5-year event of 2012-2016, and other notable historical droughts included 2007-09, 1987-92, 1976-77, and off-and-on dry conditions spanning more than a decade in the 1920s and 1930s. Paleoclimate records going back more than 1,000 years show many more significant dry periods. However, the dry conditions of the 1920s-30s were on par with the most significant 10-year droughts in the much longer paleoclimate record.

Droughts cause public health and safety impacts, as well as economic and environmental impacts. Public health and safety impacts are primarily associated with catastrophic wildfire risks and drinking water shortage risks for small water systems in rural areas and private residential wells. Examples of other impacts include costs to homeowners due to loss of residential landscaping, degradation of urban environments due to loss of landscaping, agricultural land fallowing, and associated job loss, degradation of fishery habitat, and tree mortality with damage to forest ecosystems.

Figure 3 - Photo of Folsom Lake During the 2014 Drought
Source - DWR

Unfortunately, the scientific skill to predict when droughts will occur, which involves forecasting precipitation weeks to months ahead, is currently lacking. Improving long-range weather modeling capabilities is an area of much-needed research.

Probability of Future Occurrences

A great deal of research has been conducted in recent years on explaining regional and even global climatic variability patterns to predict droughts. These patterns tend to recur periodically with enough frequency and with similar characteristics over a sufficient length of time. Thus, they offer opportunities to improve our ability for long-range climate prediction, particularly in the tropics. One such teleconnection is the El Niño/Southern Oscillation (ENSO). Teleconnections, such as ENSO and La Niña events, are atmospheric interactions between widely separated regions. In addition to predicting droughts, understanding these teleconnections can help forecast floods, tropical storms, and hurricanes. For example, this has been used in helping to determine the amount of rain that would be expected in the western portion of the United States. Other factors include:

Temperate Zone Forecast Reliability: In temperate regions (above 30 north latitude), long-range forecasts have limited reliability. Due to differences in observed conditions and statistical models, reliable forecasts for temperate regions may not be attainable for a season or more in advance.

Pressure Systems: High-pressure systems, which hinder cloud formation and lead to low relative humidity and precipitation, can cause drought. When large-scale anomalies in atmospheric circulation patterns last for months or seasons, prolonged drought occurs.

Interconnected Variables: Anomalies in precipitation and temperature may last from several months to several decades, and how long they last can depend on air-sea interactions, soil moisture, land surface processes, topography, and weather systems at the global scale.

Vulnerability / Risk Assessment

Because the source of AVEK's water is from the State Water Project's (SWP) California Aqueduct, it does not rely on local drought conditions to affect its ability to produce water to supply its customers.

However, to maintain the level of water quality being delivered to the SWP, in 2021, the Department of Water Resources (DWR) began construction on a drought barrier on the West False River in the Sacramento-San Joaquin Delta. The barrier will help slow the movement of saltwater into the central Delta and prevent contamination of water supplies for Delta agriculture and municipal supplies for millions of Californians. In addition, the barrier will help prevent saltwater contamination of water supplies used by millions of Californians. They rely on Delta-based federal and state water projects for at least some of their supplies.

In addition, the Agency can remove water stored underground using its water banking system. Groundwater banking is a process of diverting surface water into an aquifer to be stored until it is needed later. Water banking requires groundwater basins to access available surface water (in AVEK's case from the California Aqueduct), the means to transport it, and a management framework to account for what goes in and comes out. Aquifers must have accessible, unconfined storage at a relatively shallow depth. They must be easy to fill and draw from and cannot cause adverse impacts such as land subsidence, water quality degradation, or harm to nearby surface waters. This means that water banking can be used to supplement, not supplant, the water it can deliver to its customers.

4.2 Earthquake

Identifying Earthquake Hazards

An earthquake is a sudden release of energy in the earth's crust. Caused by movement along fault lines, earthquakes vary in size and severity. The focus of an earthquake is found at the first point of movement along the fault line (which may be beneath the surface), and the epicenter is the corresponding point above the focus at the earth's surface. Damage from an earthquake varies with the local geological conditions, the quality of construction, the energy released by the earthquake, the distance from the earthquake's focus, and the type of faulting that generates the earthquake. Earthquake-related hazards include primary impacts (fault rupture and ground shaking) and secondary impacts (liquefaction). This hazard profile will discuss ground shaking and liquefaction since these are the two most likely impacts anticipated due to an earthquake.

Ground Shaking

Ground motion/shaking is the primary cause of damage and injury during earthquakes. It can result in surface rupture, liquefaction, landslides, lateral spreading, differential settlement, tsunamis, building, and infrastructure failure, leading to fire and other collateral damage. Typically, areas underlain by thick, water-saturated, unconsolidated material will experience more significant shaking motion than areas underlain by firm bedrock. In some cases, topographic relief may intensify shaking along ridge tops, and landslides may develop.

Fires and structural failure are the most hazardous results of ground shaking. Most earthquake-induced fires start because of ruptured power lines and gas lines or electrically powered stoves and equipment. Structural failure is generally a result of age, quality, and type of building construction.

Liquefaction

Liquefaction transforms loose, water-saturated granular materials (such as sand and silt) from a solid to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures.

Earthquake Induced Landslides

Earthquake-induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Many communities in Southern California have a high likelihood of encountering such risks, especially in areas with steep slopes. Historically, hillsides in and around the Antelope Valley have not experienced slope failure due to earthquakes.

Profiling Earthquake Hazards

The Antelope Valley encompasses approximately 2,400 square miles in northern Los Angeles County, southern Kern County, and western San Bernardino County. The Antelope Valley represents a large topographic and groundwater basin in the western part of the Mojave Desert in southern California. It is an undrained, closed basin. The region occupies part of a structural depression down faulted between the Garlock, Cottonwood-Rosamond, and San Andreas Fault Zones. The Valley is bound southwest by the San Andreas Fault and San Gabriel Mountains, the Garlock Fault and Tehachapi Mountains to the northwest, and San Bernardino County to the east. Consolidated rocks that yield virtually no water underlie the basin and crop out in the highlands that surround the basin. They consist of igneous and metamorphic rocks of pre-Tertiary age overlain by indurated continental rocks of Tertiary age interbedded with lava flows (USGS, 1995).

Alluvium and interbedded lacustrine deposits of the Quaternary age form the important aquifers within the closed basin and have accumulated to a thickness of as much as 1,600 feet. The alluvium is unconsolidated to moderately consolidated, poorly sorted gravel, sand, silt, and clay. Older units of the alluvium are somewhat coarser-grained and are more compact and consolidated, weathered, and poorly sorted than the younger units. Consequently, the rate at which water moves through the alluvium, also known as the hydraulic conductivity of the alluvium, decreases with increasing depth (USGS, 1995).

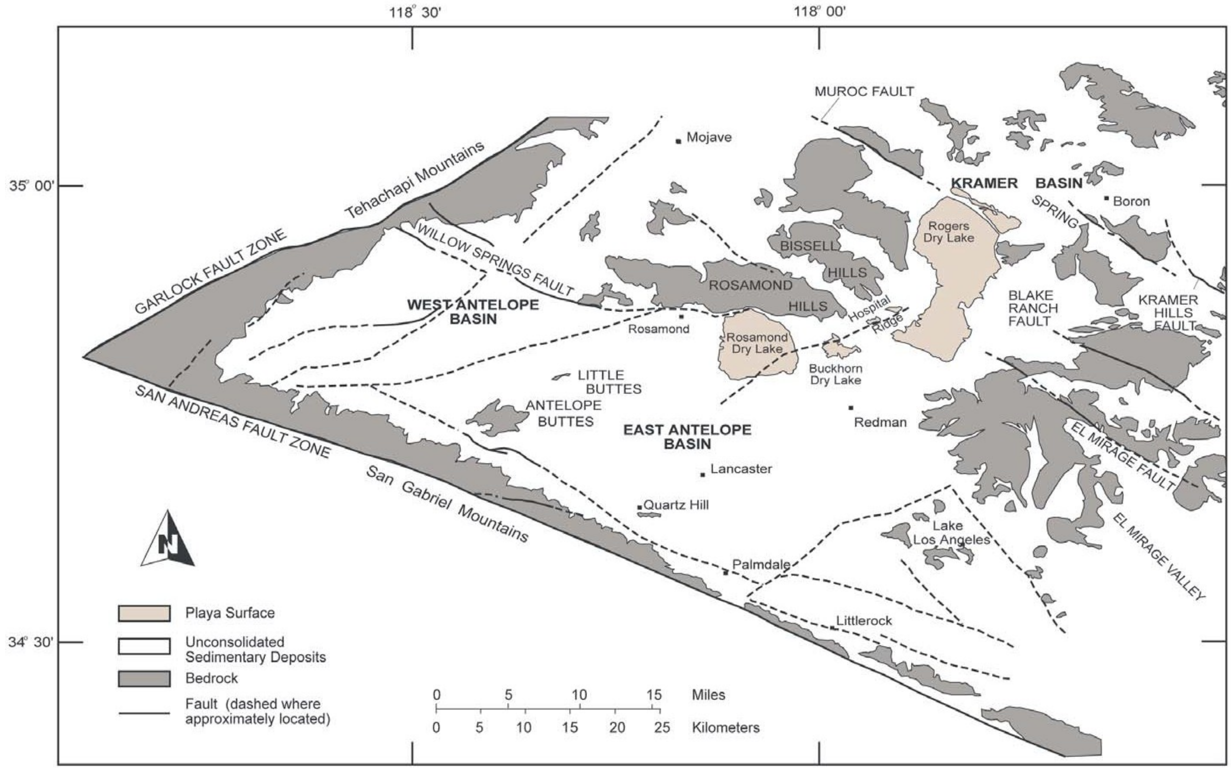
During the depositional history of the Antelope Valley region, a sizeable intermittent lake occupied the central part of the basin and was the site of accumulation of fine-grained material. The rates of deposition varied with the rates of precipitation. During periods of relatively heavy precipitation, massive beds of blue clay formed in a deep perennial lake. During periods of light precipitation, thin beds of clay and evaporative salt deposits formed in playas or shallow intermittent lakes.

Individual beds of the massive blue clay can be as much as 100 feet thick and are interbedded with lenses of coarser material as much as 20 feet thick. The clay yields virtually no water to wells, but the interbedded, coarser material can yield considerable volumes of water.

Soils within the area are derived from downslope migration of loess and alluvial materials, mainly from granitic rock sources originating along the eastern slopes of the Tehachapi and San Gabriel Mountains.

Refer to **Exhibit 6,** which notes the Fault Zones in the Antelope Valley.

Exhibit 6 - Earthquake Fault Zones Affecting the Antelope Valley



Source - North Los Angeles / Kern County Recycled Water Project

San Andreas Fault Zone

The San Andreas Fault is the principal boundary between the Pacific and North American plates. It is considered the “Master Fault” because it has frequent (geologically speaking) large earthquakes, and it controls the seismic hazard in southern California. The fault extends over 1,000 miles from Cape Mendocino in northern California to the Salton Sea region in southern California. At its closest approach, the San Andreas Fault is approximately 5 miles west of the Antelope Valley.

Significant faults, such as the San Andreas Fault, are generally divided into segments to evaluate their future earthquake potential. The segments are generally defined at discontinuities along the fault that may affect the rupture length. In central and southern California, the San Andreas Fault zone is divided into five segments named, from north to south, the Cholame, Carrizo, Mojave, San Bernardino Mountains, and Coachella Valley segments according to the Working Group on California Earthquake Probabilities (WGCEP, 1995). Each segment is assumed to have a characteristic slip rate (rate of movement averaged over time), recurrence interval (time between moderate to large earthquakes), and displacement (amount of offset during an earthquake). While this methodology has some value in predicting earthquakes, historical records and studies of prehistoric earthquakes show that more than one segment can rupture during a large quake or for ruptures to overlap into adjacent segments.

The last major earthquake on the southern portion of the San Andreas Fault was the 1857 Fort Tejon (M 8) event. This is the largest earthquake reported in California. The 1857 surface rupture broke the

Cholame, Carrizo, and Mojave segments, resulting in displacements of as much as 27 feet along the rupture zone. Peak ground accelerations in the San Gabriel Valley area resulting from the 1857 earthquake are estimated to have been as high as 0.23g. These fault segments are thought to have a recurrence interval of between 104 and 296 years.

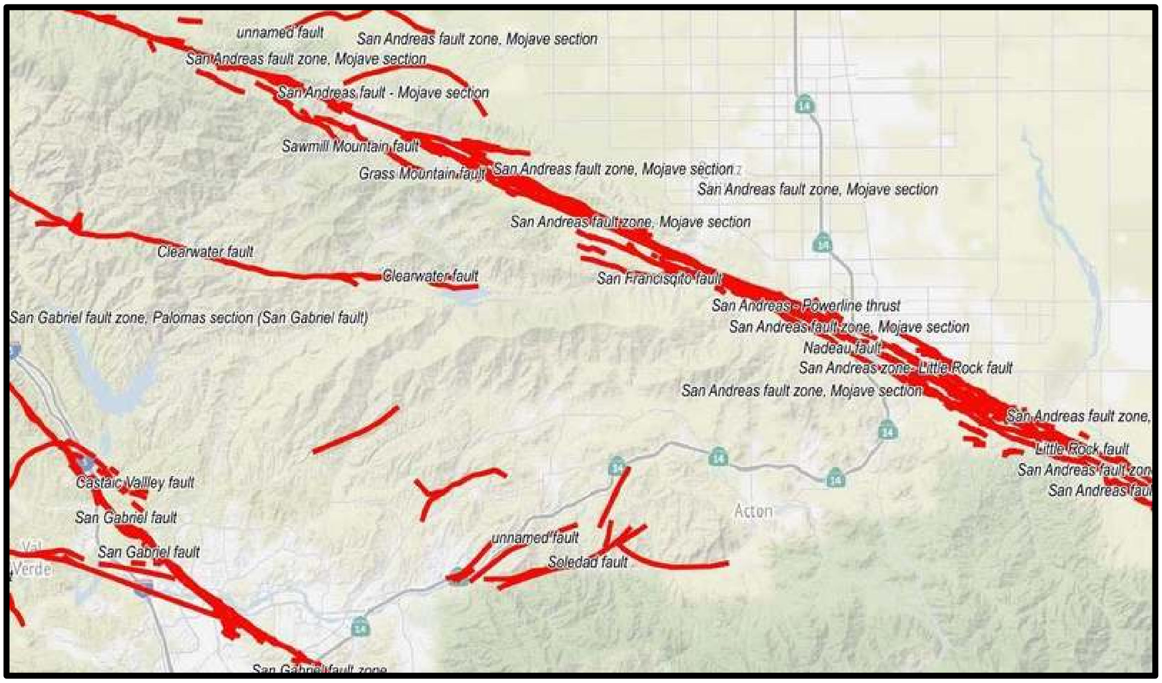
The Mojave segment of the San Andreas Fault is 83 miles long, extending from approximately Three Points southward to just northwest of Cajon Creek, at the southern limit of the 1857 rupture (WGCEP, 1995). Using a slip rate of 30±8 millimeters per year (mm/year) and a characteristic displacement of 4.5±1.5 meters (m), the WGCEP (1995) derived a recurrence interval of 150 years for this segment. The Mojave segment is estimated to produce a magnitude 7.1 earthquake, resulting in peak ground accelerations in the Antelope Valley area between 0.13g and 0.16g. The WGCEP (1995) calculated that this segment has a 26 percent probability of rupturing sometime between 1994 and 2024.

The San Bernardino Mountains segment extends approximately 49 miles from Cajon Creek to the San Gorgonio Pass. This segment is a structurally complex zone that is poorly understood and for which there are scant data on fault behavior. Using a slip rate of 24±5 mm/year and a characteristic displacement of 3.5±1.0 m, the 1995 WGCEP derived a recurrence interval on this fault of 146 years. This fault segment is estimated to produce a magnitude 7.3 earthquake, resulting in peak ground accelerations in San Gabriel between 0.11g and 0.13g. Higher ground motions will be expected if this fault segment ruptures with the Mojave and Coachella Valley segments. In 1994, the WGCEP (1995) calculated that this fault segment had a 28 percent probability of rupturing sometime in the next 30 years.

Paleoseismic studies suggest that the last surface-rupturing earthquake on this segment occurred around 1680. The data also suggest that during the 1680 earthquake and before that, in 1450, both the Coachella Valley and San Bernardino Mountain segments ruptured simultaneously. Using a slip rate of 25± 5mm/year and a characteristic displacement of 4.0 (+4,-2) m, the 1995 WGCEP derived a recurrence interval for this fault of 220 ±13 years. Thus, this segment is thought capable of producing a magnitude 7.4 earthquake, resulting in peak ground accelerations in the area of 0.12g to 0.13 g. The WGCEP (1995) also calculated a 22 percent probability that this fault segment would generate an earthquake sometime between 1994 and 2024.

Refer to **Exhibit 7**, a San Andreas Fault map along the west side of the Antelope Valley.

Exhibit 7 - San Andreas Fault Zone - West of the Antelope Valley



Source - Courtesy of Chris Chubb Cartography

Garlock Fault Zone

Stretching for 160 miles, the Garlock Fault is the second-longest fault in California and one of the most prominent geological features in the southern part of the state. It marks the northern boundary of the area known as the Mojave Block and the southern ends of the Sierra Nevada and the valleys of the westernmost Basin and Range province.

The Garlock Fault runs from a junction with the San Andreas Fault in the Antelope Valley eastward to a junction with the Death Valley Fault Zone in the eastern Mojave Desert. It is named after the historic mining town of Garlock, founded in 1894 by Eugene Garlock, and now a ghost town. Relatively few communities lie directly along with the Garlock, as it is primarily situated in the desert, with Frazier Park, Tehachapi, Mojave, and Johannesburg being the closest to it.

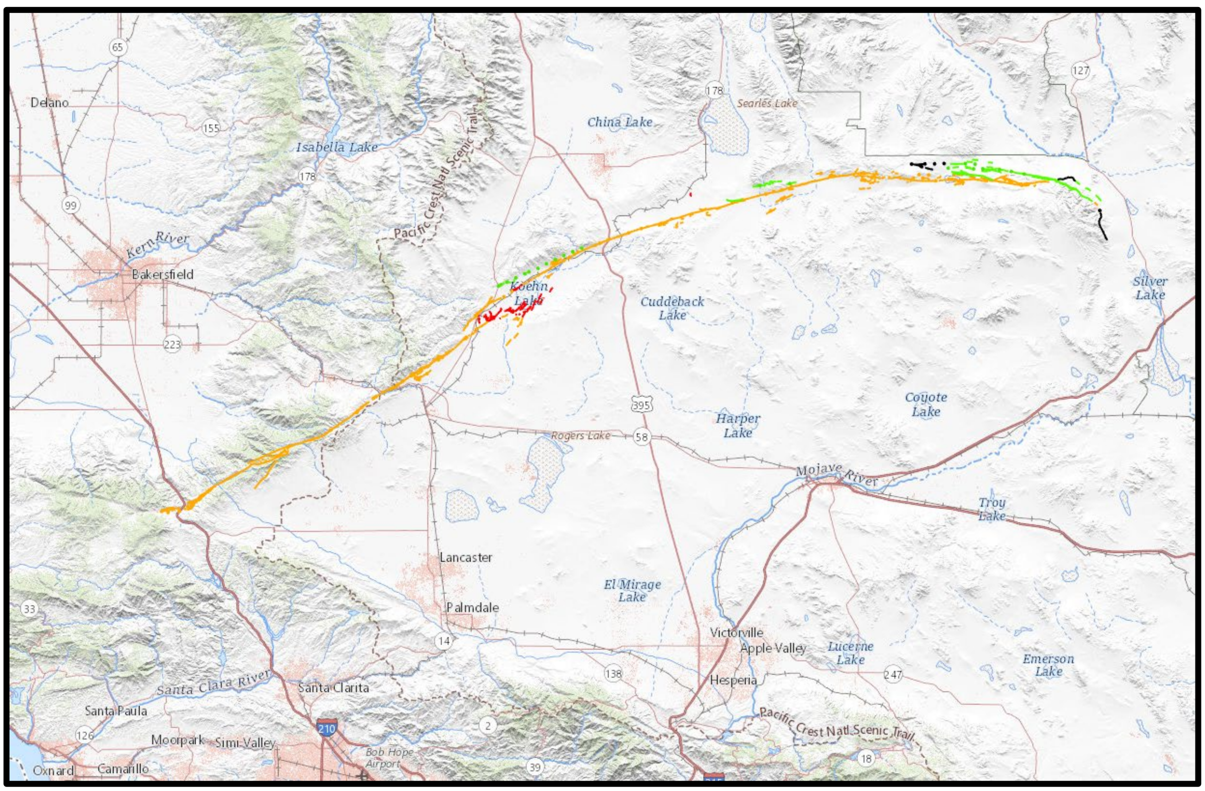
The Garlock Fault is believed to have developed to accommodate the strain between the extensional tectonics of the Great Basin crust and the right lateral strike-slip faulting of the Mojave Desert crust. Unlike most of the other faults in California, slip on the Garlock Fault is left-lateral; that is, the land on the other side of the fault moves to the left from the perspective of someone facing the fault. Thus, the terrain north of the fault moves westward, and that on the south is moving eastward.

It moves at a rate of between 2 and 11 mm a year, with an average slip of around 7 millimeters. While most of the fault is locked, specific segments have been shown to move by aseismic creep, which is motion without resulting earthquakes. The Garlock is not considered to be a particularly active fault, seldom producing any shaking detectable by humans, although it has been known to generate sympathetic seismic events when triggered by other earthquakes and in one instance by the removal of ground water. These events and continuing micro-earthquake activity and the state of the scarps from previous ruptures indicate that the Garlock will produce another major quake at some point in the future.

A study published in October 2019 in the journal *Science* indicated that a part of the Garlock fault slipped after being triggered by the earthquakes in the Ridgecrest area in July 2019. In addition, an article in the *Los Angeles Times* indicated that a magnitude eight earthquake along the Garlock fault would have the potential for grave disaster.

The last significant ruptures on the Garlock were thought to be 1050 AD and 1500 AD. Research has pinned the interval between significant ruptures on the Garlock as being anywhere between 200 and 3,000 years, depending on the segment of the fault. The most recent notable event in the Garlock Fault Zone was a magnitude 5.7 near the town of Mojave on July 11, 1992. It is thought to have been triggered by the Landers earthquake just two weeks earlier. However, no surface slippage of the fault itself had been recorded in modern times until 2019. Then, following a series of earthquakes on nearby minor faults in late July 2019, the Garlock Fault was observed moving about 0.8 inches between July and October.

Exhibit 8 - Map of the Garlock Fault Zone



Source - USGS Geologic Hazards Science Center

Additional Fault Zones

There are additional smaller faults that run along the floor of the Antelope Valley in the area east and south of Edwards Air Force Base. These faults are minor and do not have the potential for significant ground movement. Therefore, they do not pose a threat to AVEK facilities. Refer to **Exhibit 6**.

Earthquake Mapping

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate surface faulting to structures for human occupancy. This state law resulted from the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. Surface rupture is the most easily avoided seismic hazard. The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides.

The State Department of Conservation operates the Seismic Mapping Program for California. Extensive information is available at their website: http://gmw.consrv.ca.gov/shmp/index.htm.

Earthquake Measurement

The Richter Scale, developed in the 1930s, provided a useful measure of comparison between earthquakes. Another scale, the Moment Magnitude Scale, measures the magnitude of medium and large-sized earthquakes by characterizing the amount of energy released by the earthquake. The magnitude is based on the earthquake's seismic moment, which is equal to the rigidity of the Earth multiplied by the average amount of slip on the fault and the size of the area that slipped.

The Moment Magnitude Scale is now more widely used for scientific comparison since it accounts for the actual slip that generated the earthquake. Actual damage is due to the propagation of seismic or groundwaves as a result of initial failure. The intensity of shaking is related to earthquake magnitude as it is to the condition of underlying materials. Loose materials tend to amplify ground waves, while hard rock can quickly attenuate them, causing minor damage to overlying structures. Refer to **Table 14**.

Another measurement tool, the Modified Mercalli Intensity (MMI) Scale, provides a practical qualitative assessment of ground shaking. The MMI Scale is a 12 point scale of earthquake intensity based on local effects experienced by people, structures, and earth materials. Each succeeding step on the scale describes a progressively more significant amount of damage at a given point of observation. The MMI Scale is shown in **Table 15**, along with relative ground velocity and acceleration.

A major earthquake produced along any of the regional fault systems can produce strong ground shaking in the Antelope Valley. In addition, seismic risks associated with both regional fault systems and the local blind thrust faults underlying the area emphasize the need to ensure that all new development projects - and the retrofit of existing structures - incorporate appropriate design features to guard against widespread property damage and loss of life in the event of an earthquake.

Table 15 - Moment Magnitude Scale for Earthquakes

Moment Magnitude (M_w)	Earthquake Effects
Less than 3.5	Generally not felt, but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
Under 6.0	At most slight damage to well-designed buildings. Can cause significant damage to poorly constructed buildings over small regions.
6.1 - 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause severe damage over larger areas.
8 or greater	Great earthquake. Can cause severe damage in areas several hundred kilometers across.

Table 16 - Modified Mercalli Intensity Scale for Earthquakes

Intensity	Shaking	Description/Damage	Corresponding Richter Scale Magnitude
I	Not Felt	Not felt except by a very few under especially favorable conditions.	
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.	<4.2
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize itas an earthquake. Standing motor cars may rock slightly. Vibrations are similar to the passing of a truck. Durationestimated.	
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing motor cars rockednoticeably.	
V	Moderate	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned.Pendulum clocks may stop.	<4.8
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	<5.4
VII	Very Strong	Damage negligible in buildings of good design; slight to moderate in well-built ordinary structures; considerabledamage in poorly built or badly designed structures; some chimneys broken.	<6.1
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.	
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	<6.9
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed, including their foundations. Rail traffic disrupted due to bent rails.	<7.3
XI	Extreme	Few, if any, masonry structures remain standing. Bridges destroyed. Rails bent greatly.	<8.1
XII	Extreme	Damage total. Lines of sight and level are distorted. Objects are thrown into the air.	>8.1

Past Occurrences

There have been many large earthquakes in Southern California throughout the years. Many have caused deaths and significant amounts of damage. **Table 17** shows the most prominent Southern California earthquakes since 1980.

Table 17 - Largest Southern California Earthquakes 1980 to 2021

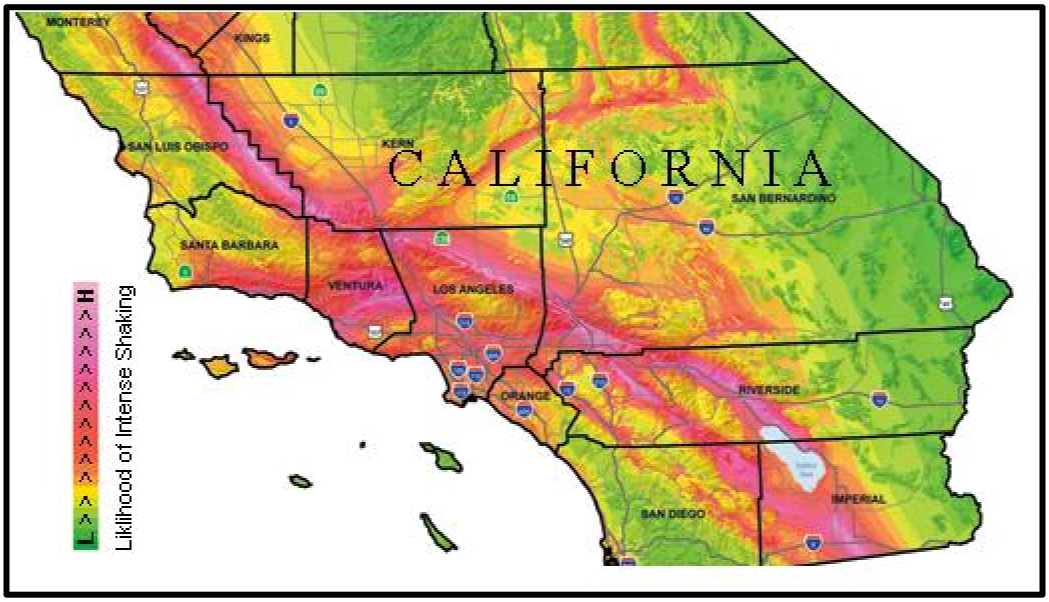
Date	Name	Mw	MMI	Deaths	Injuries	Loss
July 5, 2019	Ridgecrest	7.1 M_w	IX		5	$5.3 B
July 4, 2019	Ridgecrest	6.4 M_w	VIII	1	20	$5.3 B
March 28, 2014	La Habra	5.1 M_w	VI		Few	$10.8 M
April 4, 2010	Baja California	7.2 M_w	VII	2 - 4	100 - 233	$1.15 B
July 29, 2008	Chino Hills	5.4 M_w	VI		8	Limited
Dec. 22, 2003	San Simeon	6.6 M_w	VIII	2	40	$250 - 300 M
Oct. 16, 1999	Hector Mine	7.1 M_w	VII		4	Limited
Jan. 17, 1994	Northridge	6.7 M_w	IX	57	8,700 +	$13 - 40 B
June 28, 1992	Big Bear	6.5 M_w	VIII		63	More than 60 M
June 29, 1992	Landers	7.3 M_w	IX	3	400 +	$92 M
April 22, 1992	Joshua Tree	6.3 M_w	VII		32	Light - Moderate
July 28, 1991	Sierra Madre	5.6 M_w	VII	2	100 - 107	$34 - 40 M
Feb. 28, 1990	Upland	5.7 M_w	VII		30	$12.7 M
Nov. 24, 1987	Elmore Ranch	6.5 M_w	VIII	2	90 +	
Nov. 23, 1987	Superstition Hills	6.1 M_w	VIII			$3 M
Oct. 1, 1987	Whittier	5.9 M_w	VIII	8	200	$213 - 358 M
July 21, 1986	Chalfant Valley	6.2 M_w	VI		2	$2.7 M
July 13, 1986	Oceanside	5.8 M_w	VI		1	$700 K
July 8, 1986	N. Palm Springs	6.0 M_w	VII		29 - 40	$4.5 - 6 M

Probability of Future Occurrences

The most comprehensive statewide analysis of earthquake probabilities determined that the chance of having one or more magnitude 6.7 or larger earthquakes in California over the next 30 years is 99.7%. The fault with the highest probability of such earthquakes is the southern San Andreas, 59% in the next 30 years. For powerful quakes of magnitude 7.5 or greater, there is a 37% chance that one or more will occur in the next 30 years in Southern California.

Exhibit 9 shows a map of expected shaking from a future large earthquake along the southern section of the San Andreas Fault.

Exhibit 9 - Expected Shaking from Future Southern California Earthquakes



Source - Southern California Earthquake Center

Climate Change Considerations

With the advent of seismology, the study of earthquakes, scientists know that most quakes are caused by tectonic processes, the forces within the solid Earth that drive changes in the structure of Earth's crust, primarily the rupture of underground rock masses along faults (linear zones of weakness). They know that most earthquakes occur far beneath Earth's surface, well beyond the influence of surface temperatures and conditions. Finally, scientists know the statistical distribution of earthquakes is approximately equal across all types of weather conditions.

Vulnerability / Risk Assessment

A seismic hazard map produced by the California Geological Survey is shown in **Exhibit 9**. Areas in red and pink are more likely to experience strong earthquake shaking. The map adds together shaking from all potential earthquakes. Smaller earthquakes will only cause shaking locally, while more significant earthquakes may cause strong shaking throughout southern California.

Much of the Antelope Valley is located in the red and pink areas, meaning that AVEK's facilities are susceptible to damage due to a large earthquake along the San Andreas Fault. In addition, a large earthquake can disrupt the flow of water in the California Aqueduct due to its proximity to the Fault.

4.3 Hazardous Materials and Human-Caused Events

Identifying Hazardous Material Releases

The term Hazardous Materials covers a large number of substances that are a danger to the public. These include toxic metals, chemicals, and gases; flammable and/or explosive liquids and solids; corrosive materials; infectious substances; and radioactive materials. AVEK has adopted a Hazardous Materials plan that deals with the use, storage, and transport of hazardous materials.

In addition to the immediate risk to life safety, public health, and air quality, the potential for water source contamination, and the potential environmental impacts of accidental hazardous materials releases and toxic substances, there is also concern over the long-term public health and environmental impacts that may result from the sustained use of or exposure to certain substances. For example, an incident could result in the total evacuation of personnel, a section of a facility, or a neighboring area.

Profiling Hazardous Material Releases

Hazardous materials are everywhere and are accidentally released or spilled many times during any given day. In 2017, the California State Warning Center received approximately 11,000 hazardous material spill reports on hazardous material incidents and potentially hazardous material incidents. Of these incidents, most are minor, but some do cause significant impacts such as injuries, evacuation, and the need for cleanup.

With the assistance of the AVEK's hazardous materials contractor, the Agency reports to the State on the types and locations of the various materials used for treating water and the materials used for normal day-to-day operations using the California Environmental Reporting System (CERS).

The Water Treatment Plants (WTP) all use varying amounts of flammable solids (Activated Carbon / Potassium Permanganate), liquids (Zinc Orthophosphate / Aluminum Sulfate / Sodium Hypochlorite / Calcium Thiosulfate), and gases (Carbon Dioxide / Liquid Oxygen) for water treatment. Day-to-day materials include fuels, lubricants, and welding gases. All of these materials are stored in approved secure storage facilities within the WTP grounds.

Past Occurrences

To date, AVEK has not had a hazardous materials release. However, hazardous materials incidents have occurred in transport corridors such as freeways and other major transport arteries. The most significant of these releases have consisted of petroleum products such as gasoline and diesel fuel. Previous hazardous materials incidents do not accurately reflect the vulnerabilities that the Agency faces.

Probability of Future Occurrences

Although there have been no past occurrences, the Agency is constantly monitoring its use of hazardous materials. In addition, technological advances and increases in industry standards are also improving safety and further preventing or minimizing potential releases of hazardous materials. As a result, it is anticipated that future newer technologies, standards, and regulations will continue this trend.

Climate Change Considerations

Anticipating that precipitation regimes may change in the future due to climate change, there may be a more significant opportunity for the release of hazardous materials to enter local waterways and the groundwater aquifer. Therefore, it is anticipated that if this concern increases that the Agency and other regulating agencies would re-visit procedures and practices in place to ensure that the greatest amount of protection occurs.

Vulnerability / Risk Assessment

As stated earlier, both the AWIA Risk and Resiliency Assessment and the assessment made by the TAC have labeled this area a low risk within the Agency.

4.4 Landslide and Mudflow

Identifying Landslide and Mudflow Hazards

General slope stability is determined by several factors such as the angle of the slope, vegetative cover, wildland fire, bedrock, soil, seismic activity, precipitation, groundwater, erosion, and human alterations to land such as hillside grading activities. Slopes may be in temporary equilibrium until one of the factors, as mentioned earlier, is modified by natural or human activity resulting in an unstable condition and potential slope failure.

A landslide is defined as a downward and outward movement of soil and rock. Such a movement occurs when steep slopes are destabilized by excess water accumulation in the soil, the addition of excess weight to the top of a slope, the removal of support from the bottom of a slope, or a combination of the above. The force of rocks, soils, or other debris moving down a slope can devastate anything in its path.

Mudflows, often referred to as "debris flows" or "mudslides," are caused by sustained and intense rainfall accompanied by rocks, vegetation, and other debris. These are fast-moving down-slope flows and can cause severe damage. The rapid movement and sudden arrival of debris flows pose a hazard to life and property during and immediately following the triggering rainfall. To trigger "debris flows," a storm must have a critical combination of rainfall intensity and duration leading to saturation of the hill slope soils, generation of positive pore fluid pressures within the soil, and ultimately, slope failure.

Location and Extent

Although landslides can threaten the Antelope Valley, they are a severe geologic hazard in almost every state and many cities in America. Nationally, landslides cause 25 to 50 deaths each year. The best estimate of direct and indirect costs of landslide damage in the United States ranges between $1 and $2 billion annually. As a seismically active region, California has had a significant number of locations impacted by landslides. Some landslides result in private property damage. Other landslides impact transportation corridors, fuel and energy conduits, and communication facilities. They can also pose a serious threat to human life. Slow-moving landslides can cause significant property damage but are less likely to result in serious human injuries.

Past Occurrences

Many severe rain storms in Southern California affect Antelope Valley's areas, specifically in San Bernardino County. However, in October of 2015, a severe storm swept through Southern California, causing mudslides to close portions of Interstate 5 and Hwy 58 near Mojave. In addition, a mudslide came down into the California Aqueduct, disrupting the flow of water and damaging the aqueduct’s structure. However, DWR was able to open the blockage within a week, allowing for the normal water flow.

Refer to **Table 18** for a history of significant mudflow events in the region.

Table 18 - Major Landslides and Mudflow Events Surrounding Los Angeles County

Date	Location	Magnitude	Damage
1983	Southern California	Landslides	Over 1 Billion Dollars in Damage
1983	San Clemente	Landslide	Highway 1 Damaged
1983	Big Rock Mesa	Landslide	13 Homes Destroyed
1994	Los Angeles County (Northridge Earthquake)	Landslides	11,000 Landslides Valley Fever Outbreak
1995	Ventura and Malibu	Landslides	Numerous Homes Destroyed Many Deaths Resulted
2018	Montecito (Santa Barbara County)	Mudslides	Numerous Homes Destroyed Many Deaths Resulted

In addition to the past landslide and mudflow events listed above, severe storms can contribute to landslide and mudflow. Historical events describing severe storms of this nature can be found in severe storms and localized flooding profiles.

Probability of Future Occurrences

According to the Los Angeles County Safety Element, landslide areas exist throughout the region. The hills north and west of the Valley are a particular area of concern. Although small in geographic extent, the area has the potential for landslide issues.

Climate Change Considerations

Anticipating that precipitation regimes may change in the future due to climate change, there may be a more significant opportunity for landslides and mudflows. Current climate change science indicates that storms may become less frequent and more intense, resulting in greater runoff at higher velocities within the various drainages in the Antelope Valley. With greater precipitation, underlying soils and rock units could become saturated quicker, increasing landslides' risk. In addition, if water runoff is occurring at greater velocities, there is more significant potential for erosion, which could induce landslides and mudflows within the area.

Vulnerability/Risk Assessment

Based on the locations of AVEK's facilities, they are not in danger of damage due to mudflows and landslides. As stated earlier, a slide into the California Aqueduct is the only significant mudflow issue the Agency faces. This would only affect the flow of water in the Aqueduct, most likely reducing the Agency's ability to pull water from it. Repairs to the Aqueduct are the responsibility of the State's Department of Water Resources.

4.5 Severe Storm and Localized Flooding

Identifying Severe Storms

Severe storms are typically generated in the Pacific Ocean. As they rise over the mountains and ridges that border the western boundaries of the Antelope Valley, the air associated with these storms cools, resulting in large amounts of precipitation. The area's topography provides relatively steep and well-defined watershed areas to funnel the falling rain into runoff tributaries. As a result, periods of heavy rainfall are expected during the fall and winter months.

Identifying Localized Flooding Hazards

Flooding and severe storms present similar risks and are usually related to the Antelope Valley hazards. Severe storms can cause high winds, hill erosion, debris flows, in addition to flooding. During a flood, excess water from rainfall overflows into storm drains and creeks. Several factors determine the severity of floods, including rainfall intensity and duration, creek and storm drain system capacity, and the infiltration rate of the ground.

Localized flooding occurs when a storm drain or waterway receives a discharge greater than its conveyance capacity. Floods may result from intense rainfall, localized drainage problems, or failure of flood control or water supply structures such as culverts, levees, dams, or reservoirs. Floods usually occur in relation to precipitation. Flood severity is determined by the quantity and rate at which water enters the waterway, increasing water flow volume and velocity. The rate of surface runoff, the major component of flood severity, is influenced by the region's topography, the extent to which ground soil allows for infiltration, and the percent of impervious surfaces. Refer to **Exhibit 10** for localized flooding areas in the Los Angeles County portion of the Valley and **Exhibit 11** for the localized flooding areas of Kern County in the Valley.

Identifying Major Flooding Areas

Within the Valley is the Antelope Valley Watershed. Significant characteristics of the watershed, as shown in **Exhibit 12**, include:

- Closed basin encompasses approximately 2,400 square miles with no regional outflow of surface or groundwater.
- Bounded by the peninsular Tehachapi Mountains on the Northwest, together with the San Gabriel and the San Bernardino Mountains on the Southwest.
- Terminal dry lakes or playas are predominantly clay with little groundwater recharge, significant losses to evaporation.
- Four playas are all located on Edwards Air Force Base; the corresponding surface areas include Rosamond (21 square miles), Rich (3 square miles), Buckhorn (10 square miles), and Rogers (35 square miles).
- Approximately 80 percent of watersheds are characterized by a low to moderate slope (0-7 percent); the remaining 20 percent consists of foothills and rugged mountains that reach up to 3,600 feet in elevation.

- Watershed boundaries and surface drainage patterns are difficult to define within the low-relief terrain lakebed portions of the watershed.
- Mostly rural; sparsely populated in many areas. However, the western and southern parts of the Antelope Valley along the foothills/alluvial fan have been urbanized.
- High desert climate.
- Three major watersheds are tributary to Rosamond Lake, including (1) Cottonwood Creek (drainage area = 373 square miles), (2) Amargosa Creek (drainage area = 256 square miles), and (3) Little Rock Wash (drainage area = 144 square miles).
- The Watershed area tributary to Rogers Lake is approximately 708 square miles, primarily through Big Rock Creek; the tributary watershed area to Rich Lake is 376 square miles.
- Buckhorn Lake tributary area includes portions of Rosamond and Rogers watersheds.
- Little Rock Reservoir provides some limited flood storage within the upper portion of the watershed (surface area = 150 acres, elevation 3,200, original storage capacity = 4,300 acre-feet and currently has a useable storage capacity of 3,000 acre-feet of water).

Details of the drainage infrastructure within the watershed include:

- Not a significant amount of regional flood infrastructure compared with other, more densely urbanized areas of Los Angeles County, primarily natural drainage paths and patterns.
- The limited regional flood control facilities are generally located in urban areas and include some channelized creeks, stream bank revetments of different types, and localized protective structures.
- Urban drainage facilities have limited hydraulic capacity and are not designed to accommodate regional overland flooding that exceeds the smaller urban watershed.
- Urban drainage facilities generally consist of local retention/detention basins, street drainage inlets, underground storm drain pipes, and culverts.

Existing Antelope Valley Floodplain Hazard Mapping

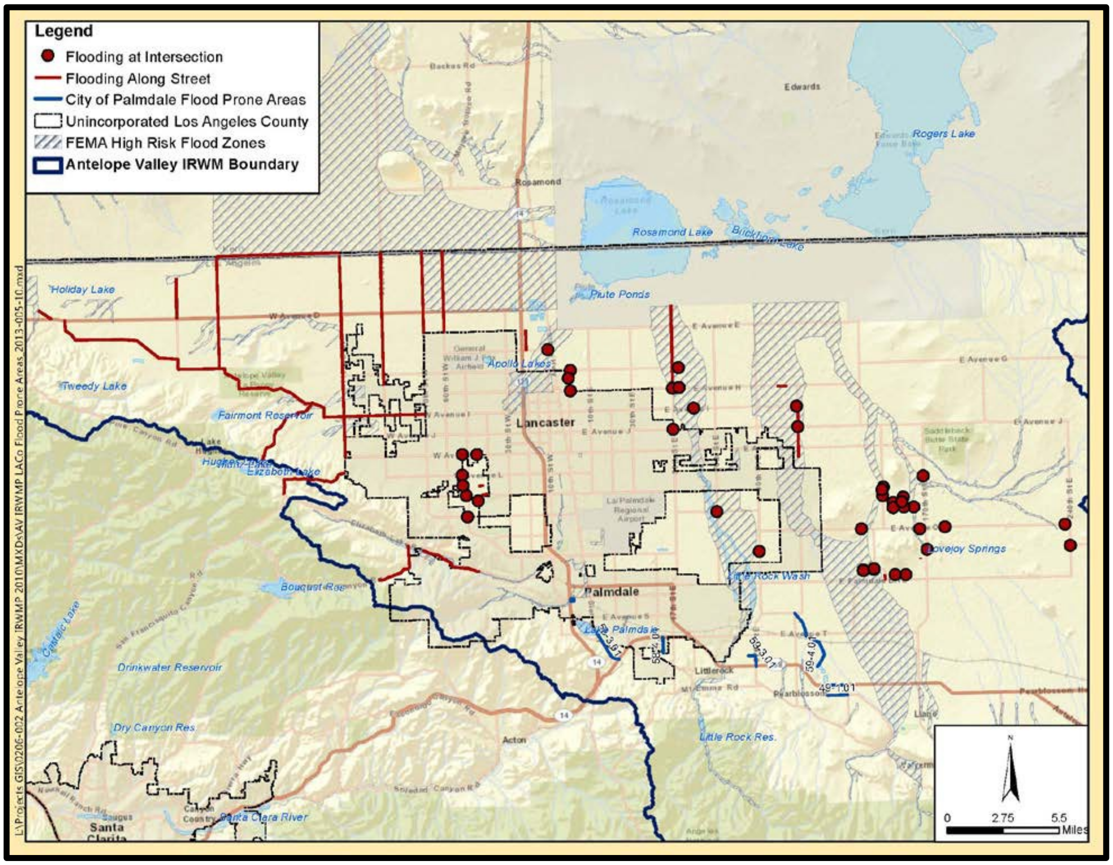
The existing published FEMA flood hazard mapping illustrates general characteristics of the floodplain and provides an understanding of the extent of the existing flood potential within the Valley (**Exhibit 9**). A critical item immediately apparent from the floodplain mapping is that the entire Edwards Air Force Base and Air Force Plant 42 areas are not part of the published mapping. This does not mean that the areas are not associated with flood hazards, only that mapping is not provided because it is located on federal lands, and those areas are not mapped.

Other general trends regarding the floodplain that can be deduced from the mapping include:

- Floodplains are very well-defined in the lower mountains/foothill areas where there are incised streams.
- Valley floor and alluvial fan areas result in vast floodplains with patterns of flow that redistribute and split to other channels downstream.
- Linear floodplain boundaries for locations of shallow flooding are present in several locations, but this appears to be associated with political boundaries and not necessarily with physical boundaries (this reflects different periods when the mapping was performed).

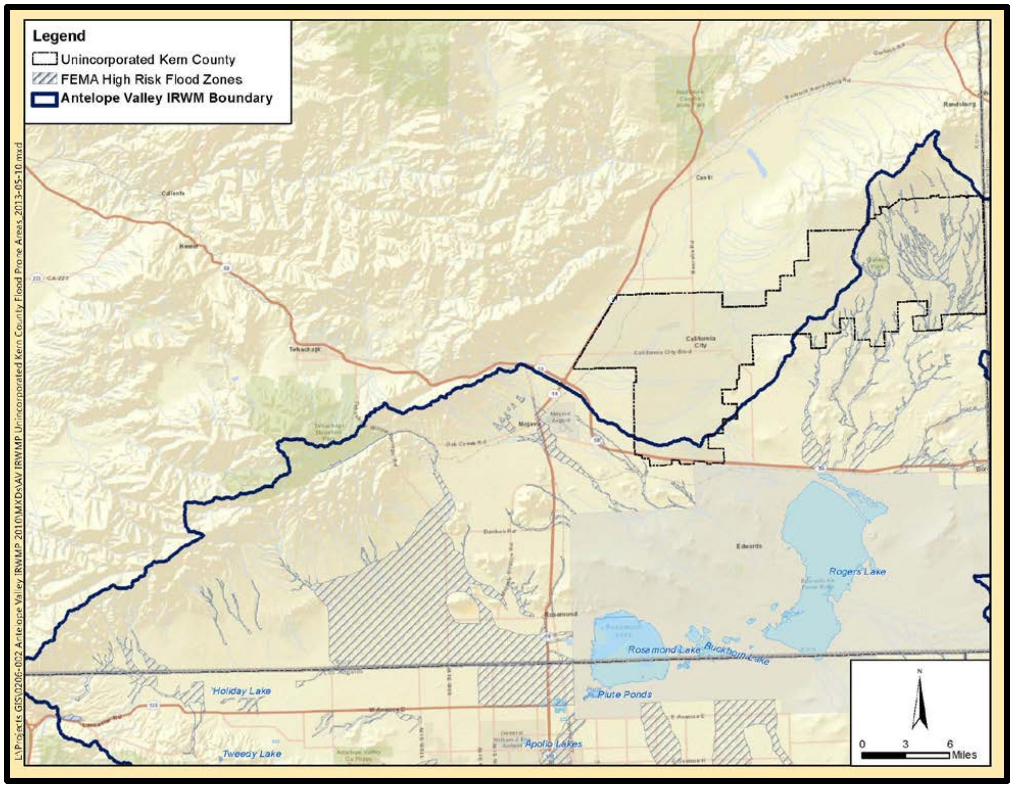
- Shallow flooding floodplains encompass urbanized portions of Palmdale and Lancaster.
- All the floodplains illustrate the general surface drainage patterns directed to the playas at Edwards Air Force Base. Uncertainties and discrepancies exist in the flood hazard mapping, particularly near local government boundaries with minimal hydraulic influences. The mapping should be used cautiously because of its approximate nature and because it does not necessarily define the magnitude of flooding.

Exhibit 10 - Localized Flooding Areas in Unincorporated Los Angeles County



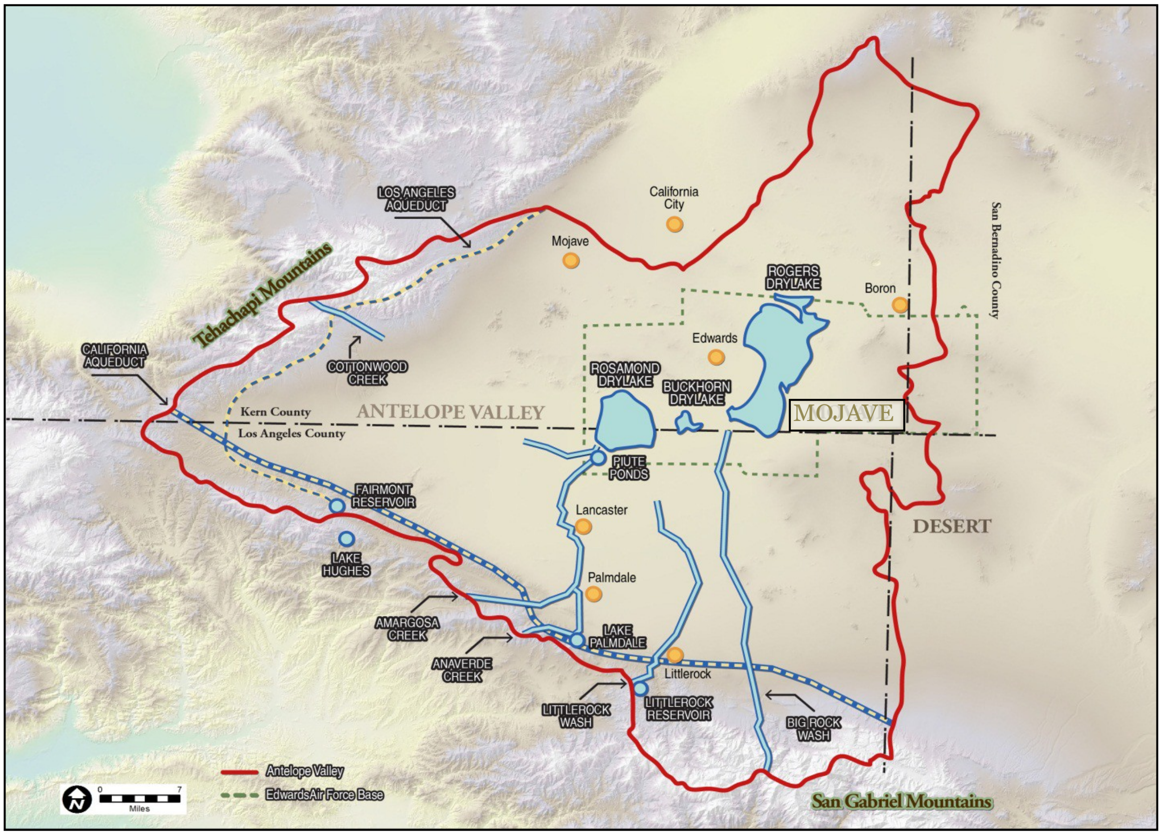
Source - Antelope Valley Integrated Regional Water Management Plan

Exhibit 11 - Localized Flooding Areas in Unincorporated Kern County



Source - Antelope Valley Integrated Regional Water Management Plan

Exhibit 12 - Boundary of Antelope Valley Watershed and Major Flood-Related Features



Source - Antelope Valley Integrated Regional Water Management Plan

Flood Zone Information

As part of the National Flood Insurance Program (NFIP), floodplain studies have been conducted for various communities in Los Angeles and Kern counties, including the areas in the Antelope Valley. The results of these studies are presented on Flood Insurance Rate Maps (FIRM), which identify 100 and 500-year floodplain boundaries.

Definition of Flood Hazard Risks

In the 1960s, the United States government decided to use the 1-percent annual exceedance probability (AEP) flood as the basis for the National Flood Insurance Program. The 1-percent AEP flood was thought to be a fair balance between protecting the public and overly stringent regulation. Because the 1-percent AEP flood has a 1 in 100 chance of being equaled or exceeded in any one year and has an average recurrence interval of 100 years, it is often referred to as the "100-year flood". More recently, people talk about larger floods, such as the "500-year flood," as tolerance for risk is reduced, and increased protection from flooding is desired. The "500-year flood" corresponds to an AEP of 0.2-percent, which means a flood of that size or greater has a 0.2-percent chance (or 1 in 500 chance) of occurring in a given year.

The following AVEK facilities are located in Zone Z, representing the 0.2% annual chance of flood.

Table 19 - AVEK Facilities in a Flood Zone (2%)

	Facility
1	80th and H Pump Station (SNIP South)
2	Bench Ranch Well Field
3	SNIP North Pump Station
4	Westside Water Bank and Well Field
5	Eastside Water Bank and Well Field

Past Occurrences

Severe storms that cause flooding have occurred numerous times over the years. Annual precipitation in Antelope Valley ranges from more than 20 inches in the mountains to less than 4 inches on the valley floor. Most precipitation in the valley falls during December through March, but cyclonic storms in the fall and convectional storms in the summer sometimes occur.

Table 20 - Historical Severe Storm Flooding Events

Year	Event
1825	L.A. River changed its course back from the Ballona wetlands to San Pedro
1832	Heavy flooding
1861-62	Heavy flooding. Fifty inches of rain falls during December and January.
1867	Floods create a large, temporary lake out to Ballona Creek.
1876	The Novician Deluge
1884	Heavy flooding causes the river to change course again, turning east to Vernon and then southward to San Pedro.
1914	Heavy flooding. Great damage to the harbor.
1934	Moderate flood starting January 1. Forty dead in La Canada.
1938	Great County-wide flood with 4 days of rain. Most rain on day 4.
1941-44	L.A. River floods five times.
1952	Moderate flooding
1969	One heavy flood after a 9-day storm. One moderate flood.
1978	Two moderate floods
1979	Los Angeles experiences severe flooding and mudslides.
1980	Flood tops banks of a river in Long Beach. Sepulveda Basin spillway almost opened.
1983	Flooding kills six people.
1992	15-year flood. Motorists trapped in Sepulveda basin. Six people dead.
1994	Heavy flooding
2005	First large flood in Los Angeles County since 1938. It centered in communities near the Los Angeles River or near creeks connected to the Los Angeles River. Three people were killed.
2009	Intense rainfall on mountain slopes denuded by the Station Fire triggered flows of mud, rock and boulders into a hillside community located in La Canada Flintridge.

Table 20 - Historical Severe Storm Flooding Events (Continued)

Year	Event
2010	A series of powerful Pacific winter storms fueled by El Nino conditions pounded Los Angeles County. They leashed mud and debris flows that prompted evacuations, flooded businesses, and downed trees and power lines.
2013	Heavy thunderstorms developed in the high desert. Radar estimated rainfall west of Victorville at seven inches.
2015	A severe storm swept through Southern California, causing mudslides to close portions of Interstate 5 and Hwy 58 near Mojave.

Probability of Future Occurrences

Severe storms and heavy rain are common in the Antelope Valley and most of Southern California. Therefore, they can be expected to reoccur on an ongoing basis during the winter months.

Climate Change Considerations

Climate change may increase the probability and intensity of rain and severe winter storms, which would increase the intensity of flooding in the Antelope Valley. Scientists have found that extreme precipitation events in California should become more frequent as the Earth's climate warms over this century. Researchers have developed a new technique that predicts the frequency of extreme rainfall events by identifying telltale large-scale patterns in atmospheric data. For California, they calculated that if the world's average temperatures rise by 4 degrees Celsius by the year 2100, the state will experience three more extreme precipitation events than the current average per year.

Vulnerability/Risk Assessment

The vast majority of AVEK's facilities are not located in a flood zone. Of the four that are in flood zones, they are limited to two pump stations and two well fields/water banks. Therefore, flood damage to these locations would be minimal. The remainder of the facilities are situated higher on or above the valley floor.

Localized flooding due to severe storms could occur in low-lying areas adjacent to the Agency's facilities, which could hamper transportation to and from these locations.

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4.6 Subsidence

Identifying Subsidence

Subsidence is the sinking or gradual downward settling of the ground's surface with little or no horizontal motion. The definition of subsidence is not restricted by the rate, magnitude, or area involved in the downward movement. It may be caused by natural processes or by human activities. The former include the thawing of permafrost, consolidation, oxidation of organic soils, slow crustal warping (isostatic adjustment), normal faulting, caldera subsidence, or withdrawal of fluid lava from beneath a solid crust. Human activities include sub-surface mining or extraction of underground fluids, e. g. petroleum, natural gas, or groundwater.

Groundwater-related subsidence is the subsidence (or the sinking) of land resulting from groundwater extraction. It is a growing problem in the developing world as cities increase in population and water use without adequate pumping regulation and enforcement. One estimate has 80% of serious land subsidence problems associated with groundwater extraction, making it a growing problem throughout the world. This is especially true in the Antelope Valley.

Earthquakes have been known to cause subsidence of the ground surface. When earthquakes occur, fractures are created that mark the fault lines along which the crust moved. Subsidence resulting from earthquakes can be caused by the downward vertical movement of one side of a fault. Depending on the length of the fault, the subsidence can affect extensive surface areas. Subsidence would also occur due to the effects of ground shaking. The shaking causes the loose particles to settle and lose their strength in bearing the particles on top of them.

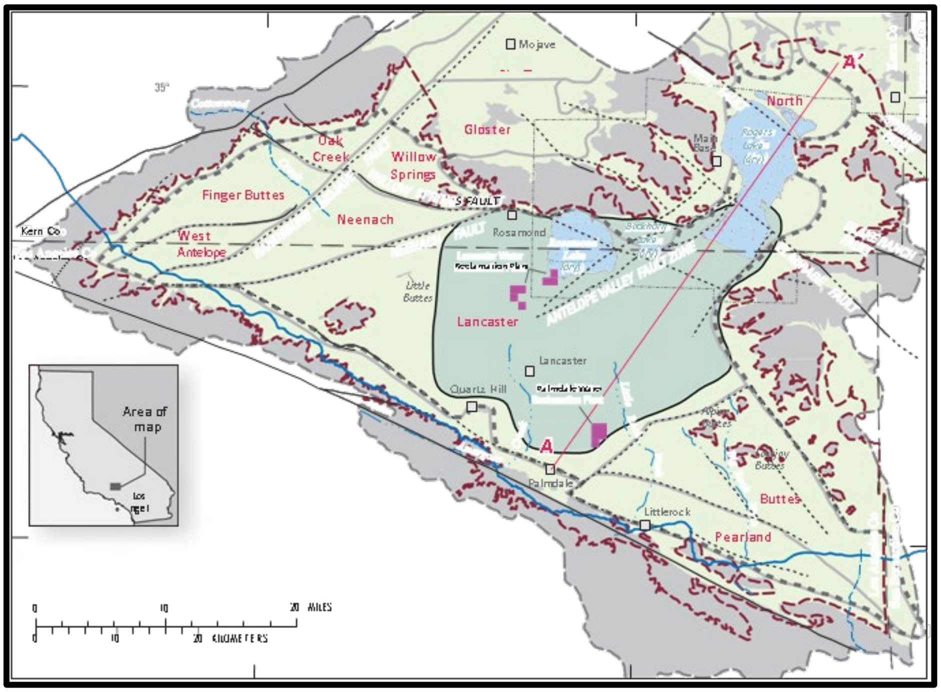
Mining methods that require digging tunnels in the ground to reach minerals (subsurface mining) are what causes subsidence. These mining methods employ processes like fracking, pillar extraction, the different caving, and longwall mining types, thus causing the collapse of the surface on top. Subsidence caused by mining can be predicted in terms of the strength and extent of damage except when a pillar collapses or a tunnel close to the surface falls in. This mainly occurs in extremely old mines. The manifestation extent to such subsidence is only in the immediate locality of the mines plus a minimal area around it.

Location and Extent

As stated, land subsidence is most often caused by human activities, mainly from the removal of subsurface water. This is what has occurred in the Antelope Valley throughout the years. Compaction of soils in some aquifer systems can accompany excessive groundwater pumping, and it is by far the single most significant cause of subsidence. Excessive pumping of such aquifer systems has resulted in permanent subsidence and related ground failures. In some systems, when large amounts of water are pumped, the subsoil compacts, thus reducing in size and number the open pore spaces in the soil the previously held water. This can result in a permanent reduction in the total storage capacity of the aquifer system.

The National Oceanic and Atmospheric Administration (NOAA) has come up with a way of measuring subsidence through the Global Positioning System (GPS). For this particular reason, NOAA has a body called the National Geodetic Survey that has put in place highly receptive GPS networks that keep track of the surface levels of different locations. These GPS networks are referred to as Continuously Operating Reference Station (CORS). However, some areas do not have CORS. In such cases, a technology that works with the satellite called the InSAR (Interferometric Synthetic Aperture Radar) can be used to track subsidence.

Exhibit 13 - Subsidence Map of Antelope Valley



Source - USGS Groundwater-Flow and Land-Subsidence Model of Antelope Valley, California

Past Occurrences

Before 1972, groundwater provided more than 90 percent of the total water supply in Antelope Valley. Since 1972, it has provided between 50 and 90 percent (the balance provided by imported surface water from the California Aqueduct). In 2015, after a 15-year legal battle, a Final Judgment was issued in the Antelope Valley Groundwater Basin Adjudication. This Judgment established the boundaries of the adjudicated basin, considered hydraulic connection throughout the basin, quantified groundwater production, and established the safe yield (the amount that can be safely pumped without resulting in subsidence). The Judgment documented overdraft conditions, established water rights among groundwater producers, and ordered a production ramp-down to the safe yield (2020 AV Watermaster Annual Report).

Probability of Future Occurrences

The likelihood of future subsidence due to overdraft of the Antelope Valley Groundwater Basin is low now that the basin is adjudicated. The Judgment established an Antelope Valley Watermaster Board of Directors to administer the Judgment. The Board hired a Watermaster Engineer, Attorney, and Administrative staff responsible for monitoring groundwater production within the basin, approving new production requests, reporting on groundwater use, and enforcing the Judgment. AVEK has a production right under the Judgment and uses water from the California Aqueduct to recharge, or "bank," water at its Westside and Eastside Water Bank locations during wet years when supply exceeds customer demand. The banked water can be recovered separately from the native production right, and recovery does not contribute to subsidence.

Climate Change Considerations

Sustained drought conditions may alter the rate of subsidence in the valley by limiting the supplemental supply from the California Aqueduct available for banking. The Judgment requires parties who pump without a right or who over pump beyond their production right to pay a replacement water fee. This fee supports the import of State Water Project water from the California Aqueduct to be banked within the groundwater basin to offset the amount pumped beyond the pumping right of the party. If no supplemental water supply is available, the over pumping could theoretically result in additional subsidence, though the long-term effects are likely to be minimal.

Vulnerability/Risk Assessment

Currently, subsidence poses a minimal threat to the Agency's facilities and pipelines.

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4.7 Water Resources

Background

Water supplied to AVEK is imported through California's State Water Project (SWP). The Agency's allocation is 144,844 acre-feet per year from the SWP. As stated in the introduction, they are the third-largest recipient of water from the Project. The SWP collects water from rivers in Northern California and redistributes it to the water-scarce but populous cities through a network of aqueducts, pumping stations, and power plants. About 70% of the water provided by the project is used for urban areas and industry in Southern California and the San Francisco Bay Area, and 30% is used for irrigation in the Central Valley. To reach Southern California, the water must be pumped 2,882 feet (878 m) over the Tehachapi Mountains, with 1,926 feet (587 m) at the Edmonston Pumping Plant alone the highest single water lift in the world. The SWP shares many facilities with the federal Central Valley Project (CVP), which primarily serves agricultural users. Water can be interchanged between SWP and CVP canals as needed to meet peak requirements for project constituents.

Since its inception in 1960, the SWP has required the construction of 21 dams and more than 700 miles of canals, pipelines, and tunnels. However, these constitute only a fraction of the facilities initially proposed. As a result, the project has only delivered an average of 2.4 million acre-feet annually compared to total entitlements of 4.23 million acre-feet. In addition, environmental concerns caused by the dry-season removal of water from the Sacramento - San Joaquin River Delta, a sensitive estuary region, have often led to further reductions in water delivery. As a result, work continues today to expand the SWP's water delivery capacity while finding solutions for the environmental impacts of water diversion.

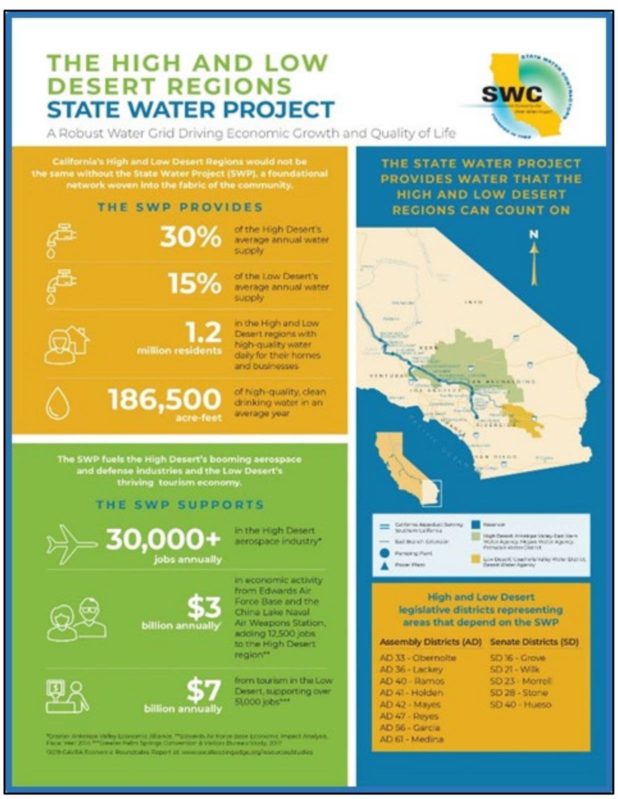

Figure 4 - State Water Project Fact Sheet
Source: DWR

The original purpose of the project was to provide water for arid Southern California. Their local water resources and share of the Colorado River were insufficient to sustain the region's growth. The SWP was rooted in two proposals. The United Western Investigation of 1951, a study by the U.S. Bureau of Reclamation, assessed the feasibility of interbasin water transfers in the Western United States. In California, this plan contemplated constructing dams on rivers draining to California's North Coast, the Klamath, Eel, Mad, and Smith River systems, and tunnels to carry the impounded water to the Sacramento River system it could be diverted southwards. In the same year, the SWP proposed the Feather River Project, which proposed the damming of the Feather River, a tributary of the Sacramento River, for the same purpose. The

Feather River was much more accessible than the North Coast rivers but did not have nearly as much water. Under both plans, a series of canals and pumps would carry the water south through the Central Valley to the foot of the Tehachapi Mountains, where it would pass through the Tehachapi Tunnel to reach Southern California.

Calls for a comprehensive statewide water management system led to creating the California Department of Water Resources in 1956. The following year, the preliminary studies were compiled into the extensive California Water Plan. The project was intended for the control, protection, conservation, distribution, and utilization of the waters of California, to meet present and future needs for all beneficial uses and purposes in all areas of the state to the maximum feasible extent.

In 1961, ground was broken on Oroville Dam, and in 1963, work began on the California Aqueduct and San Luis Reservoir. Due to concerns over the fault-ridden geography of the Tehachapi Mountains, the tunnel plan was scrapped, and the water would be pumped over the mountain. In 1973, the pumps and the East and West branches of the aqueduct were completed, and the first water was delivered to Southern California.

California Aqueduct

South of the Bay Area diversions, the bulk of the SWP water, ranging from 1 to 3.7 million acre-feet per year, travels south along the western flank of the San Joaquin Valley through the California Aqueduct. The main section of the aqueduct stretches for 304 miles. It is composed mainly of concrete-lined canals and includes 20.7 miles of tunnels, 130.4 miles of pipelines, and 27 miles of siphons. The aqueduct reaches a maximum width of 300 feet and a maximum depth of 30 feet. Some parts of the channel are capable of delivering more than 13,000 cubic feet a second. The section of the aqueduct that runs through the San Joaquin Valley includes multiple turnouts where water is released to irrigate roughly 750,000 acres of land on the west side of the valley.

Figure 5 - Dos Amigos Pumping Plant
Source: DWR

The aqueduct enters the O'Neill Forebay reservoir west of Volta, where water can be pumped into a giant off-stream storage facility, San Luis Reservoir, formed by the nearby B.F. Sisk Dam. San Luis Reservoir is shared by the SWP and the federal Central Valley Project. Here water can be switched between the California Aqueduct and Delta-Mendota Canal to cope with fluctuating demands. The SWP has a 50 percent share of the 2.04 million acre-feet of storage available in San Luis Reservoir.

South of the San Luis Reservoir complex, the aqueduct steadily gains elevation through a series of massive pumping plants. Dos Amigos Pumping Plant is located shortly south of San Luis, lifting the water 118 feet. Near Kettleman City, the Coastal Branch splits off from the central California Aqueduct. Buena Vista, Teerink and Chrisman Pumping Plants are located on the main aqueduct near the southern end of the San Joaquin Valley near Bakersfield. The aqueduct then reaches A.D. Edmonston Pumping Plant, which lifts the water 1,926 feet over the Tehachapi Mountains that separate the San Joaquin Valley from Southern California. It is the highest pump-lift in the SWP, with a capacity of 4,480 cubic feet/second across fourteen units.

Once reaching the crest of the Tehachapis, the aqueduct runs through a series of tunnels to the Tehachapi Afterbay, where its flow is partitioned between West and East Branches. The Coastal Branch diverts about 48,000 acre-feet per year from the California Aqueduct to San Luis Obispo and Santa Barbara counties. The aqueduct stretches for 143 miles and is mainly made up of buried pipelines. Pumping plants at Las Perillas, Badger Hill, Devil's Den, Bluestone, and Polonio Pass serve to lift the water over the California Coast Ranges. Once over the crest of the mountains, the water is reregulated in a series of small reservoirs numbered Tanks One through Five.

From the terminus of the main California Aqueduct at Tehachapi Afterbay, the West Branch carries water to a second reservoir, Quail Lake, via the Oso Pumping Plant. The water then runs south by gravity to the William E. Warne Powerplant, located on the 180,000 acre-feet Pyramid Lake reservoir. From Pyramid Lake, water is released through the Angeles Tunnel to the Castaic Power Plant on Elderberry Forebay and the 325,000 acre-feet Castaic Lake reservoir located north of Santa Clarita. Together, Pyramid and Castaic Lakes form the primary storage for West Branch water delivered to Southern California. Water is supplied to municipalities in Los Angeles and Ventura counties.

The East Branch takes water from Tehachapi Afterbay along the north side of the San Gabriel Mountains and San Bernardino Mountains to the Silverwood Lake reservoir, which can hold 73,000 acre-feet. From here, it passes through a tunnel under the San Bernardino Mountains to the Devil Canyon Powerplant, the largest "recovery plant," or aqueduct power plant, of the SWP system. The water then flows 28 miles through the Santa Ana Tunnel to Lake Perris, storing up to 131,400 acre-feet. The East Branch principally provides water for cities and farms in the Inland Empire, Orange County, and other areas south of Los Angeles. Through Lake Perris, the Metropolitan Water District of Southern California receives a large portion of its water from the SWP.

Past Occurrence

As stated in the **Landslide and Mudflow Hazard Assessment**, a landslide came down into the California Aqueduct during a severe storm in 2015. This caused a temporary reduction of water flow to the Agency's intakes. The blockage was cleared, and DWR made the repairs. There have been no other incidents of water disruption from the Aqueduct.

Probability of Future Occurrences

There are potential issues that could hamper the flow of water in the California Aqueduct. These include:

- Salt water intrusion into the Aqueduct at its source in the Delta. This is discussed in **Climate Change Considerations** noted below. Also, salt water intrusion could especially be an issue in drought years. Refer to the **Drought Hazard Assessment** in this section.

- Damage, either due to a malfunction or other human-caused event, at the pump stations along the Aqueduct's path. This could stop or hinder the flow of water in the Aqueduct.
- The possibility of another landslide into the Aqueduct due to an earthquake or a severe storm.
- A structural failure of the Aqueduct's structure causing a breach and significant loss of water flow anywhere along its path.
- A hazardous materials event, either accidental or human-caused, would pollute the Aqueduct's water and render it unusable or require additional treatment.

Climate Change Considerations

Climate change is already impacting water and other resources in California and will continue to do as California's population and demand for water increases. DWR has a Climate Change Team that works to educate staff and the public about the basics of climate science and how it relates to water management.

Temperature increases are already causing decreases in the snowpack. The mountain snowpack provides a third of California's water supply by accumulating snow during wet winters and releasing it slowly during our dry springs and summers. Warmer temperatures will melt the snow faster and earlier, making it more challenging to store and use throughout the dry season. By the end of this century, California's Sierra Nevada snowpack is projected to experience a 48-65% loss from the historical April 1st average. This significant decrease in snowpack has a direct impact on the water supply for Californians.

Climate change is expected to result in more variable weather patterns throughout California. More variability can lead to more prolonged and more severe droughts and floods, which present significant challenges to California's water supply.

Rising sea levels will bring more saltwater into the Sacramento-San Joaquin Delta, the heart of the California water supply system and the source of water for 25 million Californians and millions of acres of prime farmland. In order to keep the salt water out, more freshwater will need to be pushed through the Delta, decreasing the amount of water available for people who rely on it. The rising sea level also presents coastal flood hazards from storm surges and saltwater intrusion in coastal aquifers.

A critical destination for water captured and distributed by the State Water Project is agriculture, and it is not immune to climate change. California's agricultural economy developed under expectations of reasonably static hydrology. While a rise in average temperature and number of hot days may not be detrimental to crop production, a lack of adequate water sourcing and plant nutrition to combat these and other stressors may cause problems. Some regions in the state may benefit from warmer temperatures, as longer growing seasons could result in higher yields. Extreme weather, however, combined with water scarcity from droughts and increased pest species, can easily outweigh these benefits.

Less reliability of water sources due to climate change, in the face of increased population, poses grave challenges for the future of California agriculture. However, DWR has had several strategies available to mitigate and adapt to these challenges:

Mitigation: In the short term, mitigation will help minimize future climate change effects by reducing greenhouse gases (GHGs) emitted into the atmosphere. This can be accomplished by reducing on-farm energy, reducing methane release through nutrient and irrigation management plans, and implementing methane digestion systems as renewable energy sources. Lighting, pumps, and climate control systems are all potential areas in which energy consumption can be upgraded and made more efficient.

Adaptation: Agriculture can adapt to climate change by breeding for drought resistance and heat and inundation tolerance to help sustain through extreme periods. Genetic diversity would help reduce losses from disease and pests, and technological improvements can increase crop production while farmed land decreases.

Vulnerability/Risk Assessment

While the denial of water from the Aqueduct and the related issues mentioned are the responsibility of DWR, the Agency needs to be ready to take action on any of these that affect its ability to provide water to its customers. Having plans to deal with the potential denial issues are critical to the Agency's operations.

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4.8 Wildland Fire

Identifying Wildfire Hazards

Fire hazards threaten lives, property, and natural resources and present a considerable risk to vegetation and wildlife habitats. Fires occur in wildland and urban areas. A wildfire is an uncontrolled fire spreading through vegetative fuels. Wildfires can be caused by human error (such as campfires), intentionally by arson, by mechanical sources of ignition (such as heaters and generators), and by natural events (such as lightning). Wildfires often occur in forests or other areas with ample vegetation. In areas where structures and other human development meets or intermingles with wildland or vegetative fuels (referred to as the "wildland-urban interface"), wildfires can cause significant property damage and present extreme threats to public health and safety.

Urban fires, on the other hand, usually result from sources within structures themselves and are generally related to specific sites and structures. Therefore, the availability of firefighting services is essential to minimize losses that result from a fire. Effective fire protection in urban areas is based upon several factors, such as the age of structures, the efficiency of circulation routes (ultimately affects response times), and the availability of water resources to combat fires.

Location and Extent

Several areas have been identified as potential areas for urban interface brush fires. These areas are moderate in size ranging from several acres to dozens of acres in size. The majority of these identified areas are covered in light to moderate brush with topography ranging from gradual hillsides to steep hillsides. The fire department assessed the areas identified utilizing pre-fire planning, which accounts for access, water supply, and strategic operational planning.

There are three categories of interface fire:

- The classic wildland/urban interface exists where well-defined urban and suburban development presses up against open expanses of wildland areas.
- Isolated homes characterize the mixed wildland/urban interface, subdivisions, and small communities situated predominantly in wildland settings.
- The occluded wildland/urban interface exists where islands of wildland vegetation occur inside a primarily urbanized area.

Certain conditions must be present for significant interface fires to occur. The most common conditions include hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). In addition, once a fire has started, several conditions influence its behavior, including fuel topography, weather, drought, and development.

Southern California has two distinct areas of risk for wildland fire. The foothills and lower mountain areas are most often covered with scrub brush or chaparral. The higher elevations of mountains also have heavily forested terrain. The lower elevations covered with chaparral create one type of exposure.

One challenge Southern California faces regarding the wildfire hazard is the increasing number of houses built on the urban/wildland interface. Every year the growing population has expanded further into the hills and mountains, including forest lands. The increased "interface" between urban/suburban areas and the open spaces created by this expansion has significantly increased threats to life and property from fires. It has pushed existing fire protection systems beyond original or current design and capability. Property owners in the interface are not aware of the problems and threats they face. Therefore, many owners have done very little to manage or offset fire hazards or risks on their property. Furthermore, human activities increase the incidence of fire ignition and potential damage.

Figure 6 - Bobcat Fire above the Antelope Valley in 2020
Source - L.A. Times

Topography influences the movement of air, thereby directing a fire course. For example, if the percentage of uphill slope doubles, the rate of spread in wildfire will likely double. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Solar heating of dry, south-facing slopes produces up slope drafts that can complicate fire behavior. Unfortunately, hillsides with hazardous topographic characteristics are also desirable residential areas in many communities. This underscores the need for wildfire hazard mitigation and increased education and outreach to homeowners living in interface areas.

Weather patterns combined with specific geographic locations can create a favorable climate for wildfire activity. Areas where annual precipitation is less than 30 inches per year excessively fire susceptible. High-risk areas in Southern California share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. The so-called “Santa Ana” winds, which are heated by compression as they flow down to Southern California from Utah, create an exceptionally high risk, as they can rapidly spread what might otherwise be a small fire.

The Antelope Valley winters tend to lead to springs with annual growth of grasses and plants. This vegetation dries out during the hot summer months and is exposed to Santa Ana wind conditions in the fall. Winds in excess of 40 miles per hour are typical; gusts over 100 miles per hour may occur locally. In the Antelope Valley, these winds tend to travel from east to west. However, when combined with winds generated from burning vegetation, wind direction is likely to be highly erratic. Refer to **4.9 Windstorms** in this section.

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. Refer to the **4.1 Drought** in this section. Unusually dry winters, or significantly less rainfall than usual, can lead to relatively drier conditions and leave reservoirs and water tables lower.

Growth and development in scrubland and forested areas increase the number of human-made structures in Southern California interface areas. Wildfire affects development, yet development can also influence wildfire. Owners often prefer secluded homes that have scenic views and are nestled in vegetation using natural materials. A private setting may be far from public roads or hidden behind a narrow, curving driveway. These conditions, however, make evacuation and firefighting difficult. The scenic views found along mountain ridges can also mean areas of rugged topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel, leading a fire directly to the combustible fuels of the home itself.

Past Occurrences

In recent years, there has been a succession of wildland fires in the areas surrounding the Antelope Valley. In the past year, the Hughes Fire in the Leona Valley and the Bobcat Fire in the lower San Gabriel Mountains have occurred.

Probability of Future Occurrences

The hills and mountainous areas of Southern California are considered to be interface areas. The development of homes and other structures is encroaching onto the wildland and is expanding the wildland/urban interface. The interface neighborhoods are characterized by diverse housing structures, development patter, ornamental and natural vegetation, and natural fuels.

Continued development into the interface areas will have growing impacts on the wildland/urban interface. Periodically, the historical losses from wildfires in Southern California have been catastrophic, with deadly and expensive fires going back decades.

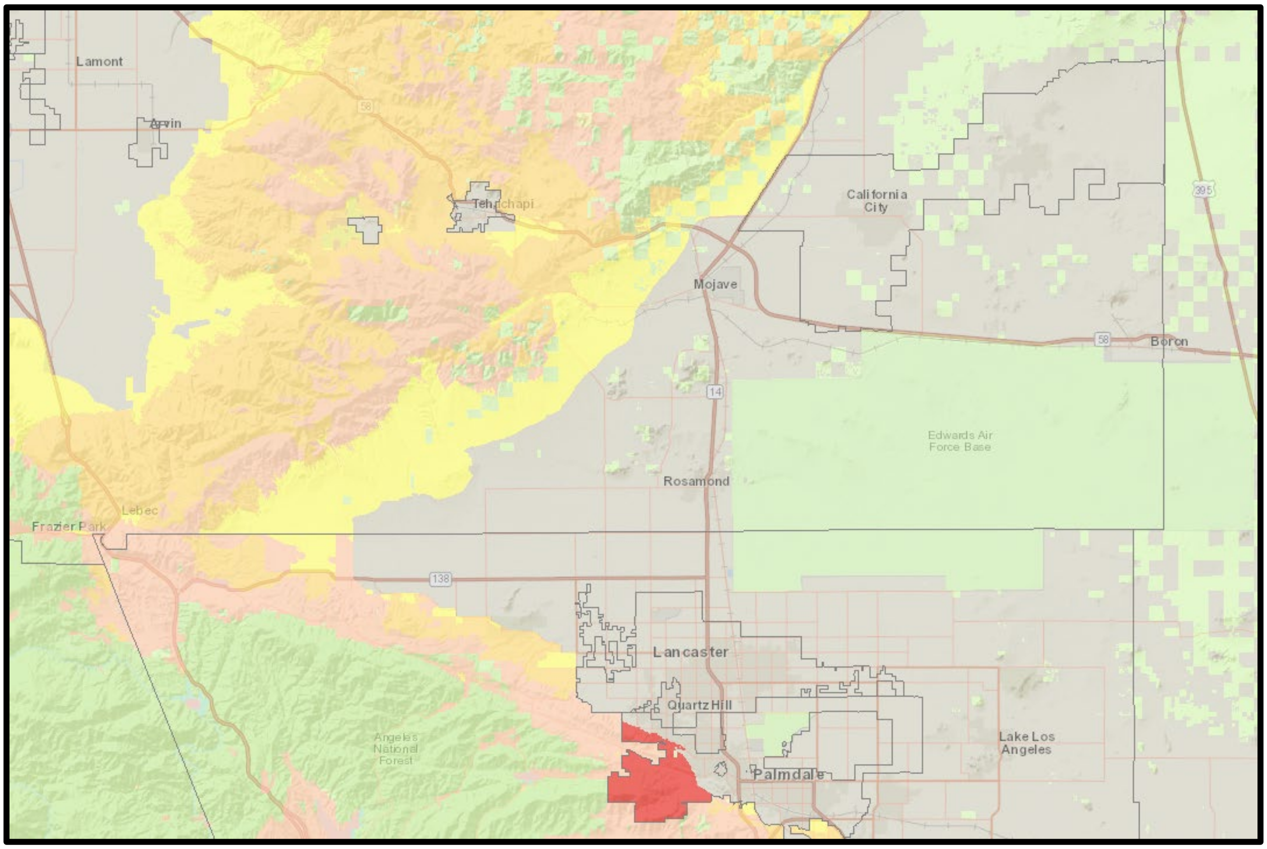
Climate Change Considerations

Anticipating that precipitation regimes may change in the future as a result of climate change, there may be greater opportunity for wildfire hazards throughout the State of California. In addition, increased future droughts and hotter temperatures could increase fuel loads within wildland interface areas, increasing the risk associated with fires.

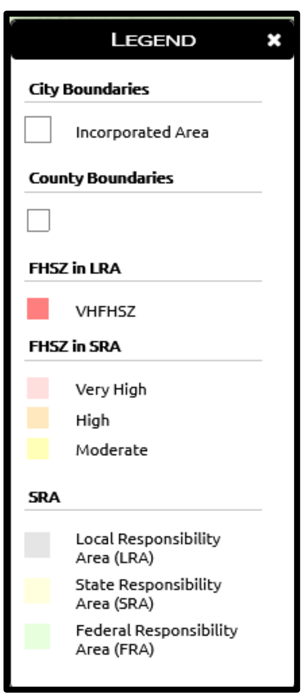
Vulnerability/Risk Assessment

While reviewing CalFire's Fire Resource Assessment Program's (FRAP) Fire Hazard Severity Map, the areas that include all of AVEKs facilities are not listed as either Very High, High, or Moderate fire risks. This is based on the facility's locations within the Antelope Valley area. However, areas adjacent to the Agency's Quartz Hill facilities, in particular, are listed as High or Very High due to their sloped grassland terrain. Refer to **Exhibit 14**.

Exhibit 14 - CalFire's Fire Resource Assessment Program's Fire Hazard Severity Map



Source: CalFire - Fire Resource Assessment Program



4.9 Windstorms

Identifying Windstorm Hazards

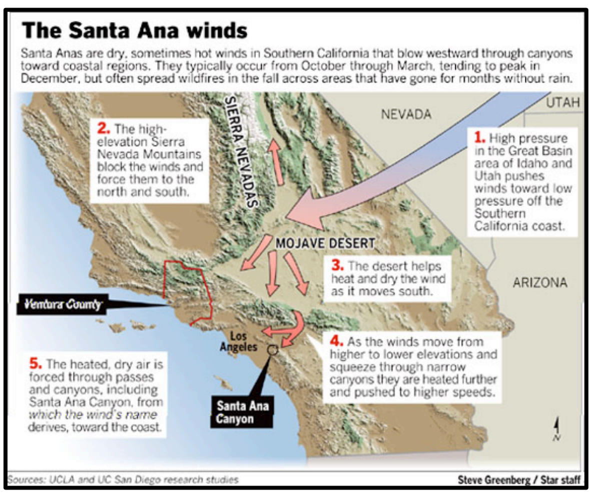
Winds are horizontal flows of air that blow from areas of high pressure to areas of low pressure. Wind strength depends on the difference between the high- and low-pressure systems and the distance between them. A steep pressure gradient results from a large pressure difference or a short distance between these systems and causes high winds. High winds are defined as those that last longer than 1 hour at greater than 39 miles per hour (mph) or for any length of time at greater than 57 mph.

Profiling Windstorm Hazards

Based on local history, most high winds in the Antelope Valley result from the Santa Ana wind conditions or those associated with severe storms. While high-impact incidents are not frequent in the area, significant Santa Ana Wind events and sporadic tornado activity have negatively impacted the local community.

What are Santa Ana Winds?

Exhibit 15 - Santa Ana Wind Causes



Source: Ventura County Star

Santa Ana winds are generally defined as warm, dry winds from the east or northeast (offshore). These winds occur below the passes and canyons of the coastal ranges of Southern California and in the Los Angeles basin. Santa Ana winds often blow with exceptional speed in the Santa Ana Canyon (the canyon from which it derives its name). Forecasters at the National Weather Service offices in Oxnard and San Diego usually place speed minimums on these winds and reserve the use of "Santa Ana" for winds greater than 25 knots. These winds accelerate to 35 knots as they move through canyons and passes, with gusts to 50 or even 60 knots.

The complex topography of Southern California combined with various atmospheric conditions create numerous scenarios that may cause widespread or isolated Santa Ana events. Commonly, Santa Ana winds develop when a region of high pressure builds over the Great Basin (the high plateau east of the Sierra Mountains and west of the Rocky Mountains, including most of Nevada and Utah). Clockwise circulation around the center of this high-pressure area forces air downslope from the high plateau. The air warms as it descends toward the California coast at the rate of 5 degrees Fahrenheit per 1000 feet due to compressional heating. Thus, compressional heating provides the primary source of warming. The air is dry since it originated in the desert, and it dries out even more as it is heated.

These regional winds typically occur from October to March and, according to most accounts, are named either for the Santa Ana River Valley where they originate or for the Santa Ana Canyon, southeast of Los Angeles, where they pick up speed.

Damage Extent

Based on the region's history, windstorm events can be expected, perhaps annually, across broad areas of the region. Therefore, the Antelope Valley and surrounding areas can be adversely impacted during a windstorm event. When severe windstorms strike the community, downed trees, power lines, and damaged property can be significant hindrances to Agency operations.

Perhaps the greatest danger from windstorm activity in Southern California comes from the Santa Ana winds, with the major fires occurring every few years in the urban/wildland interface. With the Santa Ana winds driving the flames, the speed and reach of the flames are even greater than in times of calm wind conditions. The higher fire hazard raised by a Santa Ana wind condition requires that even more care and attention be paid to proper brush clearances on property in the wildland/urban interface areas. Refer to the **4.8 Wildland Fire** in this section.

Transportation

Windstorm activity can impact local transportation in addition to the problems caused by downed trees and electrical wires blocking streets and highways. During powerful Santa Ana winds, major highways can be temporarily closed to truck and recreational vehicle traffic. However, typically these disruptions are not long-lasting, nor do they carry a severe long-term economic impact on the region. They can, however, disrupt day-to-day Agency operations.

Public Safety Power Shutoff (PSPS)

Over the last decade, California has experienced increased, intense, and record-breaking wildfires in Northern and Southern California. These fires have resulted in the devastating loss of life and billions of dollars in damage to property and infrastructure. Electric utility infrastructure has historically been responsible for less than ten percent of reported wildfires; however, fires attributed to power lines comprise roughly half of the most destructive fires in California history. With the continuing threat of wildfire, utilities may proactively cut power to electrical lines that may fail in certain weather conditions to reduce the likelihood that their infrastructure could cause or contribute to a wildfire. This effort to reduce the risk of fires caused by electric infrastructure by temporarily turning off power to specific areas is called a Public Safety Power Shutoff (PSPS). However, a PSPS can leave communities and essential facilities without power, which brings risks and hardships, particularly for vulnerable communities and individuals. From 2013 to the end of 2019, California experienced over 57,000 wildfires (averaging 8,000 per year), and the three large energy companies conducted 33 PSPS de-energizations.

In 2012, the California Public Utility Commission (CPUC) ruled that California Public Utilities Code Sections 451 and 399.2(a) give electric utilities authority to shut off the electric power to protect public safety. This allows the energy companies (SCE, SDG&E, PG&E, Liberty, Bear Valley, and PacifiCorp) to shut off power to prevent fires where strong winds, heat events, and related conditions are present.

In 2017, fires raged in Santa Rosa, Los Angeles, and Ventura, making it one of California's most devastating wildfire seasons. In response to the 2017 wildfires and Senate Bill (SB) 901, the Commission revised earlier guidelines on the de-energization of powerlines. The CPUC adopted the most current set of PSPS guidelines on June 5, 2020.

According to Southern California Edison (SCE), when there are potentially dangerous weather conditions in fire-prone areas, they may need to initiate a PSPS event. During these events, they will proactively turn off power in high fire risk areas to reduce the threat of wildfires. SCE has stated that they recognize that PSPS events create hardships for their customers and communities. The company is currently looking at opportunities to expedite grid hardening to reduce the need for PSPS events and the risk of wildfires. It is unknown how this will affect AVEK facilities going into the future. Currently, when a PSPS event occurs, AVEK personnel rely on facility-installed and mobile generators to power the treatment plants, pump stations, SCADA, and administrative buildings.

Past Occurrences

Windstorms have occurred numerous times in Southern California. One of the most damaging occurred in December of 2011 when a powerful windstorm deprived approximately 80,000 homes and businesses of power for three days in San Gabriel Valley communities. Residents remained without power in Pasadena, Temple City, San Marino, and Arcadia. This particular storm, a mutation of typical Santa Ana winds, hit the area with cold northerly winds instead of warm seasonal gusts. It knocked over numerous trees and broke power lines. More than 400,000 electric power customers throughout Los Angeles County lost power at the wind event's peak.

Probability of Future Occurrences

Due to its location, it is anticipated that the Antelope Valley will experience windstorms in the future. It is difficult to predict the amount of damage that could occur from a windstorm with great precision. Based on current modeling and information, most windstorms will follow the general patterns that have historically affected the Valley. However, what is difficult to predict far into the future is the intensity and duration of a storm. Understanding that windstorms will occur within the area, the Agency should determine potential vulnerabilities associated with a windstorm and mitigate these vulnerabilities effectively.

Climate Change Considerations

It is anticipated that wind patterns and windstorm development may be altered due to climate change. The resulting change could increase future storm intensity and duration and potentially change where these storms are generated. With this in mind, it will be necessary for AVEK to consider how anticipated changes in weather patterns may change future events and how they respond and mitigate hazards associated with windstorms.

Vulnerability/Risk Assessment

All of the Agency's facilities are susceptible to the effects of a windstorm and any associated damage. Besides a loss of electrical power, most windstorm damage is associated with blowing items or falling equipment. In addition, facilities located close to large trees or power poles may be more susceptible to windstorm damage. However, it is doubtful that a windstorm would severely damage or destroy any of the identified facilities.

4.10 Summary of Vulnerability

4.10.1 Significant Hazards

The vulnerability assessments within each hazard profile are used to understand the varying levels of risk to the Antelope Valley - East Kern Water Agency. Based on these assessments, LHMP planning personnel concluded the three hazards of most significant concern to the Agency are Earthquakes, the loss of Water Resources from the California Aqueduct, and electrical power loss related to Windstorms and PSPS events. For each of these hazards, all of AVEK's 38 critical facilities are susceptible. It should also be noted that all of the facilities could also be affected by hazardous and human-caused incidents, as well as windstorms and drought.

4.10.2 Planning Analysis by Facility

Using the CPRI Risk Assessment for the AVEK Service Area (refer to **Tables 9** and **10**) to determine the overall risks posed to the Agency by the hazards listed in **Table 8**, and the detailed assessment made for the Service area using the **Hazard Planning Analysis Worksheet** (**Table 11**), an analysis was made for each facility using the **Table 11** Worksheet. Worksheets for each facility are included in **Appendix Three**, **Hazard Planning Analysis Worksheets by Facility**.

Table 21 - Planning Consideration Assessments by Facility shows a summary of critical facilities that intersect with hazard areas for AVEK. Those facilities that intersect with a hazard area are indicated with an "**S**" for Severe, an "**M**" for Moderate Risk, and an "**L**" for Limited Risk. **N/A** notes that the hazard does not apply to that facility.

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Table 21 - Planning Consideration Assessments by Facility

	Facility	Drought	Earthquake	Hazardous Materials	Landslide & Mudflow	Severe Storms & Localized Flooding	Subsidence	Water Resource	Wildland Fire	Windstorm
1	Administration Building 1 and Laboratory	N/A	M	L	L	L	N/A	N/A	L	L
2	Administration Building 2 and Emergency	N/A	M	L	L	L	N/A	N/A	L	L
3	Quartz Hill Water Treatment Plant and Tanks	M	M	L	L	L	N/A	M	L	L
4	Rosamond Water Treatment Plant and Tanks	M	M	L	L	L	N/A	M	L	L
5	Eastside Water Treatment Plant and Tanks	M	M	L	L	L	N/A	M	L	L
6	Acton Water Treatment Plant and Tanks	M	M	L	L	L	N/A	M	L	L
7	Tejon North Pump Station	L	L	L	L	L	N/A	L	L	L
8	305th Street Pump Station	L	M	L	L	L	N/A	L	L	L
9	Tehachapi Pump Station	L	L	L	L	L	N/A	L	L	L

Hazard Planning Considerations: S - Significant Risk M - Moderate Risk L - Limited Risk N/A - Not Applicable

Table 21 - Planning Consideration Assessments by Facility (Continued)

	Facility	Drought	Earthquake	Hazardous Materials	Landslide & Mudflow	Severe Storms & Localized Flooding	Subsidence	Water Resource	Wildland Fire	Windstorm
10	Willow Pump Station	L	L	L	L	L	N/A	L	L	L
11	Leona Valley Pump Station	L	L	L	L	L	N/A	L	L	L
12	Vincent Pump Station	L	M	L	L	L	N/A	L	L	L
13	80th and H Pump Station (SNIP South)	L	L	L	L	L	L	L	L	L
14	SNIP North Pump Station	L	L	L	L	L	L	L	L	L
15	Mojave Pump Station	L	L	L	L	L	N/A	L	L	L
16	Edwards Pump Station	L	L	L	L	L	N/A	L	L	L
17	Boron Pump Station	L	L	L	L	L	N/A	L	L	L
18	Phillips Lab Pump Station	L	L	L	L	L	N/A	L	L	L

Hazard Planning Considerations: S - Significant Risk M - Moderate Risk L - Limited Risk N/A - Not Applicable

Table 21 - Planning Consideration Assessments by Facility (Continued)

	Facility	Drought	Earthquake	Hazardous Materials	Landslide & Mudflow	Severe Storms & Localized Flooding	Subsidence	Water Resource	Wildland Fire	Windstorm
19	Mojave 1 Tank	L	M	L	N/A	L	N/A	L	L	L
20	Mojave 2 Tank	L	M	L	N/A	L	N/A	L	L	L
21	Mojave 3 Tank	L	M	L	N/A	L	N/A	L	L	L
22	Mojave 4 Tank	L	M	L	N/A	L	N/A	L	L	L
23	Mojave Tank Service Building	L	M	L	N/A	L	N/A	L	L	L
24	Leona Valley Reservoir	L	M	L	N/A	L	N/A	L	L	L
25	Vincent Reservoir	L	M	L	L	L	N/A	L	L	L
26	Westside Water Bank and Well Field	M	L	L	N/A	L	L	M	L	L
27	Bench Ranch Well Field	M	L	L	N/A	L	L	M	L	L

Hazard Planning Considerations: S - Significant Risk M - Moderate Risk L - Limited Risk N/A - Not Applicable

Table 21- Planning Consideration Assessments by Facility (Continued)

	Facility	Drought	Earthquake	Hazardous Materials	Landslide & Mudflow	Severe Storms & Localized Flooding	Subsidence	Water Resource	Wildland Fire	Windstorm
28	Eastside Water Bank and Well Field	M	L	L	N/A	L	L	M	L	L
29	PWD Intertie	L	M	L	N/A	L	N/A	L	L	L
30	Willow Feeder	L	M	L	N/A	L	N/A	L	L	L
31	East Feeder	L	M	L	N/A	L	L	L	L	L
32	South Feeder	L	M	L	N/A	L	L	L	L	L
33	West Feeder	L	M	L	N/A	L	L	L	L	L
34	Central Feeder	L	M	L	N/A	L	L	L	L	L
35	Quartz Hill WTP Intake	M	M	L	L	L	N/A	M	L	L
36	Rosamond WTP Intake	M	M	L	L	L	N/A	M	L	L

Hazard Planning Considerations: S - Significant Risk M - Moderate Risk L - Limited Risk N/A - Not Applicable

Table 21- Planning Consideration Assessments by Facility (Continued)

	Facility	Drought	Earthquake	Hazardous Materials	Landslide & Mudflow	Severe Storms & Localized Flooding	Subsidence	Water Resource	Wildland Fire	Windstorm
37	Eastside WTP Intake	M	M	L	L	L	N/A	M	L	L
38	Action WTP Intake	M	M	L	L	L	N/A	M	L	L
39	**California Aqueduct**	M	M	L	M	L	N/A	M	L	L

Hazard Planning Considerations: S - Significant Risk M - Moderate Risk L - Limited Risk N/A - Not Applicable

4.10.3 Facilities Most at Risk

Table 22 - Facilities Most at Risk

Facility	Drought	Earthquake	Hazardous Materials	Landslide & Mudflow	Severe Storms & Localized Flooding	Subsidence	Water Resource	Wildland Fire	Windstorm
Quartz Hill Water Treatment Plant and Tanks	L	M	L	L	L	N/A	M	L	L
Rosamond Water Treatment Plant and Tanks	L	M	L	L	L	N/A	M	L	L
Eastside Water Treatment Plant and Tanks	L	M	L	L	L	N/A	M	L	L
Acton Water Treatment Plant and Tanks	L	M	L	L	L	N/A	M	L	L
Administration Building 2 and EOC	L	M	L	L	L	N/A	N/A	L	L
California Aqueduct	L	M	L	M	L	N/A	M	L	L

Hazard Planning Considerations: S - Significant Risk M - Moderate Risk L - Limited Risk N/A - Not Applicable

4.10.4 POTENTIAL LOSSES

Table 20 - Costliest Critical Facilities identifies the critical facilities with the highest replacement value (combination of building replacement and contents value) for AVEK. Should these facilities be destroyed by a hazard event, their replacement will be more costly than other identified critical facilities.

Table 23 - Costliest Critical Facilities

Facility	Replacement Value
Quartz Hill Water Treatment Plant and Tanks	$168,916,846
Westside Water Bank and Well Field	$60,000,000
Rosamond Water Treatment Plant and Tanks	$49,842,804
South Feeder	$40,000,000
Eastside Water Treatment Plant and Tanks	$38,468,046
West Feeder	$32,000,000
Acton Water Treatment Plant and Tanks	$21,366,476

4.11 History of Federally Declared Disasters

In order to put perspective into the hazards associated with each of the Agency's facilities and the potential for economic losses, the following table indicates federally declared disasters in the State of California since the year 1980.

Table 24 - List of Federally Declared Disasters in California from 1980 to 2021

ID #	Date	Description
4610	7/14/2021	California Wildfires
4569	10/16/2020	California Wildfires
4558	8/22/2020	Northern California Lightning Fires
5280	11/8/2018	Hill and Woolsey Fires
4407	11/8/2018	Camp Fire
5259	8/2/2018	Carr Fire
4353	1/2/2018	Santa Barbara and Ventura County Mudslides
5228	12/7/2017	Lilac Fire
5225	12/5/2017	Creek and Rye Fires
4396	12/8/2017	Thomas Wildfire
4344	10/9/2017	Sonoma and Napa Wildfires
4305	03/16/2017	Severe Winter Storms, Flooding, and Mudslides
4301	02/14/2017	Severe Winter Storms, Flooding, and Mudslides

Table 24 - List of Federally Declared Disasters in California from 1980 to 2021 (Continued)

ID #	Date	Description
4193	09/11/2014	Earthquake
4158	12/13/2013	Rim Fire
1968	04/18/2011	Tsunami Waves
1952	01/26/2011	Winter Storms, Flooding, and Debris and Mud Flows
1911	05/07/2010	Earthquake
1884	03/08/2010	Severe Winter Storms, Flooding, Debris & Mud Flows
1810	11/18/2008	Wildfires
1731	10/24/2007	Wildfires
1689	03/13/2007	Severe Freeze
1646	06/05/2006	Severe Storms, Flooding, Landslides, and Mudslides
1628	02/03/2006	Severe Storms, Flooding, Mudslides, and Landslides
1585	04/14/2005	Severe Storms, Flooding, Landslides, Mud & Debris Flows
1577	02/04/2005	Severe Storms, Flooding, Debris Flows, and Mudslides
1529	06/30/2004	Flooding As A Result Of a Levee Break
1505	01/13/2004	Earthquake
1498	10/27/2003	Wildfires
1342	09/14/2000	Earthquake
1267	02/09/1999	Severe Freeze
1203	02/09/1998	Severe Winter Storms and Flooding
1155	01/04/1997	Severe Storms/Flooding
1046	03/12/1995	Severe Winter Storms, Flooding, Landslides, Mud Flows
1044	01/10/1995	Severe Winter Storms, Flooding, Landslides, Mud Flows
1038	09/13/1994	El Nino Effect (The Salmon Industry)
1008	01/17/1994	Northridge Earthquake
1005	10/28/1993	Fires, Mud & Landslides, Soil Erosion, Flooding
979	02/03/1993	Severe Storm, Winter Storm, Mud & Landslides, Flooding
958	08/29/1992	Old Gulch, Fountain Fires
947	07/02/1992	Earthquake, Aftershocks
943	05/04/1992	Earthquake, Aftershocks

Table 24 - List of Federally Declared Disasters in California from 1980 to 2021 (Continued)

ID #	Date	Description
942	05/02/1992	Fire during a Period of Civil Unrest
935	02/25/1992	Snow Storm, Heavy Rain, High Winds, Flooding, Mudslide
919	10/22/1991	Oakland Hills Fire
894	02/11/1991	Severe Freeze
872	06/30/1990	Fires
845	10/18/1989	Loma Prieta Earthquake
815	09/29/1988	Wildfires
812	02/05/1988	Severe Storms, High Tides, Flooding
799	10/07/1987	Earthquake, Aftershocks
758	02/21/1986	Severe Storms, Flooding
739	07/18/1985	Grass, Wildlands, Forest Fires
690	09/22/1983	Flash Flooding
687	07/01/1983	Flooding
682	05/05/1983	Coalinga Earthquake
677	02/09/1983	Coastal Storms, Flooding, Slides, Tornadoes
669	09/24/1982	Levee Break
657	04/24/1982	Urban Fire
651	01/07/1982	Severe Storms, Flooding, Mudslides, High Tide
635	11/27/1980	Brush, Timber Fires
633	10/02/1980	Levee Break and Flooding
615	02/21/1980	Severe Storms, Flooding, Mudslides, Flooding

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Section Five - Hazard Mitigation Actions

5.1 Hazard Mitigation Overview

5.1.1 Hazard Mitigation Goals

The plan goals, presented in the **Mitigation Priorities and Goals** section of **Chapter 1**, serve as a basis for promoting sound public policy designed to protect critical facilities, infrastructure, and the environment from hazards. In addition, the Plan goals guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals also serve as checkpoints as agencies and organizations begin implementing mitigation action items. Refer to **Section 1.6**.

The hazard mitigation actions identified below list those activities which AVEK will utilize to reduce their risk to potential hazards. These mitigation actions were identified through the planning process with the Technical Advisory Committee and public input. Some of these actions may be eligible for funding through Federal and State grant programs and other funding sources as made available to the Agency. The mitigation actions are intended to address the comprehensive range of identified hazards. Some actions may address risk reduction from multiple hazards.

5.1.2 Hazard Mitigation Prioritization

The TAC used the STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) criteria through discussion and analysis, as described in **Table 25 - STAPLE/E Review and Selection Criteria**. This methodology (as endorsed by FEMA) requires that social, technical, administrative, political, legal, economic, and environmental considerations be considered when reviewing potential actions to undertake. This process was used to help ensure that the most equitable and feasible actions would be undertaken based on the Agency's capabilities.

Table 25 - STAPLE-E Review and Section Criteria

Social
• Is the proposed action socially acceptable to the jurisdiction and surrounding community? • Are there equity issues involved that would mean that one segment of the jurisdiction and/or community is treated unfairly? • Will the action cause social disruption?
Technical
• Will the proposed action work? • Will it create more problems than it solves? • Does it solve a problem or only a symptom? • Is it the most useful action in light of other jurisdiction goals?
Administrative
• Can the jurisdiction implement the action? • Is there someone to coordinate and lead the effort? • Is there sufficient funding, staff, and technical support available? • Are there ongoing administrative requirements that need to be met?
Political
• Is the action politically acceptable? • Is there public support both to implement and to maintain the project?
Legal
• Is the jurisdiction authorized to implement the proposed action? • Are there legal side effects? Could the activity be construed as a taking? • Will the jurisdiction be liable for action or lack of action? • Will the activity be challenged?
Economic
• What are the costs and benefits of this action? • Do the benefits exceed the costs? • Are initial, maintenance, and administrative costs taken into account? • Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)? • How will this action affect the fiscal capability of the jurisdiction? • What burden will this action place on the tax base or local economy? • What are the budget and revenue effects of this activity? • Does the action contribute to other jurisdiction goals? • What benefits will the action provide?
Environmental
• How will the action affect the environment? • Will the action need environmental regulatory approvals? • Will it meet local and state regulatory requirements? • Are endangered or threatened species likely to be affected?

5.1.3 Hazard Mitigation Benefit-Cost Review

A cost-benefit review was applied to prioritize the mitigation recommendations for implementation. The priority for implementing mitigation recommendations depends upon the recommendation's overall feasibility when considering monetary and non-monetary costs and benefits associated with each action. The cost-benefit table for each hazard analyzes the benefit, cost, and a relative priority rank (High, Medium, and Low) for each mitigation activity. The general guidelines are listed below.

- High - Benefits are perceived to exceed costs without further study or evaluation.
- Medium - Benefits are perceived to exceed costs but may require further study or evaluation before implementation.
- Low - Benefits and the associated costs require an additional evaluation prior to implementation.

Projects identified in this LHMP receiving funding, either from Agency resources or grant opportunities, shall be cost-effective and assist in efforts to help the Agency to mitigate or recover from disasters. Some of the projects identified are already funded through existing mechanisms, while others await evaluation and identification of potential funding sources. The majority of the projects are ongoing to ensure mitigation measures are implemented within the Agency. It is not anticipated that all future projects will be identified in this LHMP. The LHMP will help guide the Agency to prioritize, be flexible, and identify critical mitigation strategy needs that may arise from a disaster when there is no time to update the local plan.

It is also essential for the Agency to protect critical facilities and infrastructure. AVEK has a Capital Improvement Program in place (**Table 30**) and is actively working to protect facilities and infrastructure critical to the Agency.

Mitigation Funding Strategy

The Agency intends to fund mitigation activities deemed feasible to accomplish with a combination of AVEK budget funds and Federal and/or state grant funds when available. These funds could be from a variety of sources, including FEMA Pre-Disaster Mitigation Grant Funding (PDM), FEMA Hazard Mitigation Grant Program (HMGP) funding, Emergency Management Performance Grant (EMPG) program funds, and U.S. Bureau of Reclamation (USBR) funding. Refer to **Table 32**.

These grants will be investigated, and the Agency will apply for funding once a project has been identified as viable or, during the investigative phase, if funding is available to assist with those associated costs. In addition, the AVEK TAC will facilitate and monitor grant funding opportunities as they arise and report on grant applications' outcomes as part of the annual reporting required under the LHMP.

5.2 Hazard Mitigation Actions

The process used by the AVEK Technical Advisory Committee to identify hazard mitigation actions for this Plan included the review of the Agency's hazard assessment presented in **Section Four** and a discussion of concerns and issues to reduce hazards to critical facilities and infrastructure.

Multi-hazard action items are those activities that pertain to two or more of the nine hazards in the mitigation plan: Drought, Earthquake, Hazardous Materials, Landslide and Mudflow, Severe Storms and Localized Flooding, Water Resource, Wildland Fire, and Windstorm.

Table 26 - AVEK 2021 Hazard Mitigation Actions

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
1. Multi-Hazard Related Actions					
A. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Establish an Agency Emergency Operations Center in the lower level of the older Administration Building.	Capital Improvement Program	January 31, 2023	High
B. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Improve communications and emergency response capabilities by improving the Agency's radio system.	General Fund	January 31, 2023	High
C. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Improve facility security by upgrading the SCADA software and remote video camera system.	Capital Improvement Program	January 31, 2023	Medium
D. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Installation of a fueling system in the Agency's Maintenance Building.	Capital Improvement Program	June 30, 2024	Medium
E. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Purchase of a fuel transportation trailer to be used in refueling generators at remote facilities.	Capital Improvement Program	June 30, 2024	Medium
E. Increase the ability of the Agency to serve the community during and after hazard events.	Maintain emergency response training	Advanced Standardized Emergency Management System and Incident Command System training for Agency personnel.	General Fund	January 31, 2023	Medium

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
2. Drought Related Actions					
A. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Update drought contingency planning in the Agency's Urban Water Plan.	General Fund	December 31, 2021	Medium
B. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Participate in Phase II of the High Desert Water Bank aqueduct pump-back program	Capital Improvement Program	June 30, 2027	Medium
C. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Complete the SNIP Phase II project.	Capital Improvement Program	June 30, 2025	High
D. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Complete the High Desert Water Bank Project.	Capital Improvement Program	June 30, 2027	Medium
E. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Ongoing communication with the Department of Water Resources regarding drought related issues surrounding the California Aqueduct.	General Fund	June 30, 2023	High

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
3. Earthquake Related Actions					
A. Avoid or reduce the potential for loss of life, injury, and economic damage to the public and Agency employees from earthquakes, floods, drought, landslides, and other geological hazards.	Secure appropriate water supplies to meet the Agency's goals.	Improve earthquake resistance at Agency water storage facilities.	Capital Improvement Program	June 30, 2027	Medium
B. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Purchase and storage of emergency equipment, materials, and supplies that would be needed following a major earthquake.	General Fund	June 30, 2025	Medium
C. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Mutual Aid response planning with other area water agencies.	General Fund	December 31, 2022	High
D. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Participate in the Great California Shakeout exercise conducted annually by CalOES.	General Fund	December 31, 2022	Medium

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
4. Hazardous Materials Actions					
A. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Ongoing training and inspection of Hazardous Materials storage throughout Agency facilities.	General Fund	June 30, 2023	High

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
5. Landslide and Mudflow Actions					
A. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Ongoing communication with the Department of Water Resources regarding landslide related issues surrounding the California Aqueduct.	General Fund	June 30, 2023	Medium

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
6. Severe Storms and Localized Flooding					
A. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Increase the ability of staff to monitor weather and flood conditions in order to more accurately forecast the impacts of these events on Agency operations.	General Fund	June 30, 2024	Medium
B. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Replace the roof on the older Administration Building to prevent internal flooding of the Emergency Operations Center located on the lower level.	Capital Improvement Program	June 30, 2025	Medium

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
7. Subsidence					
A. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Ongoing communication with the Department of Water Resources regarding subsidence issues related to the California Aqueduct.	General Fund	June 30, 2024	Low

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
8. Water Resource					
A. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Ongoing communication with the Department of Water Resources regarding Hazard Mitigation issues related to the California Aqueduct.	General Fund	June 30, 2023	Medium
B. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Ongoing support of the Agency's Water Banking operations.	General Fund	June 30, 2027	High
C. Provide a level of regional water reliability that supports customers' water needs.	Secure appropriate water supplies to meet the Agency's goals.	Acquisition of local water rights to supplement those provided by the Department of Water Resources.	Grant Funding	June 30, 2023	High

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
9. Wildland Fire					
A. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Ongoing brush removal operations in the areas surrounding Agency facilities.	General Fund	June 30, 2023	Medium
B. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Increase the ability of staff to monitor local fire activity in order to more accurately forecast impacts on Agency operations.	General Fund	June 30, 2024	Medium

Table 26 - AVEK Hazard Mitigation Actions (Continued)

Goal	Objective	Mitigation Action	Potential Funding Source (Table 31)	Target Completion Date	Priority
10. Windstorms					
A. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Develop electrical denial planning and training related to extended outages due to Public Safety Power Shutoffs.	General Fund	June 30, 2023	Medium
B. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Increase the ability of staff to monitor local wind activity in order to more accurately forecast impacts on Agency operations.	General Fund	June 30, 2023	Medium
C. Increase the ability of the Agency to serve the community during and after hazard events.	Enable Agency staff to respond to disaster-related emergencies.	Develop a plan for the purchase and use of portable generators at pump stations and wells during times of power disruption.	Capital Improvement Program	June 30, 2024	High

5.3 Planning and Regulatory Capabilities Assessment

This capability assessment is designed to identify existing local agencies, personnel, planning tools, public policy and programs, technology, and funds to support hazard mitigation activities and strategies outlined in this LHMP. To create this capability assessment, the Technical Advisory

Committee collaborated to identify current local capabilities and mechanisms available to the Agency for reducing damage from future natural hazard events. These plans and resources were reviewed while developing the Local Hazard Mitigation Plan and summarized below.

Key Resources

The Antelope Valley - East Kern Water Agency has departments with resources to support mitigation actions. These departments offer various planning, technical, policy, and staffing resources, summarized in **Table 27: AVEK Planning Capabilities Assessment.**

Table 27 - AVEK Planning Capabilities Assessment

Resource Type	Resource Name	Ability to Support Mitigation
Personnel Resource	Administration Staff	Plans, develops, organizes, implements, directs, and evaluates the Agency's fiscal and operational functions and performance.
Personnel Resource	General Manager	Supports the development and implementation of this Local Hazard Mitigation Plan by allocating the appropriate personnel and resources.
Policy and Plan Resource	Capital Improvement Plan	The Capital Improvement Program should be informed by the strategies identified and prioritized in this plan.

Table 27 - AVEK Capabilities Assessment (Continued)

Resource Type	Resource Name	Ability to Support Mitigation
Technical Resource	Operations Staff	Plans, organizes, and directs all maintenance and operations work of staff assigned to water treatment plants, water banking facilities, and agency distribution systems.
Personnel Resource	Manager of Operations	Participates in the development and implementation of this Hazard Mitigation Plan.
Technical Resource	Engineering Staff	Plans, coordinates, and manages the engineering operations of the agency.
Personnel Resource	Engineering Manager	Participates in the development and implementation of this Hazard Mitigation Plan.
Personnel Resource	Water Resources Manager	Prepares and maintains a short and long-term Water Resources Plan for the Agency to improve water supply management of imported and local water
Technical Resource	Laboratory	Responsible for all analytical and operational activities, and quality and accuracy of data from the laboratory, including those of any auxiliary facilities.
Financial Resource	Finance & Administration	Oversees all aspects of the Agency's financial and administrative functions including audits, investment portfolios, and payroll and benefits administration.
Personnel Resource	Manager of Finance & Administration	Participates in the development and implementation of this Hazard Mitigation Plan.
Plan Resource	*draft* Master Plan	The *draft* Master Plan provides a vision for the Agency that supports realistic planning documents, solid financial policies, the implementation of stated goals, and the Agency's accomplishments and progress toward these goals.
Policy Resource	Board of Directors	Policy approval, legislation, and implementation

Table 28 - Outside Agency Capabilities

Resource Type	Resource Name	Ability to Support Mitigation	Web Address (URL)
Outside Agencies Within Los Angeles County			
Los Angeles County Department of Public Works			
Plan Resource	Planning Agency	Responsible for oversight of various public infrastructure programs.	https://pw.lacounty.gov
Los Angeles County Flood Control District			
Technical Resource	Flood Control	Organization charged with coordinating flood control issues in Los Angeles County.	http://ladpw.org/LACFCD/index.cfm
Sanitation Districts of Los Angeles County			
Technical Resource	Wastewater Collection and Treatment	The Sanitation Districts provide wastewater and solid waste management for over half the population of Los Angeles County.	http://www.lacsd.org/default.asp
Los Angeles County Office of Emergency Management			
Plan Resource	Operational Area Emergency Management Plan	Overall emergency management plan for the Los Angeles County Operational Area.	http://lacoa.org/aboutoem.html
Southern California Earthquake Center			
Technical Resource	Earthquake Planning	Regional Earthquake planning and technical resource organization.	https://www.scec.org/
Southern California Association of Governments			
Plan Resource	Planning Organization	SCAG is a planning organization, representing six counties, 191 cities, and more than 18 million residents.	http://www.scag.ca.gov/Pages/default.aspx

Table 28 - Outside Agency Capabilities (Continued)

Resource Type	Resource Name	Ability to Support Mitigation	Web Address (URL)
State Agencies			
California Office of Emergency Services (CalOES)			
Plan Resource	Planning Organization	State of California's emergency management agency. Assists with mitigation plans and training.	http://www.caloes.ca.gov/home
California Department of Transportation (CalTrans)			
Technical Resource	Transportation Agency	State of California's transportation agency. Assists with emergency management plans.	http://www.dot.ca.gov/
California Department of Forestry and Protection (CalFire)			
Technical Resource	Fire Protection Agency	The California Department of Forestry and Fire Protection protects over 31 million acres of California's privately-owned wildlands.	http://www.fire.ca.gov/
California State Water Resources Control Board (SWRCB)			
Technical Resource	Water Regulatory Agency	The Control Boards are dedicated to a single vision of abundant clean water for human uses and environmental protection to sustain California's future.	https://www.waterboards.ca.gov/
California Department of Water Resources (DWR)			
Technical Resource	Water Regulatory Agency	The Department of Water Resources manages the water resources of California in cooperation with other agencies.	http://www.water.ca.gov/
California Natural Resources Agency			
Technical Resource	Natural Resource Agency	The Agency restores, protects, and manages the state's natural, historical and cultural resources.	http://resources.ca.gov/

Table 28 - Outside Agency Capabilities (Continued)

Resource Type	Resource Name	Ability to Support Mitigation	Web Address (URL)
		Federal Agencies	
Federal Emergency Management Agency Region IX (FEMA)			
Plan Resource	Planning Organization	Responsible for the federal government's response to disasters.	https://www.fema.gov/fema-region-ix-arizona-california-hawaii-nevada-pacific-islands
Federal Emergency Management Agency Mitigation Division (FEMA)			
Plan Resource	Planning Organization	FEMA's division that assists with mitigation plans and training.	https://www.fema.gov/hazard-mitigation-assistance
United States Geological Survey (USGS)			
Technical Resource	Geological Agency	The Agency provides reliable scientific information to describe and understand the Earth and minimize loss of life and property from natural disasters.	https://www.usgs.gov/
National Oceanic and Atmospheric Administration (NOAA)			
Technical Resource	Atmospheric Agency	Makes weather predictions related to rain and drought conditions.	http://www.noaa.gov/
National Weather Service (NWS)			
Technical Resource	Weather Agency	Is charged with the responsibility of observing and reporting the weather and issuing forecasts and warnings of weather and floods in the interest of national safety and economy.	http://www.weather.gov/
US Environment Protection Agency (EPA)			
Technical Resource	Regulatory Agency	Is responsible for protecting human health and the environment.	https://www.epa.gov

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5.4 Organizational Capabilities Assessment

The following summarizes AVEK's organizational capabilities in terms of the Agency's resources and allocated spending. The General Fund and Enterprise accounts are the primary sources of the Agency's financial resources. The Agency has allocated the majority of these financial resources to its Administration, Operations, Engineering, Water Resources, Laboratory, and Finance & Administration sections. These sections are all relevant for implementing hazard mitigation actions. The functions of Agency departments include:

Table 29 - AVEK Department Responsibilities

Department	Responsibilities
Administration	• Plan, develop, organize, implement, direct, and evaluate the Agency's fiscal and operational functions and performance. • Ensure compliance with applicable regulations, laws, and governing authorities. • Participate in the development of plans and programs as a strategic partner. Develop policies, procedures, and Agency directives. • Conduct and/or oversee specific activities that contribute to the preservation and improvement of the quality and efficiency of services provided. • Develop and make recommendations to the Board of Directors on any policies and other matters requiring their consideration and approval, and provide supporting information as necessary, to enable the Board to properly evaluate recommendations. • Report to the Board on staff and business changes, change in Agency structure, and any significant water legislation changes. • Implement Board-adopted policies and directives.
Operations	• Plans, organizes, and directs all maintenance and operations work of staff assigned to water treatment plants, water banking facilities, and agency distribution systems. • Maintains continuous awareness of administrative practices, including water delivery, and coordination of construction and recommends changes that increase the efficiency and economy of Agency operations. • Plans, assigns, supervises, and reviews the work of staff. Hires staff. Determines need for training, and schedules and monitors workloads. • Assists in overseeing the development of engineering plans and specifications and makes suggestions regarding the planning of new facilities.
Engineering	• Plans, coordinates, and manages the engineering operations of the agency. • Coordinates the progress, inspection, and proper completion of construction projects. • Oversees the development and administration of project-related contracts. • Directs and reviews the work of professional consultants and technical engineering staff. • Provides staff assistance to the General Manager and the Board of Directors; prepares and presents staff reports.

Table 29 - AVEK Department Responsibilities (Continued)

Department	Responsibilities
Engineering (Continued)	• Plans, coordinates, and manages the engineering operations of the agency. • Coordinates the progress, inspection, and proper completion of construction projects. • Oversees the development and administration of project-related contracts. • Directs and reviews the work of professional consultants and technical engineering staff. • Provides staff assistance to the General Manager and the Board of Directors; prepares and presents staff reports, and other necessary correspondence.
Water Resources	• Prepares and maintains a short and long-term Water Resources Plan for the Agency toimprove water supply management of imported and local water supplies; identifies projects that will address long-term water resource needs. • Conducts water resources planning which includes: State Water Project importedsupplies, local banking supplies and local groundwater. • Predicts and quantifies the quantity of water resources available to meet customerdemands. • Identifies and recommends alternative water resources that might be acquired to meetcustomer demand short falls in supply. • Prepares, maintains, and submits to DWR all necessary water delivery schedules, tracks monthly SWP deliveries, tracks and recommends other supplemental water resources that might become available. • Oversees special projects related to local partnerships.
Laboratory	• Responsible for all analytical and operational activities, and quality and accuracy of data from the laboratory, including those of any auxiliary facilities. • Plans, assigns, supervises, and reviews the work of staff assigned to the Agency's public laboratory and any auxiliary facilities. Determines need for training, and schedules and monitors workload. • Administers the laboratory's TNI compliant quality system and the data integrity program. • Responsible for proper operations and maintenance of laboratory equipment. • Monitors drinking water regulatory changes and helps Agency maintain compliance with all regulations. • Monitors Department of Water Resources' State Water Project databases and real-time data to forecast influent water quality changes. • Advises the public on current drinking water regulations.
Finance & Administration	• Oversees all aspects of the Agency's financial and administrative functions including audits, investment portfolios, and payroll and benefits administration. • Plans, organizes, and coordinates daily accounting functions and assignments. • Plans, assigns, supervises, and reviews the work of staff. Determines need for training, and schedules and monitors workload. • Maintains General Ledger. • Records control of receipts and expenditures.

Capital Improvement Program

AVEK has planned $61.6 million in inflation-adjusted capital expenditures ($58.7 million in current dollars) over the five-year study period. A significant portion of the Agency's capital program is attributed to the South-North Intertie Project (SNIP) Phase II construction project ($26.0 million in current dollars). The Agency anticipates funding capital improvements with rate revenues and cash reserves. **Table 30** shows each line item in the capital improvement program, adjusted for inflation based on the Capital Projects inflationary factor of 3 percent per year.

Table 30 - AVEK Capital Improvement Program Projects FY 2021 to FY 2025

Capital Projects	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
Eastside Water Bank Expansion	$2,750,000	$515,000	$0	$0	$0
Asset Replacement	$1,500,000	$1,545,000	$1,591,350	$1,912,272	$2,251,018
Big Rock Creek Recharge	$100,000	$515,000	$0	$0	$0
GAC Replacement	$1,350,000	$721,000	$0	$0	$0
Westside Water Bank – Distribution Piping	$150,000	$4,635,000	$0	$0	$0
Vehicles/Heavy Equipment	$305,000	$128,750	$159,135	$163,909	$168,826
Information Technology/SCADA	$1,000,000	$1,287,500	$530,450	$0	$0
Upper Armargosa Recharge Project	$1,450,000	$0	$0	$0	$0
Flow Meters Replacement	$75,000	$103,000	$106,090	$109,273	$112,551
Leona Valley Storage Tank - Rehabilitation	$650,000	$0	$0	$0	$0
Existing Admin Building – Repurposing	$550,000	$103,000	$0	$0	$0
SNIP/RWTP Clearwell Intertie	$150,000	$0	$0	$0	$0
Well Rehabilitation	$0	$412,000	$477,405	$546,364	$619,030
SNIP Phase II – Final Design	$300,000	$0	$0	$0	$0
New Shop Buildings / Storage	$750,000	$257,500	$0	$0	$0
Emergency Generators & Transfer Switches	$215,000	$128,750	$132,613	$0	$0
48-Inch Parallel Pipeline @ QHWTP	$0	$103,000	$530,450	$0	$0
SNIP Phase II - Construction	$0	$8,926,667	$9,194,467	$9,470,301	$0
Replacement Lab Equipment	$150,000	$0	$53,045	$0	$84,413
Vehicle Lease Program	$95,000	$128,750	$132,613	$136,591	$140,689
Westside Water Bank - Additional Well Capacity	$0	$0	$0	$273,182	$1,688,263
Total Capital Projects	**$11,540,000**	**$19,509,917**	**$12,907,617**	**$12,611,891**	**$5,064,790**

Agency Funding Sources

There may be funding sources available in AVEK's regularly budgeted accounts. Examples of these are noted in **Table 31**.

Table 31 - Internal Agency Funding Sources

Agency Fund	Potential Mitigation Actions
General Fund	Ongoing Programs
Capital Improvement Program	Capital Projects
Grant Funding	New Projects and Programs
Impact Fees (Capacity Fees)	New Projects and Programs
Enterprise Account	Ongoing Programs
Bond Measures	Capital Projects and Programs

As noted in **5.1.3**, **Hazard Mitigation Benefit-Cost Review**, there at potential outside funding sources for mitigation measures. These include:

Table 32 - Potential Outside Funding Sources

Acronym	Funding Source Name
PDM	Pre-Disaster Mitigation (FEMA)
HMGP	Hazard Mitigation Grant Program (FEMA)
CDBG	Community Development Block Grants
FMA	Flood Mitigation Assistance (FEMA)
EMPG	Emergency Management Performance Grants
CalOES	California Office of Emergency Service
USBR	U.S. Bureau of Reclamation
DWR	California Department of Water Resources

5.5 Implementation Through Existing Programs

The effectiveness of the Agency's non-regulatory LHMP depends on the implementation of the Plan and incorporation of the outlined mitigation action items into existing Agency plans, policies, and programs. The Plan includes a range of action items that, if implemented, would reduce loss from hazard events. Together, the mitigation action items in the Plan provide the framework for activities that the Agency can choose to implement over the next five years. Accordingly, the Agency has prioritized the Plan's goals and identified actions that will be implemented (resources permitting) through existing plans, policies, and programs.

The Engineering Department has taken on the responsibility for overseeing the Plan's implementation and maintenance through the Agency's existing programs. The Engineering Manager will assume lead responsibility for facilitating LHMP implementation and maintenance meetings. Although the Engineering Department will have primary responsibility for review, coordination, and promotion, plan implementation and evaluation will be a shared responsibility among all departments identified in the mitigation action plan. The Agency will work with other Regional organizations to ensure consistency with all relevant plans.

5.6 Incorporation Into Existing Planning Mechanisms

As stated in **1.6, Mitigation Priorities and Goals**, information on hazards, risk, vulnerability, and mitigation in this Plan is based on information from similar planning documents used by the Agency. Additionally, with AVEK's *draft* Master Plan currently being updated, the LHMP process has allowed the Agency to review and expand upon the policies contained within the document. The *draft* Master Plan and the LHMP work together to reduce risk exposure to the Agency. Many of the ongoing recommendations identified in the mitigation strategy are recommended by the *draft* Master Plan and other adopted plans. One of this Plan's goals (**Section 1.6** - *Provide a level of regional water reliability that supports customers' water needs*) was applied directly from the Agency's Strategic Plan. As used in the preparation of the LHMP, the Agency will continue to coordinate the Plan's recommendations with other planning processes and programs, which include:

- AVEK *draft* Master Plan
- AVEK Strategic Plan
- AVEK Capital Improvement Program
- AVEK Urban Water Management Plan
- AVEK Emergency Response Plan
- Antelope Valley Integrated Regional Water Management Plan
- Los Angeles County Emergency Management Plan
- Kern County Emergency Operations Plan

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Section Six - Plan Maintenance Process

This Chapter identifies the formal process to ensure that the AVEK LHMP remains an active and relevant document. The Plan maintenance process includes a schedule for monitoring and evaluating the Plan annually and producing an update every five years.

This chapter describes how AVEK will integrate public participation throughout the plan maintenance and implementation process. In addition, the Plan's format allows the Agency to readily update sections when new data becomes available, resulting in a Plan that will remain current and relevant to the Agency.

6.1 Monitoring, Evaluating, and Updating the Plan

Coordinating Body

The AVEK Technical Advisory Committee (TAC) will be responsible for the maintenance of this LHMP. The Engineering Department will lead in LHMP maintenance issues by coordinating the maintenance of this plan, undertaking the formal review process, and revising the LHMP.

Convener

The Engineering Manager will facilitate the TAC meetings and assign tasks such as updating and presenting the Plan to other Departments, Stakeholder Groups, and elected officials. Plan implementation and evaluation will be a shared responsibility among all of the TAC.

Monitoring

It will be the responsibility of the Engineering Manager to track the implementation of the LHMP and report back to the TAC with their findings. As a part of the yearly budget process occurring at the beginning of the calendar year, they will evaluate the progress of each action item with the department responsible for its implementation. Refer to **Sections 6.2 and 6.3**. In addition, they will coordinate with the Assistant General Manager on an ongoing basis on the Plan's progress. Finally, public input will be obtained by consulting with the Agency's customers, associated governmental organizations, and AVEK's regulatory agencies.

Evaluation

The minimum task of the ongoing annual hazard mitigation planning team meeting will be to evaluate the Plan's progress and incorporate the actions into other planning documents. This review will include the following:

- Summary of any hazard events that occurred during the prior year and their impact on the Agency.
- Review of successful mitigation initiatives identified in the Plan.
- A brief discussion about why targeted mitigation strategies were not completed.

- Re-evaluation of the Mitigation Actions to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term project due to funding availability).
- Review by the Agency's TAC on an annual basis.
- Recommendations for new mitigation actions.
- Changes in, or potential for, new funding options/grant opportunities.
- Integration of new GIS data and maps that can be used to update the Plan.
- Evaluation of any other planning programs or initiatives within the Agency that involve hazard mitigation.

6.2 Method and Schedule for Updating the Plan Within Five Years

Section 201.6.(d)(3) of Title 44 of the Code of Federal Regulations requires that local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval to remain eligible for benefits awarded under the Disaster Mitigation Act (DMA). The Agency intends to update the Plan on a five-year cycle from the date of plan adoption. It is anticipated that this update process will occur one year before the expiration of the existing plan. This cycle may be accelerated to less than five years based on the following triggers:

- A Presidential Disaster Declaration that impacts the Agency.
- A hazard event that causes a significant amount of damage.

The update process will intend to add new planning process methods, community profile data, hazard data and events, vulnerability analyses, mitigation actions, and goals to the adopted plan so that the Plan will always be current and up to date. Based on the needs identified by the planning team, the update will, at a minimum, include the elements below:

- The update process will be convened through the Technical Advisory Committee and reviewed by the General Manager to ensure consistency between Agency plans.
- The hazard risk assessment will be reviewed and updated using the best available information and technologies annually.
- The evaluation of critical structures and mapping will be updated and improved as funding becomes available.
- The mitigation actions will be reviewed and revised to account for any actions completed, deferred, or changed to account for changes in the risk assessment or new Agency policies identified under other planning mechanisms, as appropriate (such as the *draft* Master Plan).
- The draft update will be sent to appropriate agencies for comment.
- The public will be allowed to comment before adoption.
- The AVEK Board of Directors will adopt the updated Plan.

6.3 Five Year LHMP Update Timeline

Based on a midyear 2022 CalOES and FEMA approval date.

- March 2023 - LHMP Progress Report and October 2023 Mitigation Action review
- March 2024 - LHMP Progress Report and October 2024 Mitigation Action review
- March 2025 - LHMP Progress Report and October 2025 Mitigation Action review
- March 2026 - LHMP Progress Report and Plan Update implementation
- October 2026 - Mitigation Action Review
- January 2027 - Submit Update LHMP to CalOES and FEMA
- March 2027 - LHMP Progress Report
- Summer 2027 - Implementation of approved LHMP

6.4 Annual Progress Report Form

As part of the Plan Maintenance Process for the LHMP, the TAC will convene to conduct an annual review to monitor the progress in implementing the LHMP. The LHMP Progress Report Form has been developed for this purpose and will be completed annually.

The **LHMP Progress Report Form (Section 6.8)** will provide the basis for possible changes to the overall LHMP. The Agency will have an opportunity to refocus on any new or more threatening hazards. In addition, this will allow the Agency to make any necessary adjustments to or changes in resource allocations and engage additional support for the LHMP implementation if warranted. The findings will be reviewed by the Assistant General Manager and used for the next plan update.

6.5 Adoption

The Antelope Valley - East Kern Water Agency's Board of Directors is responsible for adopting the Plan. This formal adoption should take place every five years. Once the Plan has been adopted, the Agency will be responsible for final submission to the California Office of Emergency Services (CalOES). CalOES will then submit the Plan to the Federal Emergency Management Agency (FEMA) for final review and approval.

6.6 Continued Public Involvement

The public will continue to be apprised of the LHMP actions through the Agency's website and by providing copies of the progress report to the public. Upon initiating the LHMP update process, a new public involvement strategy will be developed based on guidance from the planning team. This strategy will be based on the needs and capabilities of the Agency at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area and the Agency's website.

6.7 Point of Contact

Mr. Justin Livesay, Engineering Manager
Antelope Valley - East Kern Water Agency
6450 West Avenue N
Palmdale, CA 93551
(661) 943-3201

6.8 LHMP Annual Progress Report Form

LHMP Annual Progress Report Form

Date:

Name of Person Completing the Report:

Summary of Progress

Have any new hazard/disaster events occurred during the reporting period? If so, list the event(s).

To your knowledge, did anyone from the public comment on the plan during the reporting period? If so, list the comments.

Do the goals, objectives, and mitigation actions of the plan address current and expected conditions? If not, please explain further:

Were any mitigation projects identified in the LHMP implemented during the reporting period? If so, list the projects.

What obstacles, problems, or delays did any current or ongoing mitigation projects encounter, if any? How were the problems solved?

Are current resources appropriate for implementing the Plan?	Y	N
Have the outcomes occurred as expected?	Y	N
Have outside agencies participated as proposed?	Y	N

Were shortcomings identified, what can the Agency do to get things back on track?

Have there been changes in development trends that could create additional risks? If so, please explain.

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Section Seven - Glossary of Acronyms

Commonly Used Emergency Management Acronyms

A	
AAR	After-Action Report
AAR / IP	After-Action Report / Improvement Plan
AC	Area Command
ADA	Americans with Disabilities Act
ALS	Advanced Life Support
AQI	Air Quality Index
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
ASL	Above Mean-Sea-Level
AWMC	Agricultural Water Management Council
B	
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BLS	Basic Life Support
BRIC	Building Resilient Infrastructure and Communities
C	
C&O	Concept and Objectives
Cal Fire	California Department of Forestry and Fire Protection
Cal OES	California Office of Emergency Services
Cal OSHA	California Occupational Safety and Health Administration
CCR	California Code of Regulations (State Water Board regulations are in Title 23)
CDC	Centers for Disease Control
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CERT	Community Emergency Response Team
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CHP	California Highway Patrol
CMUA	California Municipal Utilities Association

C	
COOP	Continuity of Operations Plan
COG	Continuity of Government
COP	Common Operating Picture
CPG	Comprehensive Planning Guide
CRT	Crisis Response Team
CVP	Central Valley Project
CVRWQCB	Central Valley Water Quality Control Board
D	
DCF	Disaster Control Facility
DHS	United States Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000
DMP	Debris Management Plan
DOC	Department Operations Center
DOD	United States Department of Defense
DOJ	United States Department of Justice
DWR	Department of Water Resources
E	
EAP	Emergency Action Plan
EEG	Exercise Evaluation Guide
EF(#)	Enhanced Fujita Scale (followed by a #)
EHPSM	Environmental and Historic Preservation Screening Memo
EMA	Emergency Management Agency
EMAC	Emergency Management Assistance Compact
EMMA	Emergency Management Mutual Aid
EMPG	Emergency Management Performance Grant
EMPT	Emergency Management Planning Team
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	United States Environmental Protection Agency
ERP	Emergency Response Plan
EVC	Emergency Volunteer Center
ERT	Emergency Response Team
EXPLAN	Exercise Plan

F	
FBI	Federal Bureau of Investigation
FE	Functional Exercise
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRESCOPE	Firefighting Resources of California Organized for Potential Emergencies
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FMAG	Fire Mutual Aid Grant
FOG	Field Operations Guide
FOUO	For Official Use Only
FPC	Final Planning Conference
FPPC	Fair Political Practices Commission
G	
G&T	Preparedness Directorate's Office of Grants and Training
GIS	Graphical Information System
GPS	Global Positioning System
H	
HMAG	Hazard Mitigation Assistance Grant
HazMat	Hazardous Materials
HMGP	Hazard Mitigation Grant Program
Hotwash	Debriefing of Personnel Immediately after an Exercise
HSC	Homeland Security Council
HSEEP	Homeland Security Exercise and Evaluation Program
HSPD	Homeland Security Presidential Directive
HSPD-5	Homeland Security Presidential Directive-5
I	
IAEM	International Association of Emergency Managers
IAP	Incident Action Plan
IC	Incident Commander
ICS	Incident Command System
IDE	Initial Damage Estimate
ICP	Incident Command Post
IMAT	Incident Management Assistance Team
IPC	Initial Planning Conference
IS	Independent Study (FEMA Course)

J	
JIC	Joint Information Center
JIS	Joint Information System
JOC	Joint Operations Center
K	
L	
LDRM	Local Disaster Recovery Manager
LEPC	Local Emergency Planning Committee
LHMP	Local Hazard Mitigation Plan
LNO	Liaison Officer
LOTO	Lock-out/Tag-out
M	
MA	Mutual Aid
MAC	Multi Agency Coordination
MACS	Multi Agency Coordination System
MCI	Mass Casualty Incident
MH	Medical Health
MHOAC	Medical Health Operational Area Coordinator
MMI	Modified Mercalli Index
MOU	Memorandum of Understanding
MSEL	Master Scenario Events List
M_W	Moment Magnitude
N	
NDRF	National Disaster Recovery Framework
NFIP	National Flood Insurance Program
NIC	National Incident Management System (NIMS) Integration Center
NIMS	National Incident Management System
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NPREP	National Preparedness for Response Exercise Program
NPS	National Preparedness System
NRF	National Response Framework
NWS	National Weather Service

O	
OA	Operational Area
OES	Office of Emergency Services
OSHA	Occupational Health and Safety Administration
P	
PM2.5	Particulate Matter (2.5 microns or smaller)
PDM	Pre-Disaster Mitigation
PDRP	Post-Disaster Recovery Plan
PGA	Peak Ground Acceleration
PHA	Peak Horizontal Acceleration
PIO	Public Information Officer
PMF	Probable Maximum Flood
POC	Point of Contact
PPD	Presidential Policy Directive
PPE	Personal Protective Equipment
Q	
QPF	Quantitative Predictive Forecast
R&D	Research and Development
REOC	Regional Emergency Operations Center
RESTAT	Resources Status
RFC	Repetitive Flood Claim
RSF	Recovery Support Function
RSP	Render-Safe Procedures
S	
SCADA	Supervisory Control And Data Acquisition
SCE	Southern California Edison
SEMS	Standardized Emergency Management System
SFHA	Special Flood Hazard Area
SITREP	Situation Report
SMART	Simple, Measurable, Achievable, Realistic, Task-oriented
SME	Subject Matter Expert
SOC	State Operations Center
SOP	Standard Operating Procedure
SRL	Severe Repetitive Loss
SWP	State Water Project
SWRCB	State Water Resources Control Board

T	
TA	Homeland Security Preparedness Technical Assistance Program
T&EPW	Training and Exercise Plan Workshop
TAG	Threat Assessment Group
TCL	Target Capabilities List
Tech Spec	Technical Specialist
TFL	Task Force Leader
THIRA	Threat and Hazard Identification and Risk Assessment
TTX	Tabletop Exercise
U	
UC	Unified Command
UAC	Unified Area Command
USACE	United States Army Corps of Engineers
USAR	Urban Search and Rescue
USBR	United States Bureau of Reclamation
USFS	United States Forest Service (Dept. of Agriculture)
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTL	Universal Task List
UW	United Way
V	
VIP	Very Important Person
VOAD	Volunteer Organizations Active in Disasters
W	
WHO	World Health Organization
WUI	Wildland-Urban Interface
X	
Y	
Z	