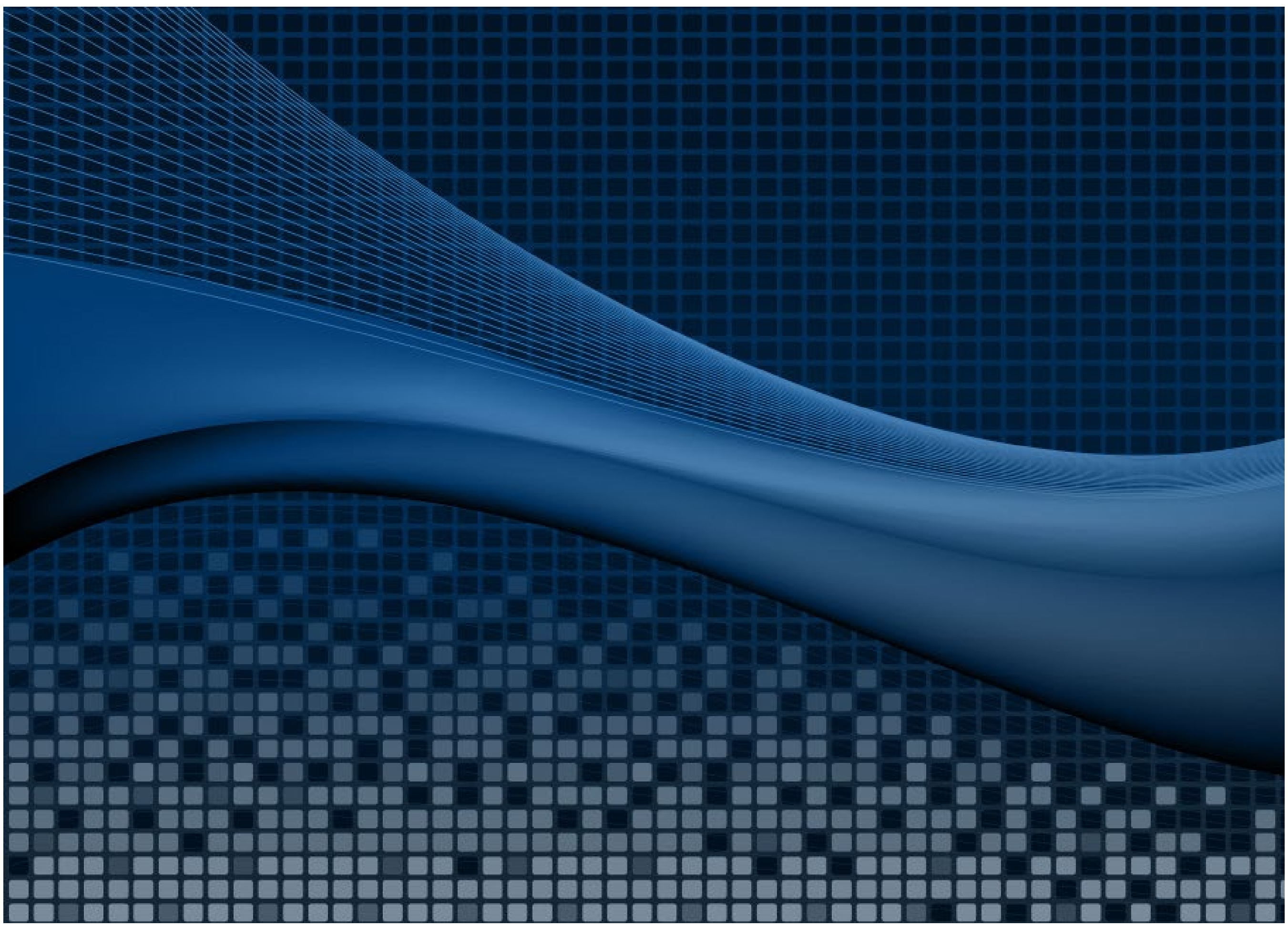
CRESCENTA VALLEY WATER DISTRICT

Hazard Mitigation Plan

Public Review Draft



TETRA TECH

July 2021

Crescenta Valley Water District Hazard Mitigation Plan

July 2021

PREPARED FOR

Crescenta Valley Water District

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ACRONYMS/ABBREVIATIONS

Acronym or Abbreviation	Definition
%g	Percent acceleration force of gravity
44 CFR	Code of Federal Regulations, Title 44
APA	Approval Pending Adoption
BRIC	Building Resilient Infrastructure & Communities grant program
Cal OES	California Governor's Office of Emergency Services
CDBG	Community Development Block Grant
COVID-19	Coronavirus Disease 2019
CVWD	Crescenta Valley Water District
DWR	California Department of Water Resources
EMPG	Emergency Management Performance Grant
EPA	U.S. Environmental Protection Agency
ESA	US Endangered Species Act
FEMA	Federal Emergency Management Administration
FHSZ	fire hazard severity zone
FMWD	Foothill Municipal Water District
GIS	Geographic Information System
Hazus	Hazards U.S.
HMA	Hazard Mitigation Assistance
HUD	U.S. Department of Housing and Urban Development
IBC	International Building Code
IT	Information Technology
MWD	Metropolitan Water District of Southern California
NEHRP	National Earthquake Hazards Reduction Program
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PGA	Peak Ground Acceleration
ppm	Parts per million
SC	Steering Committee (CVWD Hazard Mitigation Plan)
ULARA	Upper Los Angeles River Area
USACE	US Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	United States Geological Survey

ACKNOWLEDGMENTS

Crescenta Valley County Water District

- David Gould, Director of Engineering
- Brook Yared, Senior Engineer
- Nem Ochoa, General Manager
- Christy Colby, Regulatory and Public Affairs Manager
- James Lee, Director of Finance and Administration
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- Sharon Raghavachary, Board Member for CVWD
- Harry Leon, President of Crescenta Valley Town Council
- James Bodnar, Board Member for CVWD
- Paul Dutton, CERT Program lead for Dutton Real Estate
- Ken Herman, District Engineer for Foothill Municipal Water District
- Doug Caister, General Manager of La Cañada Irrigation District
- Shahan Atmajian, Emergency Operations Center Coordinator for the City of La Cañada Flintridge
- Brian Hodge, President of Crescenta Valley Fire Safe Council
- Michael De Ghetto, Chief Asst. General Manager of Glendale Water and Power
- Dan Hardgrove, Deputy Director of Public Works/Field Services, City of Glendale
- David Weeshoff, Conservation Chair, San Fernando Valley Audubon Society

Special Appreciation

Development of this plan would not have been possible without the commitment of the Crescenta Valley Water District Hazard Mitigation Plan Steering Committee. The dedication of this committee's volunteer members to allocate their time to developing the plan is greatly appreciated. Also, residents of the District's service area are commended for their participation in the outreach strategy identified by the Steering Committee. This outreach success will set the course to successful implementation of this plan during its next performance period.

EXECUTIVE SUMMARY

To Be Completed for Next Draft

Part 1. BACKGROUND AND METHODS

1. INTRODUCTION TO THE PLANNING PROCESS

1.1 THE BIG PICTURE

Hazard mitigation is defined as any action taken to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves long- and short-term actions implemented before, during and after disasters. Hazard mitigation activities include planning efforts, policy changes, programs, studies, improvement projects, and other steps to reduce the impacts of hazards.

The federal Disaster Mitigation Act (DMA) emphasizes planning for disasters before they occur. The DMA requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Regulations developed to fulfill the DMA's requirements are included in Title 44 of the Code of Federal Regulations (44 CFR). The DMA promotes sustainability in hazard mitigation. To be sustainable, hazard mitigation needs to incorporate sound management of natural resources and address hazards and mitigation in the largest possible social and economic context.

1.2 A PLAN FOR THE CRESCENTA VALLEY WATER DISTRICT

The Crescenta Valley Water District (the District, or CVWD) has completed a planning process to prepare for the impacts of hazards that could impact the CVWD service area. The District worked with its neighbors and identified stakeholders to prepare a detailed, multi-hazard plan, and to identify what steps it can take in advance to mitigate impacts from those hazards. It was the District's aim to engage CVWD customers, through the hazard mitigation planning process, to communicate risk and seek input on ways that the District can reduce that risk and become more resilient.

The *Crescenta Valley Water District Hazard Mitigation Plan* is the District's first formal plan pursuant to the Disaster Mitigation Act of 2000 (Public Law 106-109). The plan promotes sound policy to protect the District's critical assets from the impacts of natural hazards. It identifies resources, information, and strategies for reducing risk from those hazards. Elements and strategies in the plan were selected because they meet a program requirement and because they best meet the needs of CVWD and its community.

All residential and commercial CVWD customers are the ultimate beneficiaries of this hazard mitigation plan. The plan strives to reduce risk for District assets that are vital for its continuity of operations following hazard events. The District provides essential services (water supply and wastewater collection), and its ability to continue to provide these services will be critical to the area's ability to recover from a hazard event. This plan provides a viable planning framework for all hazards that are likely to impact the District. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The plan's goals and recommendations lay the groundwork for implementing local mitigation activities and partnerships.

1.3 PLAN ORGANIZATION

The *Crescenta Valley Water District Hazard Mitigation Plan* consists of three parts:

- Part 1 describes the concept of hazard mitigation, the process and methodologies used to develop this hazard mitigation plan, and significant hazard-related profile characteristics of the District.
- Part 2 provides a detailed risk assessment of the specific hazards of concern to the District. The assessment of each hazard describes the history, location, frequency and severity of the hazard, the District's exposure to the hazard, and the potential losses that could result from occurrences of the hazard.
- Part 3 defines the District's goals and objectives for hazard mitigation, recommended actions to mitigate hazard risks, and a strategy for implementing the recommended actions.

2. THE PLANNING PROCESS

2.1 CORE PLANNING TEAM, PLANNING AREA AND STEERING COMMITTEE

To address the federal mandates in the DMA, the District applied for and was awarded a planning grant (Project #DR-4407-0020-P) funded by the Federal Emergency Management Agency (FEMA) to develop a hazard mitigation plan. The first step in developing the hazard mitigation plan was to establish a planning team to carry out the planning process and document preparation and a steering committee of local stakeholders to guide the planning team.

The District hired Tetra Tech through a procurement process to assist in the facilitation of the planning process. The Tetra Tech project manager assumed the role of the lead planner, reporting directly to a District-designated project manager. A core planning team was formed to lead the planning effort, made up of the following members:

- David Gould, Director of Engineering, Crescenta Valley Water District
- Brook Yared, Senior Engineer, Crescenta Valley Water District
- Nem Ochoa, General Manager, Crescenta Valley Water District
- Dennis Maxwell, Director of Operations, Crescenta Valley Water District
- Christy Colby, Regulatory and Public Affairs Manager, Crescenta Valley Water District
- James Lee, Director of Finance and Administration, Crescenta Valley Water District
- Jennifer Bautista, Project Coordinator, Crescenta Valley Water District
- John Robinson, Grant Administrator, John Robinson Consulting, Inc
- Rob Flaner, CFM, Project Manager, Tetra Tech
- Bart Spencer, Lead Project Planner, Tetra Tech
- Carol Baumann, Risk Assessment Lead, Tetra Tech
- Desmian Alexander, MUP, Planner, Tetra Tech

Over the course of this planning process, the core planning team met biweekly as needed for a total of 14 times (meeting summaries are available upon request). At the outset of planning, the core planning team defined the specific boundaries of the planning area to be addressed. These boundaries affect both the detailed risk assessment and the selection of mitigation actions. For this hazard mitigation plan, the planning area was defined as the District's service area boundaries for both fresh-water and wastewater services.

To be successful, hazard mitigation planning requires the collaboration and support of diverse parties whose interests can be affected by hazard losses. The plan was developed with significant public input, and its development was overseen by a steering committee. The core planning team assembled a list of candidates representing interests within the planning area that could have recommendations for the plan or be impacted by its recommendations. From these candidates, the Steering Committee was formed to oversee all phases of the plan. Table 2-1 lists the committee members.

Table 2-1. Steering Committee Members

Name	Title	Department or Agency
Sharon Raghavachary	Board Member, Chair of Steering Committee	Crescenta Valley Water District
Harry Leon	President, Vice-Chair of Steering Committee	Crescenta Valley Town Council
James Bodnar	Board Member	Crescenta Valley Water District
Paul Dutton	CERT Program	Dutton Real Estate
Ken Herman	District Engineer	Foothill Municipal Water District
Doug Caister	General Manager	La Cañada Irrigation District
Shahan Atmajian	Emergency Operations Center Coordinator	City of La Cañada Flintridge
Brian Hodge	President	Crescenta Valley Fire Safe Council
Michael De Ghetto	Chief Assistant General Manager	Glendale Water and Power
Dan Hargrove	Deputy Director of Public Works/Field Services	City of Glendale, Public Works
David Weeshoff	Conservation Chair	San Fernando Valley Audubon Society

The Steering Committee, made up of local stakeholders, was tasked with identifying potential natural hazards and providing input into preparation and mitigation efforts to be outlined in the hazard mitigation plan. The committee met nine times over the 10-month period commencing in October 2020. See Appendix A for summaries of all Steering Committee meetings.

2.2 COORDINATION WITH OTHER AGENCIES

During a ten-month process to prepare the plan, CVWD customers and officials from neighboring agencies were invited to contribute by sharing local knowledge of the area's vulnerability to hazards and by suggesting ways the District can mitigate disasters. The following agencies were invited to participate and were kept apprised of plan development milestones:

- Crescenta Valley Fire Safe Council
- Crescenta Valley Town Council
- Glendale Water and Power
- City of Glendale Public Works
- City of Glendale Police Department
- City of Glendale Fire Department
- City of La Cañada Flintridge
- Los Angeles County Office of Emergency Management
- Los Angeles County Sheriff's Department

- Los Angeles County Public Works
- Los Angeles County Fire Department
- La Cañada Irrigation District
- Foothill Municipal Water District
- California Governor's Office of Emergency Services (Cal OES)
- California Department of Water Resources, Division of Safety of Dams
- FEMA Region IX

These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan update process or were kept apprised through other outreach methods. They supported the effort by attending meetings or providing feedback on issues. They were provided an opportunity to comment on this plan, primarily through the hazard mitigation plan website. Each was sent an e-mail message informing them when draft portions of the plan were available for review. In addition, the complete draft plan was sent to Cal OES and FEMA Region IX for a pre-adoption review to ensure program compliance.

2.3 REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports, and technical information (44 CFR, Section 201.6(b)(3)). Chapter 4 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation actions. In addition, the following programs can affect mitigation within the planning area:

- 2019 County of Los Angeles All-Hazards Mitigation Plan
- 2021 Los Angeles County Comprehensive Flood Hazard Management Plan
- City of Glendale Hazard Mitigation Plan
- Foothill MWD (CVWD's wholesaler) America's Water Infrastructure Act Plan
- Safety elements of the General plans for Cities withing the District's service area
- CVWD 2020 Strategic Plan
- CVWD 2015 Urban Water Management Plan

2.4 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). The core planning team developed a public involvement strategy at this projects onset that sought to provide the public as defined for this process access to all phases of the plan's development. This strategy was significantly influenced by the State of California and the District's response to the ongoing COVID-19 global pandemic that limited the districts capabilities for "in-person" public engagement during this process. With these impacts in mind the public engagement strategy for this plan relied heavily of digital, remote media techniques that centered upon a dedicated website, survey, and social media as the mediums to engage the public.

2.4.1 Defining the "Public"

As a special purpose district with authorities to provide water and wastewater services to the planning area, the CVWD role in mitigating the impacts from natural hazards that can impact its service area are different than those municipal local governments within the same planning area. CVWD lacks the permit/regulatory authorities that municipal governments have to implement mitigation actions on the general building stock (private property) withing the planning area. It is not the district's responsibility to implement actions that protect property that they do not own or operate. It is the district's responsibility as a "lifeline service provider" to assure its ability to provide is critical function after being impacted by a hazard event. Continuity of operation is the principal focus for the District's mitigation strategy in this plan. With this premise in mind, the "public" as defined for this planning process are those rate payers and constituents that make up the CVWD serviced population. While this is the same population that municipal governments represent in their local hazard mitigation plans, the district's messaging to this population will be different. While the messaging will include elements of the impacts from the natural hazards assessed in this plan may have on "John Q Citizen", the emphasis will be on what the district can and should do to maintain its continuity of operations for lifeline services.

2.4.2 Stakeholders and the Steering Committee

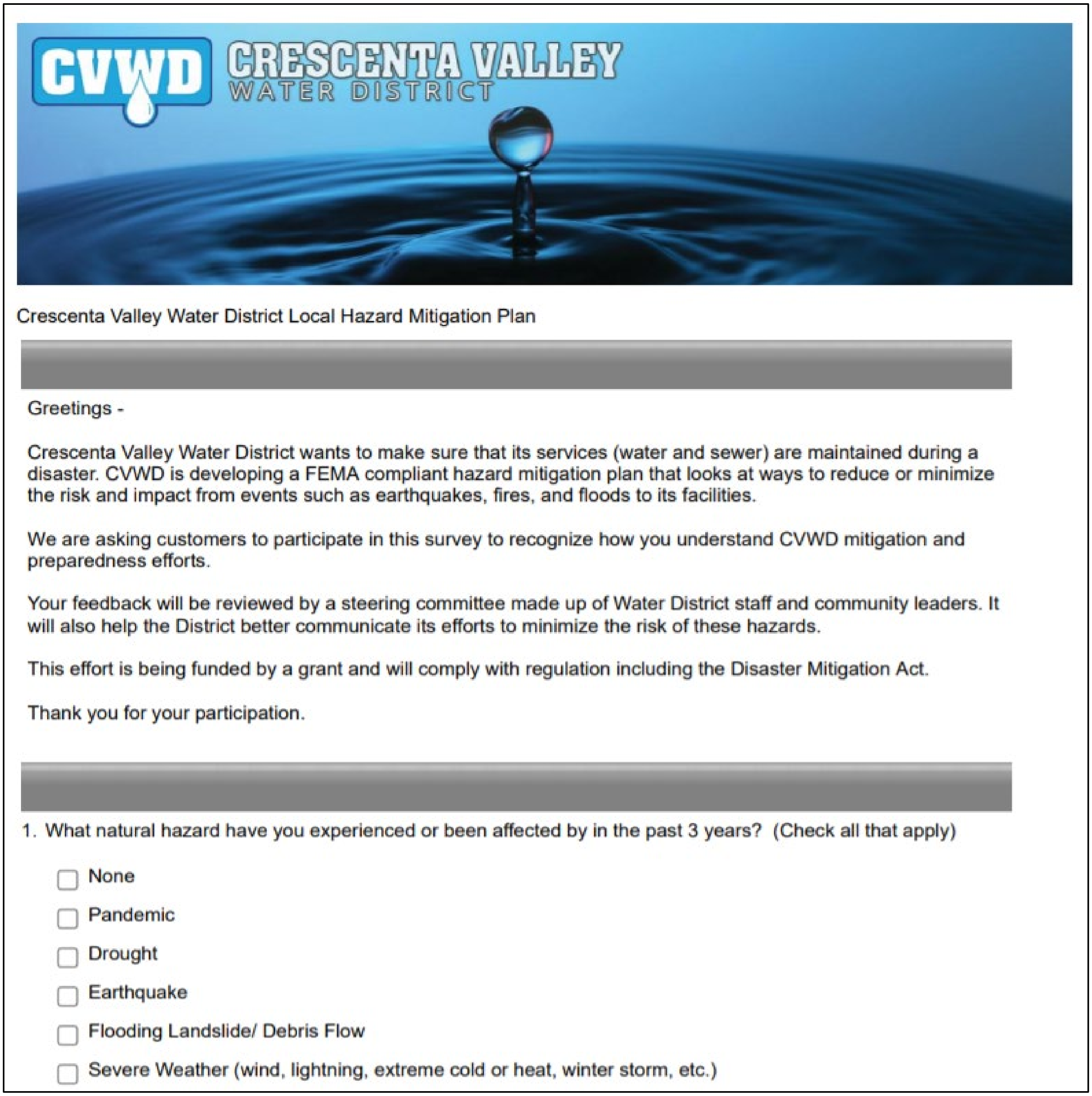
Stakeholders are the individuals, agencies, advisory groups, and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan. The District's goal was to include stakeholders in this process including participation on the Steering Committee. Stakeholders targeted for this process included the following:

- Local public safety and emergency services agencies
- Community member representatives
- Local disaster-preparedness and relief organizations
- Local special-purpose districts and utilities

Steering Committee meeting notices were posted on the District's website; opportunity was provided for public comment during these meetings.

2.4.3 Survey

The core planning team developed a hazard mitigation plan survey with guidance from the Steering Committee. The survey was used to gauge household preparedness for natural hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards. The survey was designed to help identify areas vulnerable to one or more natural hazards. The answers to its 12 questions helped guide the Steering Committee in affirming goals and objectives and in the development of mitigation strategies. In addition to multiple choice questions, respondents were offered the opportunity to provide additional information through several open response sections, the majority of which were associated with a closed response question to ensure as much detail as possible. The survey was available through a link on the District website. A sample page is shown in Figure 2-1


CVWD CRESCENTA VALLEY WATER DISTRICT

Crescenta Valley Water District Local Hazard Mitigation Plan

Greetings -

Crescenta Valley Water District wants to make sure that its services (water and sewer) are maintained during a disaster. CVWD is developing a FEMA compliant hazard mitigation plan that looks at ways to reduce or minimize the risk and impact from events such as earthquakes, fires, and floods to its facilities.

We are asking customers to participate in this survey to recognize how you understand CVWD mitigation and preparedness efforts.

Your feedback will be reviewed by a steering committee made up of Water District staff and community leaders. It will also help the District better communicate its efforts to minimize the risk of these hazards.

This effort is being funded by a grant and will comply with regulation including the Disaster Mitigation Act.

Thank you for your participation.

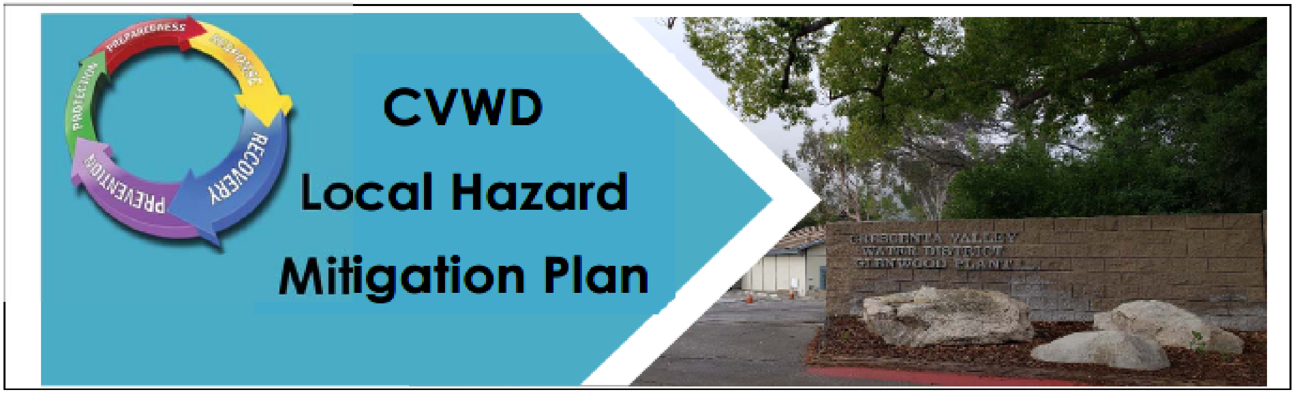
1. What natural hazard have you experienced or been affected by in the past 3 years? (Check all that apply)

- ☐ None
- ☐ Pandemic
- ☐ Drought
- ☐ Earthquake
- ☐ Flooding Landslide/ Debris Flow
- ☐ Severe Weather (wind, lightning, extreme cold or heat, winter storm, etc.)

Figure 2-1. Sample Page from Survey Distributed to the Public

2.4.4 Public Meeting

On April 21, 2021, the District hosted a virtual public meeting to discuss the current findings on hazards of concern and potential mitigation measures. In addition to streaming live on-line, a recording of the meeting was available for on-line viewing at the District office. In total, there were 17 attendees to this virtual session. The District's Regulatory and Public Affairs Manager developed and deployed a public outreach plan for the public meeting. Figure 2-2 shows the general contents of the plan.



PUBLIC OUTREACH PLAN for the April 21, 2021 Public Presentation

News Paper **Social Media** **Email blast** Constant Contact

Objective → Strategy → Development of deliverables → Distribution of materials → Collect Data → Analyze Data → Summerize Findings

Objective	Develop customer interest and participation at the April 21st Public Presentation
Strategy	Brainstorm ideas to capture public attention and motivate them to attend the presentation. Develop tag line for the outreach campaign. We just had an earthquake – Do you know what your Water District is doing? It's the middle of the night and you have no water – Do you know how to contact your Water District? When a disaster strikes – Do you know where to go to get the most update information?
Development of Materials	Create resources for press releases, social medial posts, E-mail blasts, website posts and flyers
Distribution of Materials	Press release – 04/05/2020 Social Media Posts - 04/08/2020 E-Mail Blast - 04/12/2020 News Paper Ad - 04/15/2020
Collect Data	Conduct 2 quick surveys during Zoom Meeting. 1. Age demographics 2. How did you hear about this meeting
Analyze Data	Analyze which method was most successful in attracting customers to the meeting. Determine if there is any correlation between the success of the method and the age group.
Summarize Findings	Report to the Committee on the statistics of attendees and the most successful delivery method.

Figure 2-2. Public Outreach Plan

2.4.5 Review of Draft Plan

A two-week public comment period was run from July 13, 2021 to July 27, 2021 to allow the public and opportunity to review and comment on the proposed draft of the plan. A virtual public meeting was held on July 27, 2021 to provide the opportunity for open public comment. The draft mitigation plan was posted to the District's website and a public outreach plan similar to that used for the previous public meeting was deployed. In total, there were ____ attendees to this virtual session.

2.4.6 Internet

At the beginning of the plan update process, a District hazard mitigation website was created to include information about the update process (https://www.cvwd.com/local-hazard-mitigation-plan; see Figure 2-3). Throughout the process, the website was used to keep the public informed on milestones and to solicit relevant input. The site's address was publicized in all press releases, mailings, surveys, and public meetings. Information on the plan development process, the Steering Committee, the survey, and phased drafts of the plan was made available to the public on the site throughout the process. The District intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

Figure 2-3. Sample Page from Hazard Mitigation Plan Website

2.4.7 Public Involvement Results

Event Attendance

Opportunity was provided for public comment during Steering Committee meetings. No written or oral public comment was received during these meetings.

XX participants signed in to view the live stream of the April 21, 2021, virtual public meeting. Appendix A includes a summary of public interaction for this meeting.

XX participants signed in to view the live stream of the July 27, 2021 virtual public meeting held during the public comment period.. Appendix A includes a summary of public interaction for this meeting.

Survey Results

To Be Provided with Next Draft

2.5 PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

Table 2-2 summarizes important milestones in the plan update process.

Table 2-2. Plan Development Chronology/Milestones

Date	Event	Description	Attendance
2020			
8/11	Organize Resources	• CVWD selects Tetra Tech as technical support consultant to facilitate development of the CVWD local hazard mitigation Plan	N/A
9/1	Organize Resources	• Project Kick-off meeting with District staff, Technical consultant, and other stakeholders.	9
9/10	Core Planning Team Call #1	• Goal setting • Hazards of Concern • Data needs • Steering Committee makeup • Public outreach strategy	11
9/24	Core Planning Team Call #2	• Data sharing access • Finalize Steering Committee • Proposes Steering Committee Charter • Virtual meeting protocol • Public Outreach strategy	12
10/8	Core Planning Team Call #3	• Steering Committee status • Finalize draft Charter for the Steering Committee • Goal setting • Hazard types (natura vs. non-natural)	9
10/16	Public Outreach Strategy	• Hazard mitigation plan website set up on the District's website • https://www.cvwd.com/local-hazard-mitigation-plan	N/A
10/22	Core Planning team Call #4	• 1st Steering Committee Meeting Agenda items • Standard meeting date and time for Steering Committee meetings • Goal setting-continued • Public Outreach-website • Survey Options	10

Date	Event	Description	Attendance
10/28	Steering Committee Meeting #1	• Project Overview • Steering Committee Ground rules • Public Involvement Strategy • Defining "the Public" • Action Items	22
11/5	Core Planning Team Meeting #5	• Finalize survey content • Goal setting-continued • Asset inventory data needs • Local Hazards • Risk assessment methodology • Steering Committee Meeting # 2 agenda • County representative for the Steering Committee	11
11/17	Core Planning team Call #6	• Survey status • Critical Facilities definition • Demographics and Land use data • GIS Data needs	10
11/18	Steering Committee Meeting #2	• Planning Process-Old Business • Goal setting-approve core planning team recommended goals • Objectives preview • Hazards of concern • Critical Facilities/Infrastructure (Lifelines) • Public Outreach Strategy	22
12/2	Public Outreach	• Hazard Mitigation Survey deployed under the District's platform, "Constant Contact." Survey link was posted on the District's website and the survey link was e-mailed to the District's distribution list	N/A
12/3	Core Planning Team Call #7	• Steering Committee Meeting # 3 preparation • Public Outreach-Survey Status • Critical Asset inventory and hazard data • Finalize goals and objectives • Grant administration needs	12
12/15	Core Planning Team Call #8	• Action plan framing • Preliminary Survey Results • Critical Assets and Hazards • Replacement costs	10
12/16	Steering Committee Meeting #3	• Planning Process-Old Business • Finalize objectives • Hazard of concern Scenarios • Project Example-Stormwater capture • Public Outreach Strategy-Survey results status	18

Date	Event	Description	Attendance
2021			
1/7	Core Planning team Call #9	• Hazard analysis profile • Public Outreach strategy-status	12
1/14	Core Planning Team Call #10	• Hazard analysis • Critical Assets • Exposure summary • Public Outreach Strategy-status	12
1/20	Steering Committee Meeting #4	• Planning Process-Old Business • District Profile • Hazard profile content • Risk Assessment Results-Exposure • Public Outreach Strategy-Survey results status	19
2/11	Core Planning team Call #11	• Planning Process-Timeline check • Plan Maintenance strategy • Action plan prioritization • Action Plan-Schedule • Public Outreach Strategy-status	9
2/17	Steering Committee Meeting #5	• Planning Process-Old Business • Project timeline • Plan maintenance strategy • Risk assessment results, loss estimation • Public Outreach Plan-Flyer	20
3/11	Core Planning team Call #12	• Next Steps • Action Plan-benefit cost analysis • Public Outreach Strategy-status	9
3/17	Steering Committee Meeting #6	• Planning Process-Old Business • Preliminary action plan • Findings from the Survey	21
4/21	Public Outreach	• Public Meeting # 1. Virtual Format	17
6/30	Steering Committee Meeting #7	• TBD	XX
TBD	Public Outreach	• Initiation of Final Public Comment Period	N/A
TBD	Public Outreach	• Phase 2 Public Meeting (Virtual)	XX
TBD	Public Outreach	• Closure of the final public comment period	N/A
TBD	Plan Review	• Submittal of Draft plan to Cal OES	N/A
TBD	Approval Pending Adoption	• Approval pending adoption received from FEMA Region IX	
TBD	Plan Adopted by the District	• Plan is finalized with the Board's adoption	
TBD	Final Approval	• FEMA granted final approval of the adopted plan.	

3. District Profile

The Crescenta Valley Water District is in the Crescenta Valley area of Los Angeles County in the foothills of the San Gabriel Mountains, between the San Fernando and San Gabriel valleys. CVWD provides water distribution and sewage collection within its boundaries to the unincorporated communities of La Crescenta, Montrose, and Verdugo City as well as a small portion of the City of La Cañada -Flintridge.

The District serves an area of approximately 4 square miles in relatively steep terrain ranging from 1,200 feet to almost 3,000 feet above sea level. The District currently provides water to over 8,000 accounts representing a population of approximately 33,000. Figure 3-1 provides an overview of District information.

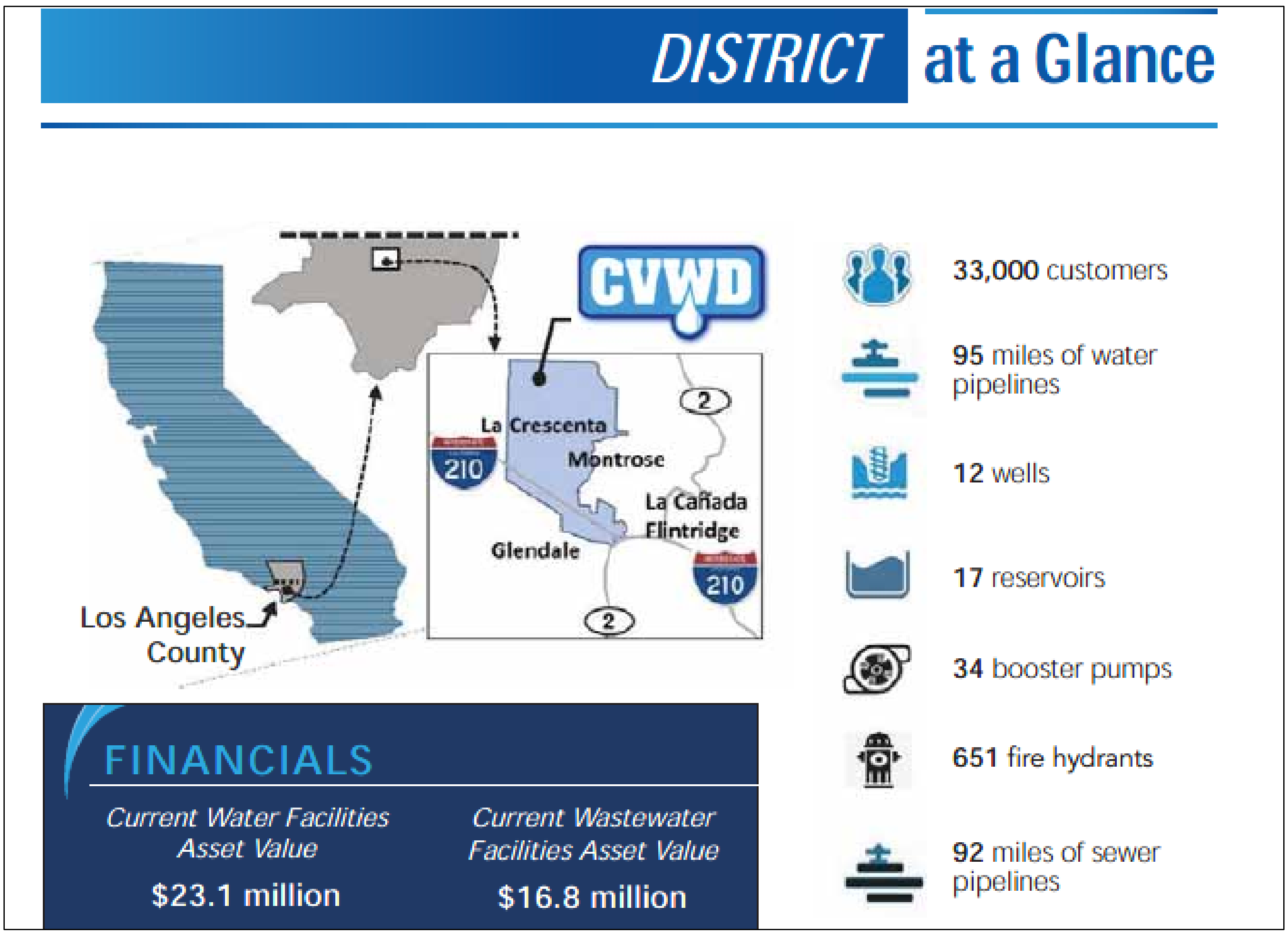


Figure 3-1. District at a Glance

3.1 DISTRICT STRUCTURE AND LEADERSHIP

The CVWD is an independent special district, which operates under the authority of Division 12 of the California Water Code. The CVWD has been providing water and wastewater services to residents since 1950. The District is governed by a five-member Board of Directors, elected at-large from within the District boundaries. The District General Manager administers the day-to-day operations of the District in accordance with the policies and procedures established by the Board of Directors. The CVWD employs a full-time staff of 27 employees. The District's Board of Directors regularly scheduled meetings are on the second and fourth Tuesdays of each month. Meetings are publicly noticed, and customers are encouraged to attend. The Board of Directors will adopt this plan once approval pending adoption has been granted by FEMA, and the Director of Engineering will oversee its implementation.

3.2 FINANCIAL SUMMARY

The District Board of Directors adopts and operating and capital budget every year. The budget authorizes and provides the basis for reporting and control of financial operations and accountability for the District's enterprise operations and capital projects. The budget and reporting treatment applied to the District is consistent with the accrual basis and the financial statement basis of accounting.

The District Board of Directors has adopted and investment policy that conforms to State law, District ordinance and resolutions, prudent money management, and the "prudent person" standards. The objects for the District's investment policy are safety, liquidity, and yield.

It is the District's financial policy that all revenue for user charges and surcharges generated from District customers must support all District operations including capital project funding in accordance with cost-of-service principles. Accordingly, water and wastewater rates are reviewed annually by District staff and periodically reviewed externally to ensure that revenues collected reflect the cost of providing services. Water and wastewater rates are charges imposed on customers for services and are the primary component of the District's revenue. Water and wastewater rates are composed of a commodity (usage) charge and a fixed (readiness-to-serve) charge to all residential and commercial units in the District's service area.

3.3 DISTRICT HISTORY

The Crescenta Valley County Water District (CVWD) was formed on December 14, 1950 by the vote of local residents. Organized under the provisions of Division 12 of the State of California Water Code, the District operates as a political subdivision of the State. The term "County" was officially deleted from the District's name in 1996.

CVWD receives its water from two main sources: wells drawing groundwater from the Verdugo Groundwater Basin and imported water from MWD through the Foothill Municipal Water District. In the early 1950s, the District purchased the assets and consolidated the groundwater-source infrastructure of several small private water companies then in existence. This was made possible by voter approval of two capital improvement bonds with a value of $1.35 million. Within a few years, with rapid growth in the Crescenta Valley and surrounding foothill communities, it became apparent that the local groundwater supply was not going to be sufficient to meet the increasing demand.

By 1953, residents from La Crescenta to Altadena voted to form the Foothill Municipal Water District to purchase and distribute imported water from the Metropolitan Water District of Southern California (MWD), which was formed by 13 Southern California cities in 1928 to import water from the Colorado River. By 1955, the District was augmenting its local well water with MWD water from the Colorado River. In the 1960s, MWD increased its supply by also contracting for Northern California water with the completion of the State Water Project. Today's source of supply for CVWD customers fluctuates from 40 to 60 percent groundwater versus imported water.

In the 1970s, District officials were becoming aware of potential problems with private wastewater disposal systems (septic tanks) in the vicinity and potential impacts on the local groundwater supply. With federal funds available through the Clean Water Act, the District created two sewer assessment districts in 1979 and sold bonds for the construction of 64 miles of mainline sewer and 27 miles of house-connection laterals. Approximately 75 percent of the $35 million cost was satisfied with federal grant money and the remainder through direct assessment of local property owners. The project also included the purchase of treatment plant capacity from the City of Glendale and the construction of 7 miles of large-diameter sewer interceptor through the City of Glendale. All sewer system construction was completed in the mid-1980s.

3.4 SERVICE AREAS

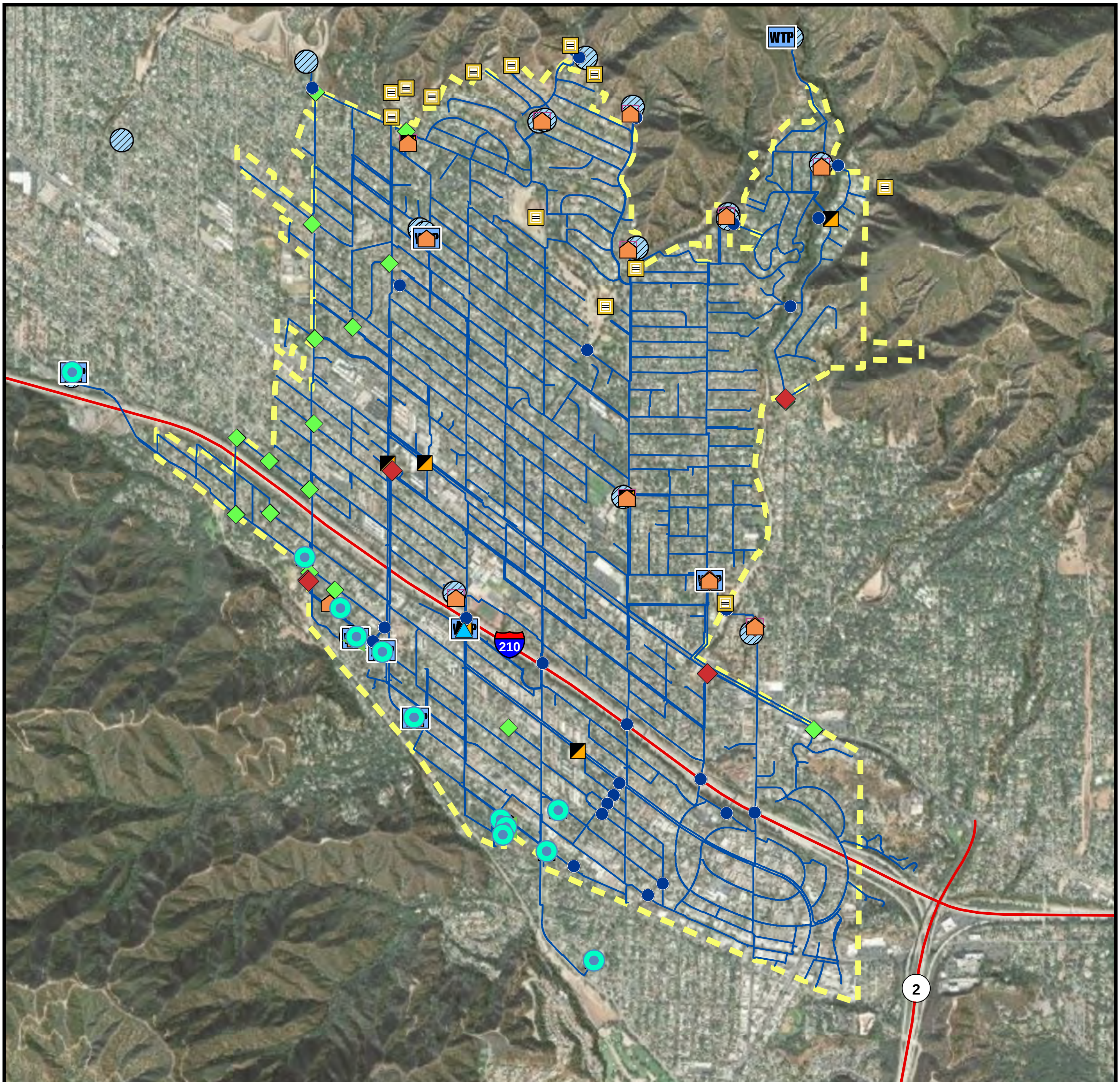
3.4.1 Water Supply

The District pumps groundwater from the Verdugo Basin. The basin is located beneath the District's service area, about 200 feet below the ground's surface. Water production out of the Verdugo basin is highly dependent on replenishment from precipitation, which may take up to three years to fully infiltrate into the basin. District procurement of imported water is contracted through Foothill Municipal Water District, which purchases 100% of its water from MWD. Figure 3-2 shows the District's water service area.

Upper Los Angeles River Area (ULARA)

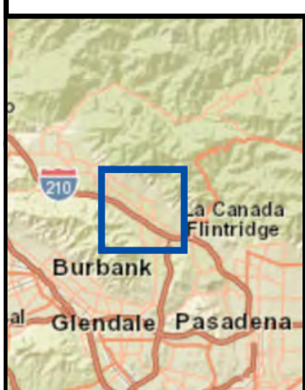
The Upper Los Angeles River Area (ULARA) encompasses all the watershed and tributaries of the Los Angeles River and four groundwater basins, located above a point in the river designated by the Los Angeles County Department of Public Works as Gaging Station F-57C-R, near the junction of the Los Angeles River and the Arroyo Seco. ULARA encompasses 328,500 acres, which includes 122,800 acres of valley fill areas (these represent the four groundwater basins), and 205,700 acres of tributary hills and mountains. ULARA is bounded on the north and northwest by the Santa Susana Mountains; on the north and northeast by the San Gabriel Mountains; on the east by the San Rafael Hills; and on the south by the Santa Monica Mountains (ULARA Watermaster, 2021).

Water rights in ULARA were first established by Superior Court Case No. 650079, signed March 14, 1968, which defined four distinct groundwater basins: San Fernando, Sylmar, Verdugo, and Eagle Rock. The water supplies of these basins are separate and are replenished by deep percolation from rainfall, surface runoff, and a portion of the municipal-supply water that is delivered for use within these basins. The judgment is enforced by a court-appointed watermaster. It also created an administrative committee to advise with, request or consent to, and review actions of the Watermaster. The committee consists of one voting member from each of five municipal water agencies: Los Angeles, Glendale, Burbank, San Fernando, and Crescenta Valley Water District.



Crescenta Valley Water District

Figure 3-2. Potable Water System



- Water District Boundary
- Potable Water System Pipeline
- Aeration Tower
- Debris Basin
- Emergency Water Supply Interconnection
- Interconnection
- Mixing Station
- Motor Control Center
- Pipeline Crossing
- Potable Water Treatment Plant
- Pressure Reducing Station
- Reservoir
- Water Booster Pump Station
- Well

N

0 0.25 0.5 Miles

Data Sources: CVWD, Los Angeles Co., Esri

Foothill Municipal Water District

The Foothill Municipal Water District (FMWD) was incorporated in 1952 to help meet the water needs of the rapidly growing foothill communities. Water leaders and voters saw the need to supplement local groundwater with water imported by the MWD, of which FMWD became a member agency. FMWD is a wholesaler that serves retail agencies located in the foothills of the San Gabriel Mountains in Los Angeles County, including Crescenta Valley Water District, La Cañada Irrigation District, Las Flores Water Company, Lincoln Avenue Water Company, Liberty Utilities, Rubio Cañon Land & Water Association, and Valley Water Company.

Metropolitan Water District of Southern California

The Metropolitan Water District of Southern California is a public agency incorporated in 1928 to build the Colorado River Aqueduct, a facility it still owns and operates. MWD's primary purpose is to provide a supplemental water supply for domestic and municipal uses at wholesale rates to its member agencies. MWD imports water from two sources: the Colorado River via the Colorado River Aqueduct and Northern California via the California Aqueduct. MWD consists of 26 member agencies that include 14 cities, 11 municipal water districts, and one county water authority. It is governed by a 38-member board of directors made up from the member agencies.

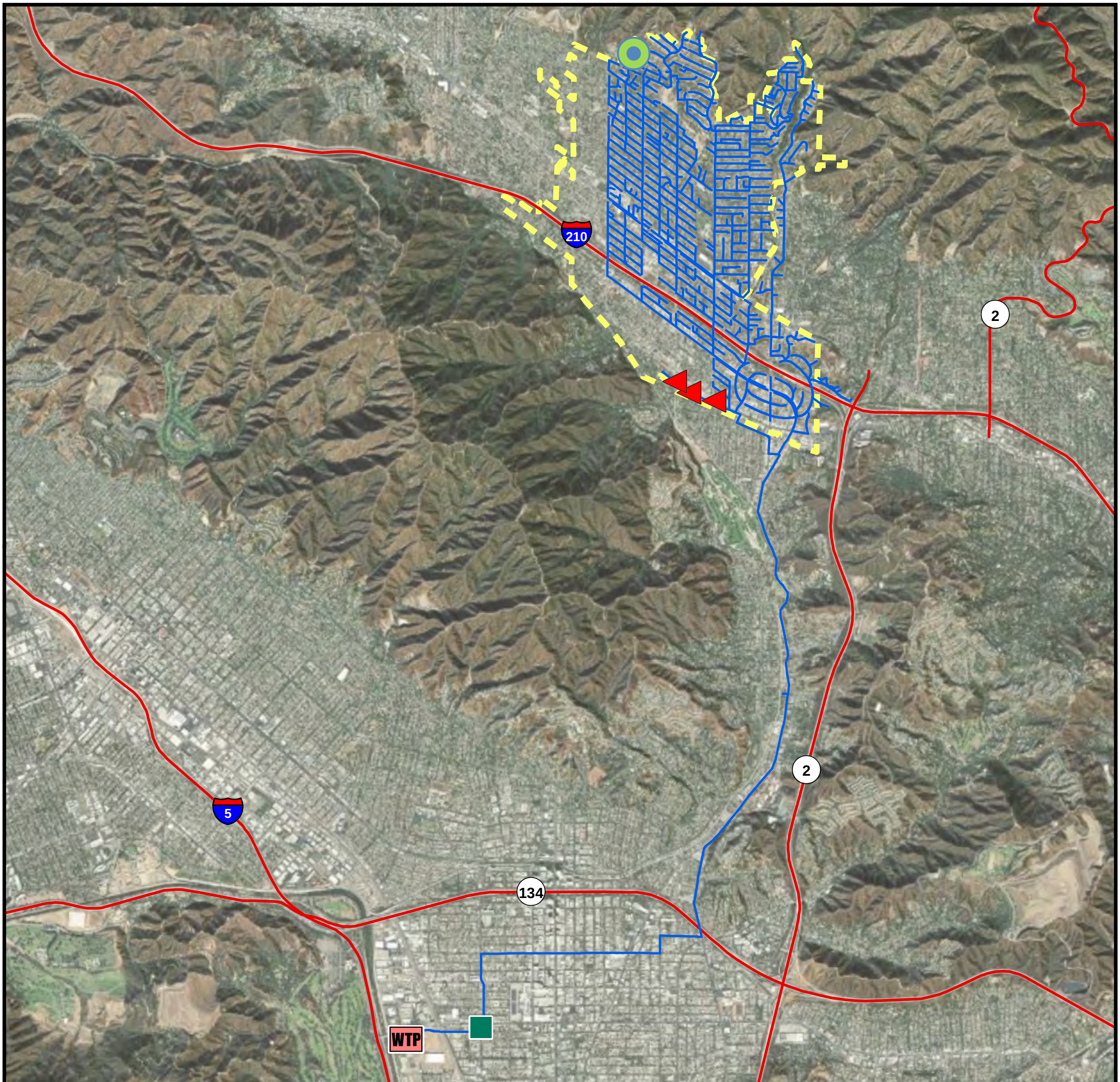
MWD's service area comprises 5,200 square miles and includes portions of the counties of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura. Existing MWD facilities include a 242-mile-long Colorado River Aqueduct with five pumping plants, a distribution system utilizing eight functional reservoirs, five water treatment plants, 43 pressure control structures, 16 hydroelectric plants, and 830 miles of large diameter pipelines.

Emergency Interconnections

In the event of a water outage, CVWD has the ability to receive water from the City of Glendale, La Cañada Irrigation District, and Los Angeles Department of Water and Power through emergency water supply interconnections.

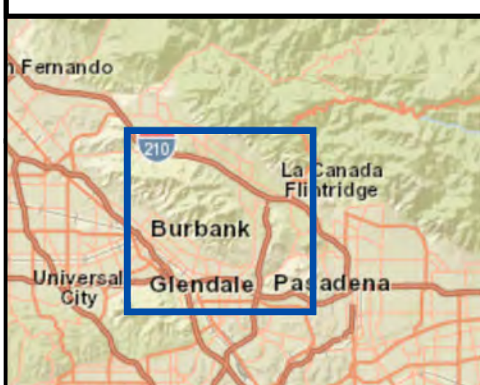
3.4.2 Wastewater

CVWD has owned and operated a wastewater collection system on behalf of its customers since the sewers were constructed in the early 1980s. The installation of this collection system was mandated by the Los Angeles Region State Water Resources Control Board (Order No. 76-2). The District does not treat or dispose of this sewage but merely conveys it in a large sewer pipe (interceptor) through the City of Glendale until it reaches the Los Angeles – Glendale Wastewater Reclamation Plant located adjacent to the Los Angeles River, southwest of Glendale. The sewage undergoes treatment at the plan, with the treated effluent discharged to the Los Angeles River and the residual sludge transported by large interceptor lines to the Hyperion Wastewater Treatment Plant in Playa Del Rey for further processing and ultimate disposal into Santa Monica Bay. The wastewater service area is shown on Figure 3-3.



Crescenta Valley Water District

Figure 3-3. Wastewater System



Wastewater Pipelines

Water District Boundary

Sewer Control Valve

Sewer Flow Meter

Sewer Wet Well

Wastewater Treatment Plant

N

0 0.5 1 Miles

Data Sources: CVWD, Los Angeles Co., Esri

3.5 DISTRICT FACILITIES

This Hazard Mitigation Plan assesses the potential risk that natural hazards pose to buildings, infrastructure and equipment owned by the District. This assessment of risk requires that an inventory of key facilities be developed. The inventory created for this plan includes two parts: an overview count of specific types of assets that the District owns, and a listing of the estimated replacement value of key assets.

All of the District's key assets—buildings, wells, pump, tanks, and pipelines—are defined for this plan as the District's critical facilities. Table 3-1 summarizes the District's critical assets and their estimated value.

Table 3-1. Crescenta Valley Water District Assets

Asset	Count	Estimated Replacement Cost
General Structures		
Buildings	4	$8,180,000
Total	*4*	*$8,180,000*
Potable Water Structures		
Aeration Tower	2	$380,000
Emergency Interconnection	21	$1,575,000
Fitting	1,924	$2,886,000
Hydrant	695	$5,212,500
Interconnection	2	$606,250
Mixing Station	1	$510,000
Motor Control Center	21	$6,500,000
Potable Water Treatment Plant	10	$1,512,500
Potable Water Valve	2,279	$11,395,000
Pressure Reducing Station	7	$2,375,000
Reservoir	19	$47,405,000
Water Booster Pump Station	14	$13,175,000
Well	12	$31,500,000
Total	***5,007***	***$125,032,250***
Wastewater Structures		
Sewer Control Valve	3	$1,350,000
Sewer Fitting	6,482	$6,482,000
Sewer Flow Meter	1	$150,000
Sewer Manhole	1,270	$25,400,000
Sewer Wet Well	1	$20,000
Wastewater Lift Station	2	$1,700,000
Total	***7,759***	***$35,102,000***
Pipelines	**Miles**	
Potable Water Pipelines	95	$231,919,368
Wastewater Pipelines	68.9	$181,863,149
Total	*172.2*	*$413,782,517*
Total Value for All District Assets		**$582,096,767**

3.6 PHYSICAL CHARACTERISTICS

3.6.1 Topography

The District serves an area of approximately 4 square miles in relatively steep terrain ranging from 1,200 feet to almost 3,000 feet above sea level along the foothills of the San Gabriel Mountains.

3.6.2 Soils and Geology

The geologic setting of the County of Los Angeles is largely the result of the tectonic plate boundary between the North American and Pacific plates that runs along the northern edge of the county. The San Andreas Fault forms the boundary between these plates and bisects the state in a northwest to southeast direction. In the Los Angeles area, the fault bends to an east-west orientation before returning to its former course. Crustal forces resulting from this change in geometry are uplifting the San Gabriel Mountains. The San Gabriel Mountains experience a high rate of uplift that is being counteracted by high erosion rates. As a result, the county's valleys contain deep deposits of alluvial sediments.

The District service area occupies the west end of the Crescenta Valley and adjacent highlands to the south. The Crescenta Valley is the westernmost portion of the larger San Gabriel Valley and is set between the San Gabriel Mountains to the north and the Verdugo Mountains and San Rafael Hills to the south. Topography in the service area is dominated by dramatic alluvial fans along the San Gabriel range front. Consistent with this setting, slopes are steeper adjacent to the range front, decreasing southward toward the valley floor. The valley floor itself is fairly flat and slopes eastward toward the main San Gabriel Valley.

The District service area is situated on soils assigned to the Hanford and Vista-Amargosa soil associations. Lowland areas are underlain by Hanford soils; uplands are underlain by Vista-Amargosa soils (U.S. Soil Conservation Service 1969). The Hanford association consists of loam and sandy loam soils that are well drained, with slow runoff, slight erosion hazard (except where dry soils are subject to wind erosion), and moderately rapid subsoil permeability. Shrink-swell hazard (i.e., expansion potential) is typically low (U.S. Soil Conservation Service 1969).

The Vista-Amargosa association consists of thinner sandy loam soils are well drained and exhibit moderately rapid subsoil permeability. Amargosa soils are excessively drained, with rapid runoff and moderately rapid subsoil permeability. Erosion hazard is high; Amargosa soils are prone to sheet and rill erosion and gullying. Shrink-swell hazard is low (U.S. Soil Conservation Service 1969). As noted above, soils upon which the City is situated pose potential hazards, including erosion and topsoil loss due to wind and rainfall, and slope instability resulting from development.

3.6.3 Climate

In the district service area, the summers are warm, arid, and clear and the winters are long, cold, wet, and partly cloudy. Over the course of the year, the temperature typically varies from 41°F to 86°F and is rarely below 34°F or above 94°F (WeatherSpark, 2020). Table 3-2 summarizes key climate data in the District.

Table 3-2. Average Los Angeles County Climate Data

	Pasadena	San Gabriel Canyon
Period of record	1893-2016	1917-2016
Annual Average Minimum Temperature	51.0º F	52.8º F
Annual Average Maximum Temperature	76.8º F	78.2º F
Average Annual Mean Temperature	63.9º F	65.5º F
Average Annual Precipitation	20.24”	22.28”

Source: Western Region Climate Center, 2020

Most precipitation occurs from December through March. Precipitation during the summer is infrequent, and rainless periods of several months are common. Precipitation usually occurs as localized cloudbursts, mostly in the mountains and deserts after summer, and light to moderate rains in winter. Six to eight heavy rain events each year result in most of the total precipitation. In general, the quantity of precipitation increases with elevation.

Although the basic air flow above the area is from the west or northwest during most of the year, mountain chains deflect these winds so that, except for the immediate coast, wind direction is more a product of local terrain than of the prevailing circulation. Strong and sometimes damaging winds from the east or northeast occur when there is a strong high-pressure area to the east and an intense low-pressure area approaching the coast from the west. In southern California, these winds are called Santa Ana winds. Their air is typically very dry, and the winds are strong and gusty, sometimes exceeding 100 mph, particularly near the mouth of canyons oriented along the direction of airflow. These conditions occasionally lead to serious fire suppression problems and often result in the temporary closing of highways to campers, trucks, and light cars. These land and sea breezes are more pronounced in summer and impact air pollution levels.

The Greater Los Angeles Basin area is almost completely enclosed by mountains on the north and east. In addition, a vertical temperature structure (inversion) in the air along most of coastal California tends to prevent vertical mixing of the air. The geographical configuration and coastal location of the basin area permit a fairly regular daily reversal of wind direction—offshore at night and onshore during the day.

3.7 DEVELOPMENT PROFILE

The customer base is primarily residential with some light commercial uses along Foothill Boulevard in La Crescenta and Honolulu Avenue in Montrose. Customer growth is steady although the Crescenta Valley area is nearly built-out. Residential growth is occurring through increased housing density in the multiple-unit zoned areas (primarily Montrose) as well as limited in-fill housing development on random parcels in La Crescenta.

3.7.1 Current Land Use

As a service provider, the District possesses no land use authority. Such authority lies with the municipal governments that intersect the District’s service area. However, a land use analysis can provide a gauge of service demand the District can face. Table 3-3 presents existing land uses in the CVWD service area, as listed in the District’s 2006 Water Master Plan.

Table 3-3. Land Use within the CVWD Service Area

Land Use	Planning Area	
	Area (acres)	% of total
Residential		
R-1, Single Family Residential	1,555.7	81.1%
R-2, Duplex Family Residential	51.7	2.7%
R-3, Multiple Family Residential	167.1	8.7%
Commercial/Industrial		
C-1, Restricted Small Commercial	27.0	1.4%
C-2, Neighborhood Commercial	62.7	3.3%
C-3, Retail Commercial	38.4	2.0%
Other		
IT, Institutional	8.7	0.4%
OS, Open Space	5.3	0.3%
PARK, Parks	2.2	0.1%
Total Service Area	**1,918.8**	**100%**

3.7.2 Development Trends

Future growth within the District's service area will impact the demand for its services. The following is an overview of the expected future development trends for the portions of Los Angeles County, City of Glendale, and City of La Canada Flintridge that interface with the District service area.

City of Glendale Land Use Element

The City of Glendale's Land Use Element supports the creation of higher density residential development and alternative forms of medium and high-density housing in areas best suited from the standpoint of accessibility, current development, community organization, transportation and circulation facilities and economic feasibility. Higher density development may increase the demand on CVWD services. The City of Glendale is also undertaking a visioning process in the Verdugo Wash, where most of Crescenta Valley Water District's wells are located. The City is currently seeking firms with project expertise to assist in developing a high level vision, including but not limited to, conceptual design, programming, and integration of the Verdugo Wash into the existing and anticipated land use framework as a linear park and spine of the City's pedestrian and bicycle infrastructure. CVWD should investigate this project to determine potential impacts on well locations.

City of La Cañada Flintridge General Plan

Development within the City of La Cañada Flintridge is guided by the city's general plan. Based upon the general plan's housing element the city is largely built out, adding only 106 net new units to the city between 2000 and 2014. However, recent population changes in the area have caused the city to strategize on bringing more mixed-use and senior housing to the community, as well as single-family infill and accessory dwelling units. Given these housing changes, it is possible that CVWD will face greater demand for their services.

Crescenta Valley Town Council Land Use Committee

The Crescenta Valley Town Council's Land Use Committee has had several discussions on upcoming land use changes in the La Crescenta-Montrose area. In their February 6, 2020 committee meeting, members discussed the

Southern California Association of Governments estimation that the area around Crescenta Valley needs 36,000 more housing units to be on track for state-required housing needs. Given local and state legislation has been focused on increasing housing in the county and state, including allowing the construction of accessory dwelling units, it is likely that Crescenta Valley Water District will have a larger clientele within the next few years, increasing the demand on their services and infrastructure.

Los Angeles County General Plan-Housing Element Update

Los Angeles County is updating the Housing Element portion of its General Plan for 2021-2029. As part of this update, the County will provide for development of housing to meet projected future needs. The County has determined that for the 8-year housing cycle (2021-2029), unincorporated areas of Los Angeles County require 90,000 additional housing units.

The County is proposing that 1,200 of those units be provided within unincorporated La Crescenta and Montrose. The County is proposing to accomplish this by rezoning 33 lots in the Montrose area to a higher density. This means that the County is proposing to allow about 1,300 additional housing units in Montrose. Clustered at the intersections of Florencita Avenue and Ocean View Boulevard and Florencita Avenue and Montrose Avenue.

Regional planning is currently working on community outreach. A final recommendation is going to be voted on at the Planning Commission in August 2021. It will then be voted on by the board of supervisors and sent to the state by the end of 2021. Once the rezoning plan is approved, changes will go into effect in 2024.

3.8 DEMOGRAPHICS

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly, women, children, ethnic minorities, renters, individuals with disabilities, and others with access and functional needs, all experience more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would help to extend focused public outreach and education to these most vulnerable residents.

The following demographic profiles represent estimates of District demographics based on data from the U.S. Census American Community Survey data sets. Census data is communicated by census tracts and blocks that target municipal boundaries and other census designated places. These boundaries do not align with the District's service area boundaries, which encompasses the La Crescenta-Montrose Census Designated Place (CDP), a portion of the City of La Cañada Flintridge, and a portion of the City of Glendale.

3.8.1 Population Characteristics

Knowledge of the composition of the population and how it has changed in the past and how it may change in the future is needed for making informed decisions about the future. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Population demographics are not typically reported for special purpose districts by state and federal agencies as district boundaries typically do not align with Census tracks or blocks. Demographics for special purpose districts are often assessed based on the largest municipal population centers within the district's service area. The population data sources used for this demographic profile was the city of La Cañada Flintridge and the La Crescenta-Montrose CDP. The American Community Survey's estimated 2019 population is 20,261 for La Cañada Flintridge and 19,689 for the La Crescenta-Montrose CDP (Census Bureau, 2019).

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population may signify economic decline. Figure 3-4 shows the population change in La Cañada Flintridge from 2000 to 2019 compared to that of the State of California (California Department of Finance, 2020).

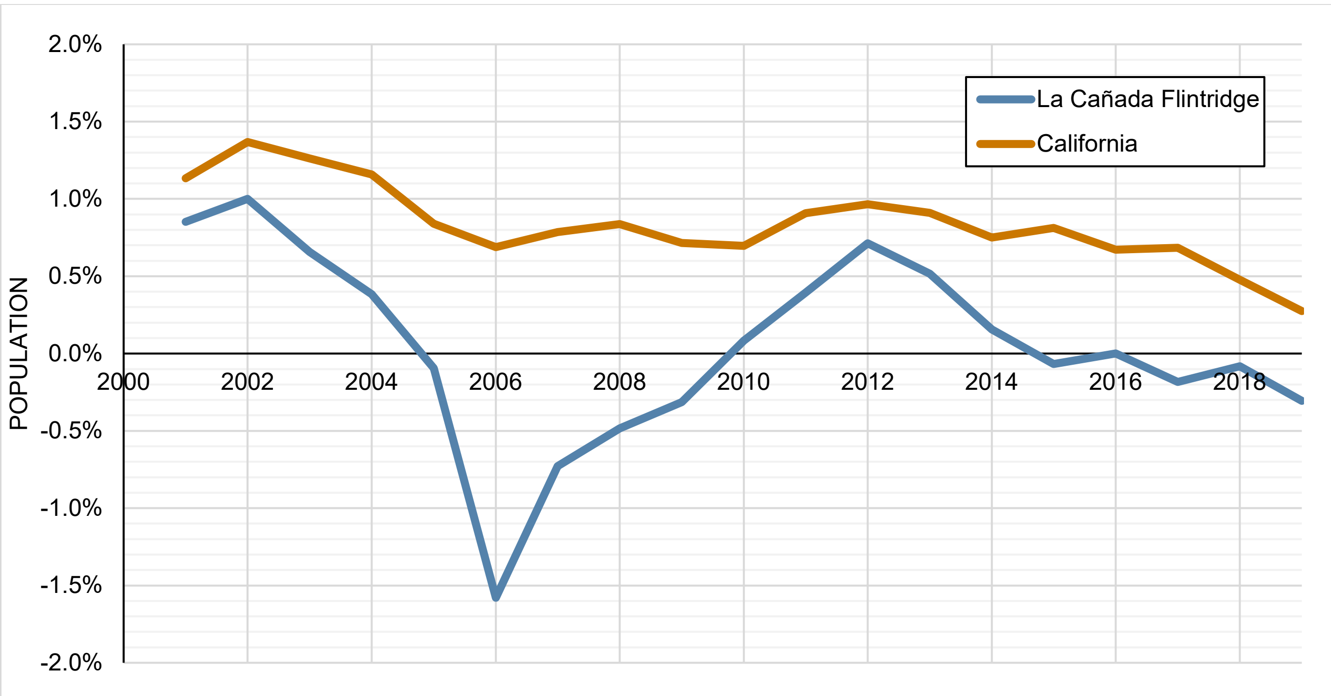


Figure 3-4. California and La Cañada Flintridge Population Growth

Between 2000 and 2019, California's population grew by 0.91 percent (about 0.05 percent per year) while La Cañada Flintridge's population increased by 15.93 percent (0.84 percent per year). The city experienced peak population growth in 2012, after rising between 2007 and 2012. The state experienced peak growth in 2002, with the annual state growth rate generally slowing from 2016 to 2019. The rate has slowly decreased since 2016, resulting in net population loss from 2017 on. The city population decreased from 2004 through 2006 and 2012 through 2019. Between 2012 and 2019, the population increased an average of 0.69 percent per year, for a total of 5.55 percent. Table 3-4 shows the population in La Cañada Flintridge and Los Angeles County from 2000 to 2019.

Table 3-4. Annual Population Data

Year	La Cañada Flintridge	Los Angeles County	Year	La Cañada Flintridge	Los Angeles County
2000	20,318	9,519,330	**2010**	20,266	9,822,121
2001	20,491	9,590,080	**2011**	20,346	9,879,298
2002	20,696	9,679,212	**2012**	20,491	9,956,882
2003	20,832	9,756,914	**2013**	20,597	10,025,712
2004	20,912	9,806,944	**2014**	20,629	10,078,930
2005	20,892	9,816,153	**2015**	20,615	10,126,423
2006	20,562	9,798,609	**2016**	20,615	10,158,196
2007	20,412	9,780,808	**2017**	20,577	10,193,735
2008	20,313	9,785,474	**2018**	20,560	10,209,676
2009	20,249	9,801,096	**2019**	20,497	10,184,378

Source: California Department of Finance, Demographic Research Unit

3.8.2 Age Distribution

As a group, elderly populations are more likely to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as “critical facilities” by emergency managers because they require extra notice to implement evacuation. Elderly customers living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for their basic needs. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

The overall age distribution is shown in Figure 3-5 for the La Crescenta Montrose CDP and the City of La Cañada Flintridge, based on the most recent 5-year estimates from the U.S. Census Bureau’s American Community Survey (2015-2019). According to the Census data, 37 percent of the over-65 population in La Crescenta Montrose and 19.2 percent in the City of La Cañada Flintridge have disabilities of some kind; 7.4 percent (La Crescenta Montrose CDP) and 2.2 percent (City of La Cañada Flintridge) have incomes below the poverty line. Among children under 18 in the La Crescenta Montrose CDP, 4.9 percent are below the poverty line. Among children under 18 in the City of La Cañada Flintridge, 2.3 percent are below the poverty line.

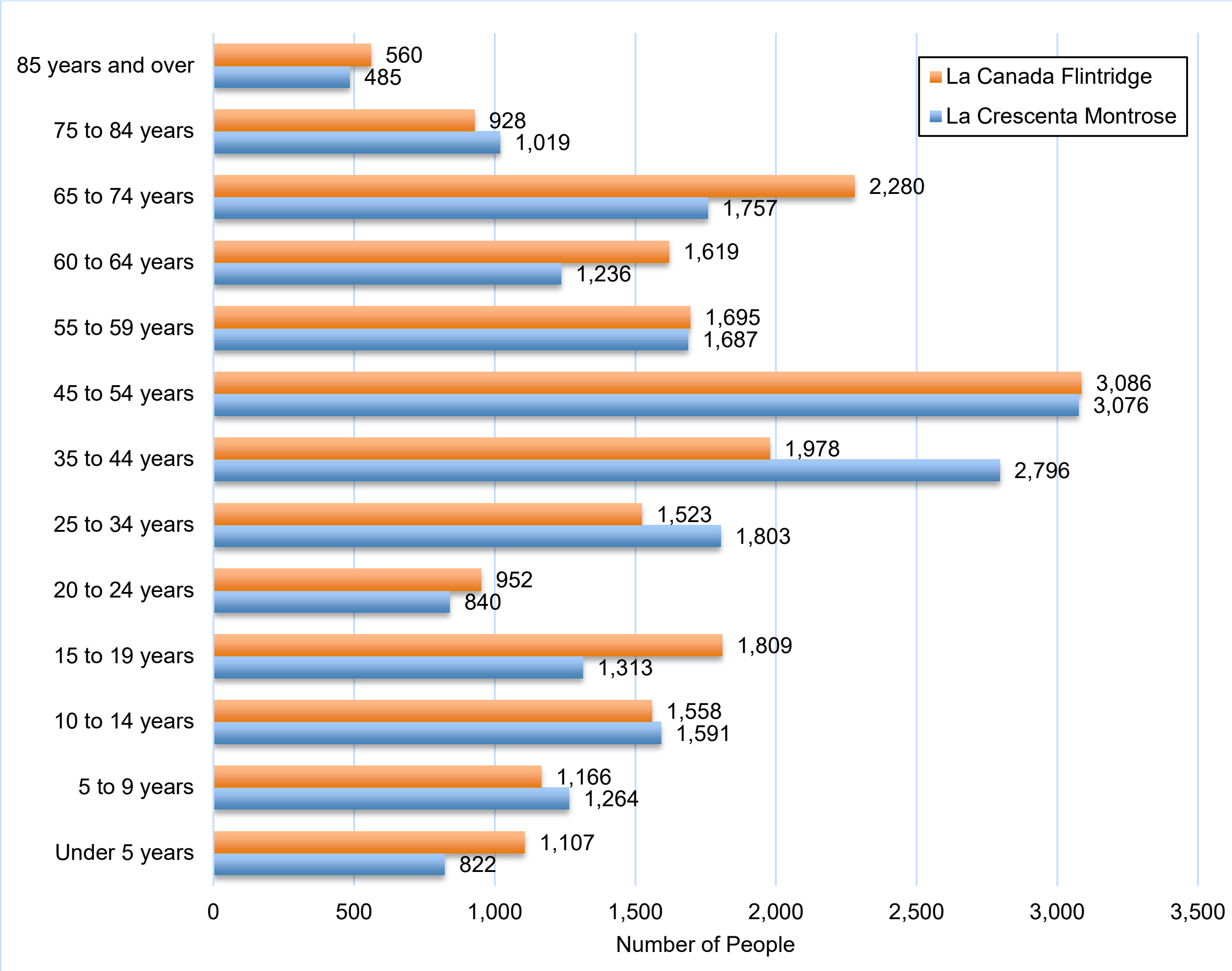


Figure 3-5. Age Distribution in the La Crescenta Montrose CDP

3.8.3 Race, Ethnicity and Language

Research shows that racial and ethnic minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability (Office of Minority Health, 2008).

Figure 3-6 and Figure 3-7 show the U.S. Census 2019 racial distribution in the La Crescenta Montrose CDP and the City of La Cañada Flintridge, based on race categories defined by U.S. Office of Management and Budget standards. The Census Bureau also reports that 16.3 percent of the La Crescenta Montrose CDP and 10.0 percent of City of La Cañada Flintridge's population is of Hispanic origin, which indicates the heritage, nationality, lineage, or country of birth of the person or the person's parents or ancestors before arriving in the United States and may be any race.

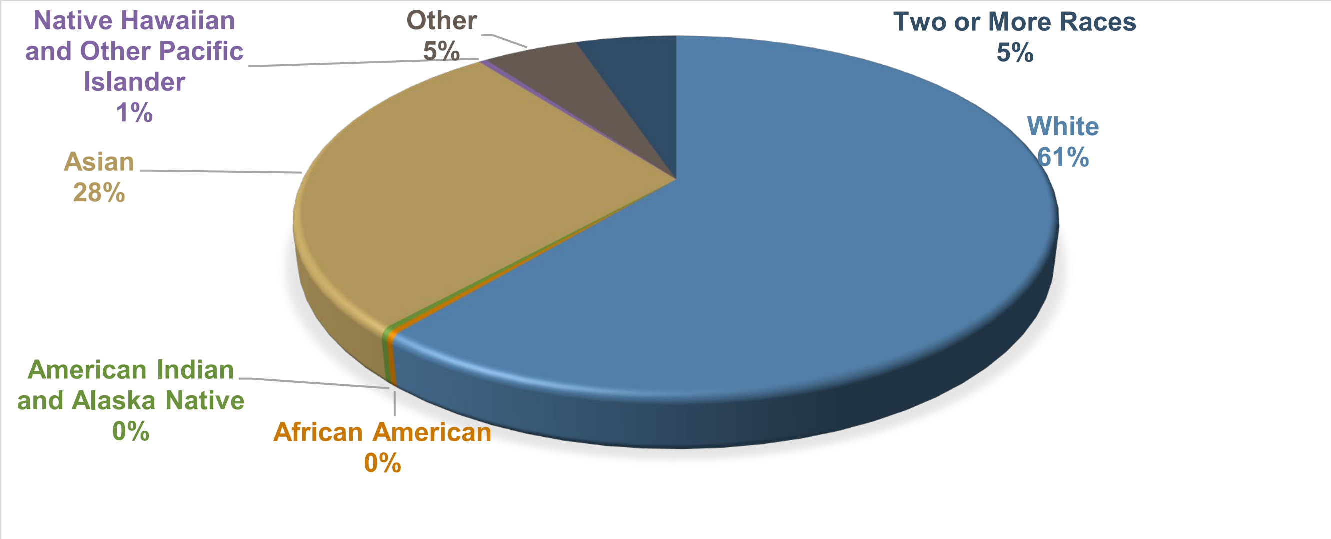


Figure 3-6. La Crescenta-Montrose CDP Race Distribution

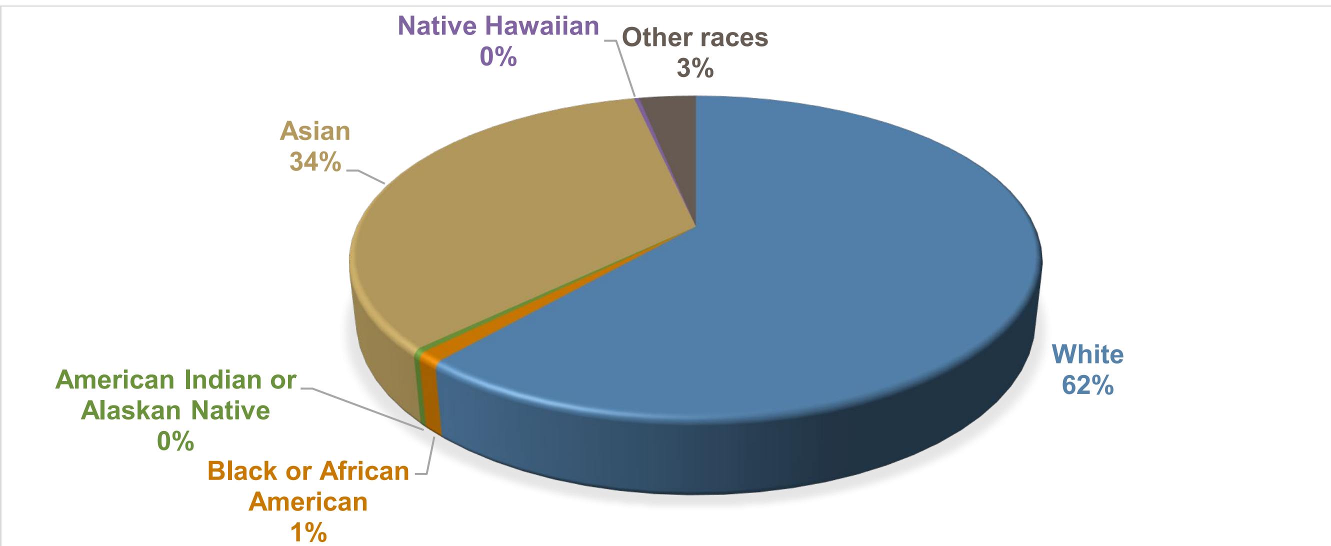


Figure 3-7. City of La Cañada Flintridge Race Distribution

According to the U.S. Census, 57.2 percent of families in the La Crescenta Montrose CDP speak English only at home. 42.8 percent of families speak a language other than English at home; the largest contingent of those families speak Asian and Pacific Island languages (20.6 percent).

According to the U.S. Census, 64.8 percent of families in the City of La Cañada Flintridge speak English only at home. 35.2 percent of families speak a language other than English at home; the largest contingent of those families speak Asian and Pacific Island languages (16.7 percent).

3.8.4 Individuals with Disabilities or Access and Functional Needs

Individuals with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability gives emergency management personnel and first responders an opportunity to ensure that emergency plans and procedures include considerations for addressing the needs of that population.

According to the 5-year American Community Survey (2015-2019), there are 2,036 individuals in the La Crescenta Montrose CDP and 1,118 individuals in the City of La Cañada Flintridge with some form of disability. These individuals represent 10.3 percent and 5.5 percent of the total population respectively.

4. RELEVANT LAWS, ORDINANCES, PROGRAMS AND CAPABILITIES

Existing laws, ordinances, plans and capabilities at the federal, state, and local level can support, or impact hazard mitigation initiatives identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process, as stated in 44 CFR, Section 201.6(b)(3). Pertinent federal, state, and local laws are described below.

4.1 RELEVANT FEDERAL AND STATE AGENCIES, PROGRAMS AND REGULATIONS

State and federal regulations and programs that need to be considered in hazard mitigation are constantly evolving. For this plan, a review was performed to determined which regulations and programs are currently most relevant to hazard mitigation planning for CVWD. The findings are summarized in Table 4-1 and Table 4-2. Short descriptions of each program are provided in Appendix B.

Table 4-1. Summary of Relevant Federal Agencies, Programs and Regulations

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
A Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment	Wildfire Hazard	This strategy implementation plan prepared by federal and western state agencies outlines measures to restore fire-adapted ecosystems and reduce hazardous fuels.
Americans with Disabilities Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
America's Water Infrastructure Act (2018)	Infrastructure Improvements	This act provides for water infrastructure improvements throughout the country.
Civil Rights Act of 1964	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Clean Water Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Community Development Block Grant Disaster Resilience Program	Action Plan Funding	This is a potential alternative source of funding for actions identified in this plan.
Disaster Mitigation Act	Hazard Mitigation Planning	This is the current federal legislation addressing hazard mitigation planning.
Endangered Species Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
Federal Energy Regulatory Commission Dam Safety Program	Dam Failure Hazard	This program cooperates with a large number of federal and state agencies to ensure and promote dam safety.
Federal Wildfire Management Policy and Healthy Forests Restoration Act	Wildfire Hazard	These documents mandate community-based collaboration to reduce risks from wildfire.
National Environmental Policy Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
National Dam Safety Act	Dam Failure Hazard	This act requires a periodic engineering analysis of most dams in the country
National Fire Plan (2001)	Wildfire Hazard	This plan calls for joint risk reduction planning and implementation by federal, state, and local agencies.
National Incident Management System	Action Plan Development	Adoption of this system for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards is a prerequisite for federal preparedness grants and awards.
Presidential Executive Order 11988 (Floodplain Management)	Flood Hazard	This order requires federal agencies to avoid long and short-term adverse impacts associated with modification of floodplains.
Presidential Executive Order 11990 (Protection of Wetlands)	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable presidential executive orders.
U.S. Army Corps of Engineers Dam Safety Program	Dam Failure Hazard	This program is responsible for safety inspections of dams that meet size and storage limitations specified in the National Dam Safety Act.
U.S. Army Corps of Engineers Flood Hazard Management	Flood Hazard, Action Plan Implementation, Action Plan Funding	The Corps of Engineers offers multiple funding and technical assistance programs available for flood hazard mitigation actions.
U.S. Fire Administration	Wildfire Hazard	This agency provides leadership, advocacy, coordination, and support for fire agencies and organizations.
U.S. Fish and Wildlife Service	Wildfire Hazard	This service's fire management strategy employs prescribed fire throughout the National Wildlife Refuge System to maintain ecological communities.

Table 4-2. Summary of Relevant State Agencies, Programs and Regulations

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
AB 32: The California Global Warming Solutions Act	Action Plan Development	This act establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020.
AB 2242- Urban Water Management Planning Act	Drought Hazard	Requires an urban water management plan, among other things, to describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for average, single-dry, and multiple-dry water years.
AB 2800: Climate Change—Infrastructure Planning	Action Plan Development	This act requires state agencies to take into account the impacts of climate change when developing state infrastructure.
Alquist-Priolo Earthquake Fault Zoning Act	Earthquake Hazard	This act restricts construction of buildings used for human occupancy on the surface trace of active faults.
California Department of Forestry and Fire Protection (CAL FIRE)	Wildfire Hazard	CAL FIRE has responsibility for wildfires in areas that are not under the jurisdiction of the Forest Service or a local fire organization.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
California Governor's Office of Emergency Services (Cal OES)	Emergency Management including Hazard Mitigation	Cal OES oversee emergency management compliance including the use of Standardized Emergency Management System and approval of submitted Hazard Mitigation Plans. Local governments must use this system to be eligible for state funding of response-related personnel costs.
California Department of Parks and Recreation	Wildfire Hazard	State Parks Resources Management Division has wildfire protection resources available to suppress fires on State Park lands.
California Department Water Resources	Flood Hazard	This state department is the state coordinating agency for floodplain management.
California Division of Safety of Dams	Dam Failure Hazard	This division monitors the dam safety program at the state level and maintains a working list of dams in the state.
California Environmental Quality Act	Action Plan Implementation	This act establishes a protocol of analysis and public disclosure of the potential environmental impacts of development projects. Any project action identified in this plan will seek full California Environmental Quality Act compliance upon implementation.
California Fire Alliance	Wildfire Hazard	The alliance works with communities at risk from wildfires to facilitate the development of community fire loss mitigation plans.
California Fire Plan	Wildfire Hazard	This plan's goal is to reduce costs and losses from wildfire through pre-fire management and through successful initial response.
California Fire Safe Council	Wildfire Hazard	This council facilitates the distribution of National Fire Plan grants for wildfire risk reduction and education.
California Multi-Hazard Mitigation Plan	Hazard Mitigation Planning	Local hazard mitigation plans must be consistent with their state's hazard mitigation plan.
California Water-Use Efficiency Legislation	Hazard Mitigation Planning	Could be a program promoted by District outreach efforts.
Office of the State Fire Marshal	Wildfire Hazard	This office has a wide variety of fire safety and training responsibilities.
CA Governor Executive Order B-37-16	Making Water Conservation a Way of Life	Water Districts must conduct a "stress test," that is, examine the projected reliability of all their water supply resources over the next three years, and assume that water demand is high, and that precipitation levels are low. Results of this analysis could support the identification of projects for this hazard mitigation plan.
State Water Resources Control Board Order No. 2006-0003-DWQ Statewide General Waste Discharge Requirements for Sanitary Sewer Systems	Action Plan identification	The purpose of the order is to prevent sanitary sewer overflows or sewer spills by establishing a statewide Monitoring and Reporting Program and requiring each local or regional sewer agency to create and implement its own sewer system management plan based on the mandatory requirements of the order.

4.2 COUNTY, CITY OR OTHER DISTRICT

The following local plans provide information and guidance relevant to hazard mitigation planning for the District:

- Los Angeles County Emergency Operations Plan
- 2019 County of Los Angeles All-Hazards Mitigation Plan
- City of La Cañada Flintridge Hazard Mitigation Plan, 2019
- City of Glendale Natural Hazards Mitigation Plan, 2018
- Los Angeles County General Plan 2035-Safety Element

- City of La Cañada Flintridge General Plan-Safety Element
- Metropolitan Water District of Southern CA, Integrated Water Resources Plan
- Metropolitan Water District of Southern CA, Urban Water Management Plan
- Metropolitan Water District of Southern CA, Water Surplus and Drought Management Plan
- Metropolitan Water District of Southern CA, Long Term Conservation Plan

4.3 DISTRICT CORE CAPABILITIES

The Planning Team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of an agency's mission, programs, and policies, and evaluates its capacity to carry them out. It presents a toolkit for implementation of the hazard mitigation plan.

The capability assessment identifies potential gaps in core capabilities and filling those gaps may eventually become actions in the plan. Assessment findings were shared with the Steering Committee as it developed the action plan shown in Chapter 18. If the review identified an opportunity to add or expand a capability, then doing so has been identified as a mitigation action. The District views each core capability to be fully adaptable as needed to meet the best interests of the District. This adaptability is an overarching District capability that is acknowledged by this reference.

4.3.1 Ordinances and Plans

Resolution No. 681

Resolution No. 681gives authority to the General Manager to implement a color-coded water conservation alert system. This is Phase II of the goal to reduce the risk and severity of water shortage, a result of increased demands, consecutive years of below normal precipitation in the Verdugo Basin watersheds, and the potential of reduced water allotments. The current color-coded system is described in Section 7.3.5.

Resolution No. 682

Resolution No. 682 authorizes the General Manager to implement a water conservation program as Phase I of the goal to reduce water use to below pre-drought water usage and reduce the risk and severity of water shortage. This resolution prohibited or had stringent restrictions for several water usages for all Crescenta Valley Water District customers, including:

- Water hose usage
- Overspray and runoff
- Fountains, similar structures
- Leaks
- Irrigating times
- Hand watering
- Windy and rainy days
- Vehicle washing
- Swimming pools
- Construction water restrictions
- Fire hydrants
- Drinking water upon request
- Hotels/Motels
- Reporting waste of water
- Pre-rinse spray valve

The district also urges the following water conservation practices to its customers:

- Reduce the amount of turf and install new drought tolerant landscaping, low-water using trees and plants, and efficient irrigation systems including but not limited to evapotranspiration (ET) controllers, drip irrigation, and "high efficiency sprinkler heads".
- Wash only full loads of dishes or clothes in automatic washers, and do not allow indoor faucets to run continuously.
- Turn off water system when leaving property unoccupied for an extended period of time.

2020 Strategic Plan

In October 2019, the CVWD Board of Directors adopted the 2020 Strategic Plan. CVWD and other water providers throughout California face a growing number of issues that directly impact the cost of providing reliable service. These issues include escalating energy costs, expanding regulatory costs, rising imported water costs, growing cumulative costs of deferred facility maintenance, increasing construction costs, a changing climate, and declining revenues due to conservation measures mandated by the state.

This new reality requires better planning and execution. A vision statement expands upon CVWD's mission to define what CVWD strives toward. During the planning process, the Board and staff established the following vision statement for the District: ***Secure sustainable water supplies and ensure infrastructure reliability, while furthering our commitment to accountability, transparency, and cost-effectiveness.***

CVWD developed this 2020 Strategic Plan to serve as a blueprint for future success. Transparency, partnership, and commitment are the guiding principles that define the connections between the District's customers, Board, and employees. This dynamic is best represented by the inverted pyramid shown to the left.

In order to develop a comprehensive plan capable of meeting the District's mission and vision, Effective Utility Management was identified as the preferred planning tool to determine strategy, goals, and objectives. The planning group, consisting of CVWD's Board and staff, conducted a self-assessment to gauge need and performance. Based on the results, the areas of concern were prioritized as follows:

1. Water Resource Sustainability
2. Infrastructure Strategy & Performance
3. Water Quality
4. Financial Viability
5. Customer Satisfaction
6. Stakeholder Understanding
7. Employee Leadership & Development
8. Enterprise Resiliency
9. Operational Optimization
10. Community Sustainability

As part of the Effective Utility Management process, CVWD will continue to measure success and adapt to fully execute the Strategic Plan. A Strategic Plan Update is scheduled in 2023 as part of our dedication to make this a living document.

2015 Urban Water Management Plan

The 2015 update of the CVWD Urban Water Management Plan was prepared consistent with Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act, which requires such plans for every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. These plans must be filed with the California Department of Water Resources (DWR) every five years describing and evaluating reasonable and practical efficient water uses, reclamation, and conservation activities.

The total water demand for the 32,385 people served by CVWD in 2015 was over 3,600 acre-feet of potable water. On average, 60 percent of CVWD's source water is local groundwater supply in the Basin. The majority of CVWD's groundwater wells are located along the Verdugo Wash, south of Honolulu Avenue. The remaining 40 percent of CVWD's source water is imported water supplied by FMWD, which is a member agency to MWD. The sources of imported water supplies include the Colorado River and the State Water Project. MWD's 2015 Integrated Water Resources Plan update describes the core water resource strategy, which will be used to meet full-service demands at the retail level under all foreseeable hydrologic conditions from 2020 through 2040.

CVWD is in the design phase of a wellhead treatment facility for Well No. 2. Installing the ARoNite biological nitrate removal treatment system will allow CVWD to reactivate Well No. 2, thereby aiding in groundwater recovery. When completed, this treatment facility will increase CVWD's ability to pump its adjudicated rights within the Verdugo Basin, utilize a local water source, reduce CVWD's dependence on imported water from MWD purchased through FMWD, and reduce nitrates levels in the groundwater pumped from the Basin.

CVWD is working towards the development of the Crescenta Valley County Park Multiuse Project. This Project will allow CVWD to increase groundwater storage in the Basin by the installation and maintenance of underground infiltration galleries underneath portions of the existing park. This will be accomplished by utilizing the existing Los Angeles County flood control channels, Verdugo Wash, and surface flow within the Crescenta Valley to divert storm water during the rainy season into underground infiltration basins within the recreational areas. The project will potentially increase the local groundwater supply by an annual average of 340 acre-feet per year, thus enhancing CVWD's groundwater resource and reducing dependence on imported supplies. Also, through the process of capture, treatment, and reuse of storm water and dry weather flow, the project could potentially reduce the pollutant load from contaminating the Los Angeles River.

CVWD is able to receive up to 2.2 cubic feet per second or 1.9 million gallons per day through an emergency interconnection with the City of Los Angeles Department of Water and Power, and can provide an emergency water supply to FMWD and its sub-agencies. As funding permits, CVWD plans to rehabilitate its older groundwater wells with new technologies over the 10-year period starting in 2015. The existing wells are between 55 to 80 years old and have reached the end of their useful life. CVWD's current program is to perform at least two well rehabilitations a year, which include cleaning the well casing with chemical treatment and installation of a liner to extend the life of the well.

Sewer System Management Plan

The 2019 Sewer System Management Plan supplements CVWD's operations and maintenance program and goals by providing high-level, consolidated guidelines and procedures for all aspects of the District's sewer system management. The Sewer System Management Plan will contribute to the proper management of the collection system and assist the District in minimizing the frequency and impacts of sewer system overflows by providing guidance for appropriate maintenance, capacity management, and emergency response.

Rainfall History

Crescenta Valley Water District has been tracking rainfall for the County of Los Angeles Public Works Water Resources Department since 1962. Staff have presented this historical rainfall information in a report that breaks the amounts down by month, year, and decade for each rain year (October 1 – September 30) from 1962 to present. The decade from 2010 – 2019 had an average yearly rainfall of 17.99 inches, compared to 26.31 inches from 1962 – 1969 and 22.39 inches between 1970 – 1979.

4.3.2 Financial Capabilities

Assessing a jurisdiction's fiscal capability provides an understanding of the ability to fulfill the financial needs associated with hazard mitigation projects. This assessment identifies both outside resources, such as grant-funding eligibility, and local jurisdictional authority to generate internal financial capability, such as through fees. An assessment of fiscal capabilities is presented in Table 4-3.

Table 4-3. Fiscal Capability

Financial Resources	CVWD Accessible or Eligible to Use?
Capital Improvements Project Funding	Yes
Authority to Levy Taxes for Specific Purposes	No
User Fees for Water, Sewer, Gas or Electric Service	Yes
Incur Debt through General Obligation Bonds	Yes
Incur Debt through Special Tax Bonds	No
State-Sponsored Grant Programs	Yes
Los Angeles County Sponsored Grant Programs	Yes
Federal-Sponsored Grant Programs	Yes

4.3.3 Administrative and Technical Capabilities

Administrative and technical capabilities focus on the availability of personnel resources responsible for implementing all the facets of hazard mitigation. An assessment of administrative and technical capabilities is presented in Table 4-4.

Table 4-4. Administrative and Technical Capability

Staff/Personnel Resources	Available?	Department/Agency/Position
Planners or engineers with knowledge of water supply infrastructure	Yes, 5	Engineering Department
Planners or engineers with an understanding of natural hazards	Yes, 5	Engineering Department
Staff with training in benefit/cost analysis	Yes, 2	Engineering Department
Personnel skilled or trained in GIS applications	Yes, 2	Engineering Department
Scientist familiar with natural hazards in local area	No	
Emergency manager	Yes, 2	Engineering Department
Grant writers	Yes, 1	Engineering Department

4.3.4 Public Outreach Capabilities

Regular engagement with the public on issues regarding hazard mitigation provides an opportunity to directly interface with community members. Assessing this outreach and education capability illustrates the connection between the government and community members, which opens a two-way dialogue that can result in a more resilient community based on education and public engagement. An assessment of education and outreach capabilities is presented in Table 4-5.

Table 4-5. Education and Outreach Capability

Criterion	Response
Do you have a public information officer or communications office?	Yes, Christy Colby
Do you have personnel skilled or trained in website development?	No
Do you have hazard mitigation information available on your website? • **If yes, briefly describe.**	Yes https://www.cvwd.com/local-hazard-mitigation-plan
Do you use social media for hazard mitigation education and outreach? • **If yes, briefly describe.**	Yes Website, Facebook, Nixle
Do you have any citizen boards or commissions that address issues related to hazard mitigation? • **If yes, briefly describe.**	Crescenta Valley Fire Safety Council a non-profit volunteer organization whose mission is preparing for and recovering from forest fires and other natural disasters; Neighbors Helping Neighbors.
Do you have any other programs already in place that could be used to communicate hazard-related information? • **If yes, briefly describe.**	Yes The Los Angeles County Hazard Mitigation Plan website provides a good source of information for the general population within the CVWD service area (https://lacounty.gov/emergency/county-of-los-angeles-all-hazards-mitigation-plan/)
Do you have any established warning systems for hazard events? • **If yes, briefly describe.**	Yes Email to customers through Everbridge

4.4 OPPORTUNITIES FOR INTEGRATION

As this core capability assessment has identified, the District has a high degree of core capability with its existing plans, programs, and core capacities for funding, administrative and technical and public outreach. Each of these capabilities represents an opportunity for future plan integration with the Hazard Mitigation Plan. The District recognized that this Plan includes valuable information that can inform, support, or enhance future updates to the core capabilities identified in this assessment. These capabilities include:

- Future updates to the District's Strategic Plan.
- Future updates to the Sewer System Management Plan
- Future updates to the Urban Water Management Plan
- Future updates to the Water Master Plan
- Future Wastewater Master Plan

The District is fully committed to plan integration where feasible and valuable, as evidenced by the identification of plan integration in the action plan provided in Chapter 18.

Part 2. Risk Assessment

5. HAZARDS OF CONCERN

5.1 HISTORY OF HAZARD EVENTS IN THE PLANNING AREA

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without federal assistance. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses, and public entities. Table 5-1 lists declared hazard events whose effective area included the District service area (declared events within Los Angeles County). Such a declaration does not necessarily indicate that any District assets were damaged by the event.

Table 5-1. Presidential Disaster Declarations with Affected Area Including the District Service Area

Type of Event	Date	Disaster Declaration	Counties Impacted[a]
Wildfires	10/16/2020	DR-4569	Fresno, Los Angeles, Madera, Mendocino, Napa, San Bernardino, San Diego, Shasta, Siskiyou, Sonoma
COVID-19 Pandemic	03/22/2020	DR-4482	All California Counties
Wildfires	11/12/2018	DR-4407	Butte, Los Angeles, Ventura
Wildfires, Mudflows, and Debris Flows	01/02/2018	DR-4353	Los Angeles, San Diego, Santa Barbara, Ventura
Severe Winter Storms, Flooding, and Mudslides	03/16/2017	DR-4305	Alameda, Calaveras, Contra Costa, El Dorado, Inyo, Kern, Los Angeles, Mendocino, Modoc, Mono, Napa, Orange, Sacramento, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Trinity, Tuolumne, Yolo
Severe Winter Storms, Flooding, and Debris and Mud Flows	03/08/2010	DR-1884	Calaveras, Imperial, Los Angeles, Riverside, San Bernardino, Siskiyou
Wildfires	11/18/2008	DR-1810	Los Angeles, Orange, Riverside, Santa Barbara
Wildfires	10/24/2007	DR-1731	Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, Ventura
Severe Freeze	03/13/2007	DR-1689	Fresno, Imperial, Kern, Kings, Los Angeles, Madera, Merced, Monterey, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, Tulare, Ventura
Severe Storms, Flooding, Landslides, and Mud and Debris Flows	04/14/2005	DR-1585	Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Ventura
Severe Storms, Flooding, Debris Flows, and Mudslides	02/04/2005	DR-1577	Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, Ventura
Wildfires	10/27/2003	DR-1498	Los Angeles, Riverside, San Bernardino, San Diego, Ventura

Type of Event	Date	Disaster Declaration	Counties Impacted[a]
Severe Winter Storms and Flooding	02/09/1998	DR-1203	Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Del Norte, Fresno, Glenn, Humboldt, Kern, Lake, Los Angeles, Marin, Mendocino, Merced, Monterey, Napa, Orange, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus, Sutter, Tehama, Trinity, Tulare, Ventura, Yolo, Yuba
Severe Winter Storms, Flooding, Landslides, Mud Flows	03/12/1995	DR-1046	Alameda, Alpine, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Humboldt, Imperial, Inyo, Kern, Kings, Lake, Lassen, Los Angeles, Madera, Marin, Mariposa, Mendocino, Merced, Modoc, Mono, Monterey, Napa, Nevada, Orange, Placer, Plumas, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Solano, Sonoma, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, Ventura, Yolo, Yuba
Severe Winter Storms, Flooding, Landslides, Mud Flows	01/10/1995	DR-1044	Alameda, Amador, Butte, Colusa, Contra Costa, Del Norte, El Dorado, Glenn, Humboldt, Kern, Kings, Lake, Lassen, Los Angeles, Madera, Marin, Mendocino, Modoc, Monterey, Napa, Nevada, Orange, Placer, Plumas, Riverside, Sacramento, San Bernardino, San Diego, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Solano, Sonoma, Sutter, Tehama, Trinity, Ventura, Yolo, Yuba
Northridge Earthquake	01/17/1994	DR-1008	Los Angeles, Orange, Ventura
Fires, Mud & Landslides, Soil Erosion, Flooding	10/28/1993	DR-1005	Los Angeles, Orange, Riverside, San Bernardino, San Diego, Ventura
Severe Winter Storm, Mud & Landslides, Flooding	02/03/1993	DR-979	Alpine, Contra Costa, Del Norte, Fresno, Humboldt, Imperial, Lassen, Los Angeles, Madera, Mendocino, Modoc, Monterey, Napa, Orange, Plumas, Riverside, San Bernardino, San Diego, Santa Barbara, Shasta, Sierra, Siskiyou, Sonoma, Tehama, Trinity, Tulare, Ventura
Fire During a Period of Civil Unrest	05/02/1992	DR-942	Los Angeles
Snowstorm, Heavy Rain, High Winds, Flooding, Mudslide	02/25/1992	DR-935	Kern, Los Angeles, Orange, San Bernardino, Ventura
Severe Freeze	02/11/1991	DR-894	Alameda, Butte, Colusa, Fresno, Glenn, Imperial, Kern, Los Angeles, Madera, Marin, Mendocino, Merced, Monterey, Napa, Riverside, San Benito, San Bernardino, San Diego, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tulare, Ventura, Yolo, Yuba
Fires	06/30/1990	DR-872	Los Angeles, Riverside, San Bernardino, Santa Barbara
Severe Storms, High Tides, Flooding	02/05/1988	DR-812	Los Angeles, Orange, San Diego, Santa Barbara, Ventura
Earthquake & Aftershocks	10/07/1987	DR-799	Los Angeles, Orange
Coastal Storms, Floods, Slides, Tornadoes	02/09/1983	DR-677	Alameda, Butte, Colusa, Contra Costa, Del Norte, Glenn, Humboldt, Kern, Kings, Lake, Los Angeles, Marin, Mariposa, Mendocino, Merced, Monterey, Napa, Orange, Placer, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Solano, Sonoma, Stanislaus, Sutter, Tehama, Trinity, Ventura, Yolo, Yuba
Brush, Timber Fires	11/27/1980	DR-635	Los Angeles, Orange, Riverside, San Bernardino
Severe Storms, Mudslides, Flooding	01/08/1980	DR-615	Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, Santa Cruz, Ventura

Type of Event	Date	Disaster Declaration	Counties Impacted[a]
Coastal Storms, Mudslides, Flooding	02/15/1978	DR-547	Inyo, Kern, Kings, Los Angeles, Mono, Monterey, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, Tulare, Ventura
San Fernando Earthquake	02/09/1971	DR-299	Los Angeles
Forest, Brush Fires	09/29/1970	DR-295	Alameda, Kern, Los Angeles, San Bernardino, San Diego, Ventura
Severe Storms, Flooding	01/26/1969	DR-253	Amador, Contra Costa, El Dorado, Fresno, Humboldt, Inyo, Kern, Kings, Los Angeles, Madera, Marin, Mariposa, Mendocino, Merced, Modoc, Mono, Monterey, Orange, Placer, Plumas, Riverside, Sacramento, San Benito, San Bernardino, San Joaquin, San Luis Obispo, Santa Barbara, Shasta, Sierra, Solano, Sonoma, Stanislaus, Tehama, Tulare, Tuolumne, Ventura, Yuba
Fire	11/16/1961	DR-119	Los Angeles

a. All declarations include Los Angeles County

5.2 HAZARDS IDENTIFIED FOR RISK ASSESSMENT

The Steering Committee considered the full range of natural hazards that could impact the planning area and then identified the hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as local, state, and federal information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area’s assets to them was also used. Based on the review, this plan update addresses the following hazards of concern:

- Drought
- Earthquake
- Flood
- Landslide (including debris flows)
- Severe weather
- Wildfire
- Climate Change

6. RISK ASSESSMENT METHODOLOGY

The risk assessments in this hazard mitigation plan describe the risks associated with each identified hazard of concern. The following steps were used to define the risk of each hazard:

- **Identify and profile each hazard**—The following information is given for each hazard:
  - A summary of past events that have impacted the planning area
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity estimates
  - Warning time likely to be available for response.
- **Determine exposure to each hazard**—Exposure was determined by overlaying hazard maps with an inventory of CVWD's structures, facilities, and systems to determine which of them would be exposed to each hazard.
- **Assess the vulnerability of exposed facilities**—Vulnerability of CVWD's exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and FEMA's hazard-modeling program called Hazus were used to perform this assessment for the flood and earthquake hazards. Outputs similar to those from Hazus were generated for other hazards, using maps generated by the Hazus program.

6.1 RISK ASSESSMENT TOOLS

6.1.1 Mapping

National, state, county, and district databases were reviewed to locate available spatially based data relevant to this planning effort. Maps were produced using geographic information system (GIS) software to show the spatial extent and location of hazards when such datasets were available. These maps are included in the hazard profile chapters of this document.

6.1.2 Hazus

Overview

In 1997, FEMA developed the standardized Hazards U.S., or Hazus, model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology with new models for estimating potential losses from hurricanes, floods, and tsunamis.

Hazus is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, community lifelines, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

Hazus provides default data for inventory and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

6.2 RISK ASSESSMENT APPROACH

6.2.1 Hazard Profile Development

Hazard profiles were developed for CVWD through web-based research and review of previously developed reports and plans, including state and local hazard mitigation plans. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others.

6.2.2 Exposure and Vulnerability

Earthquake

A Level 2 Hazus analysis was performed to assess earthquake exposure and vulnerability for five scenario events and one probabilistic event within CVWD's service area:

- A Magnitude-6.89 event on the Northridge fault with an epicenter 20 miles west-northwest of La Crescenta.
- A Magnitude-6.95 event on the Puente Hills fault with an epicenter 8 miles south-southeast of La Crescenta.
- A Magnitude-6.71 event on the Raymond fault with an epicenter 9.5 miles southeast of La Crescenta.
- A Magnitude-7.16 event on the Sierra Madre fault with an epicenter 14 miles east of La Crescenta.
- A Magnitude-6.9 event on the Verdugo fault with an epicenter in La Crescenta.
- The standard Hazus 100-year probabilistic event.

Flood, Landslides, Severe Weather, and Wildfire

Historical datasets were not adequate to model future losses for most of the hazards of concern. However, areas and inventory susceptible to some of the hazards of concern were mapped by other means to evaluate exposure. A qualitative analysis was conducted for these hazards using the best available data and professional judgment.

Drought

Most of the risk assessment methodologies used for this plan focus on damage to structures. Because drought does not impact structures, the assessment for this hazard was more limited and qualitative than the assessment for the other hazards of concern.

6.3 SOURCES OF DATA USED IN MODELING AND EXPOSURE ANALYSES

6.3.1 Structure and Pipelines Cost Data

Replacement cost is the cost to replace an entire structure with one of equal quality and utility. Replacement costs for structures and pipelines were provided by the District. Hazard exposure analyses were conducted for all structures in the District's system. Hazus was used to determine damage to pipelines and to the following structures: potable water treatment plants, reservoirs, water booster pump stations, wells, wastewater lift stations, and administrative buildings.

The Hazus earthquake module calculates the economic loss to pipelines using the number of leaks and the number of breaks multiplied by cost to repair each leak or break. Default cost-to-repair values included in Hazus were updated with the following information provided by the District:

- Cost to repair a pipeline leak: $5,000
- Cost to repair a pipeline break: $15,000

Hazus default values for pipeline restoration time also were updated with information provided by the District:

- Number of fixed breaks per day per worker:
  - 0.11 for pipes 20 inches or more in diameter
  - 0.25 for pipes less than 20 inches in diameter
- Number of fixed leaks per day per worker:
  - 0.25 for pipes 20 inches or more in diameter

- 0.5 for pipes less than 20 inches in diameter
- Number of workers available to fix leaks and breaks: 7 workers.

6.3.2 Hazus Data Inputs

Earthquake ShakeMaps and probabilistic data prepared by the USGS were used for the analysis of the earthquake hazard. A National Earthquake Hazard Reduction Program (NEHRP) soils map from the California Department of Conservation, Los Angeles County's liquefaction zones data, and susceptibility to deep-seated landslides data from the California Geological Survey were also integrated into the Hazus model.

6.3.3 Other Local Hazard Data

Locally relevant information on hazards was gathered from a variety of sources:

- **Landslide**—Susceptibility to deep-seated landslides data were provided by the California Geological Survey. Areas categorized as very high and high susceptibility (Categories X, XI, VIII, and VII) were used in the exposure analysis.
- **Severe Weather**—No severe weather area datasets in GIS format were identified for the District.
- **Wildfire**—Fire severity zone data were acquired from California Department of Forestry and Fire Protection (CAL FIRE). The very high fire severity zone category was used in the exposure analysis.

6.3.4 Data Source Summary

Table 6-1 summarizes the data sources used for the risk assessment for this plan.

Table 6-1. Hazus Model Data Documentation

Data	Source	Date	Format
Structure and pipeline data	CVWD	2021	Digital (GIS)
Replacement costs for structures and pipelines	CVWD	2021	Digital (tabular)
ShakeMap – Northridge M6.89	USGS	2017	Digital (GIS)
ShakeMap – Puente Hills (LA) M6.95	USGS	2017	Digital (GIS)
ShakeMap – Raymond M6.71	USGS	2017	Digital (GIS)
ShakeMap – Sierra Madre M7.16	USGS	2017	Digital (GIS)
ShakeMap – Verdugo M6.9	USGS	2017	Digital (GIS)
NEHRP soils	California Department of Conservation	2008	Digital (GIS)
Liquefaction zones	Los Angeles County (via City of Los Angeles GIS portal)	2016	Digital (GIS)
Susceptibility to deep-seated landslides	California Geological Survey	2011	Digital (GIS)
Very High Fire Hazard Severity Zones in Local Responsibility Areas	California Department of Forestry and Fire Protection	2007	Digital (GIS)
Fire Hazard Severity Zones for State Responsibility Areas	California Department of Forestry and Fire Protection	2007	Digital (GIS)

6.4 LIMITATIONS

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice the District has to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and should be used only to understand relative risk. Over the long term, the District will collect additional data to assist in estimating potential losses associated with other hazards.

7. DROUGHT

7.1 GENERAL BACKGROUND

Drought is a normal phase in the climactic cycle of most geographical regions. According to the National Drought Mitigation Center, drought "originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector." Drought is the result of a significant decrease in water supply relative to what is "normal" in a given location.

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple of months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

Drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

7.1.1 Drought Definitions

There are four generally accepted operational definitions of drought (National Drought Mitigation Center, 2006):

- **Meteorological drought** is an expression of precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought. Definitions are usually region-specific and based on an understanding of regional climatology. A definition of drought developed in one part of the world may not apply to another, given the wide range of meteorological definitions.
- **Agricultural drought** occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.
- **Hydrological drought** refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. After precipitation has been reduced or deficient over an extended period of time, this shortage is reflected in declining surface and subsurface water levels.

- **Socioeconomic drought** occurs when a physical water shortage starts to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with the supply and demand of an economic good.

The National Drought Mitigation Center recommends that decision makers adopt an operational definition of drought for their own circumstances, incorporating local data such as grazing conditions or stream flow at a nearby gauge.

7.1.2 Monitoring Drought

The National Oceanic and Atmospheric Administration has developed several indices to measure drought impacts and severity and to map their extent and locations:

- The ***Crop Moisture Index*** measures weekly short-term drought to quantify drought impacts on agriculture during the growing season. Figure 7-1 shows this index for the week ending July 4, 2020.
- The ***Palmer Z Index*** measures monthly short-term drought. Figure 7-2 shows this index for June 2020.
- The ***Palmer Drought Severity Index*** measures the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months. Weather patterns can change quickly from a long-term drought pattern to a long-term wet pattern, and the Palmer Drought Index can respond fairly rapidly. Figure 7-3 shows this index for June 2020.
- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The ***Palmer Hydrological Drought Index*** quantifies long-term hydrological effects. It responds more slowly to changing conditions than the Palmer Drought Index. Figure 7-4 shows this index for June 2020.
- While the Palmer indices consider precipitation, evapotranspiration and runoff, the ***Standardized Precipitation Index*** considers only precipitation. In the Standardized Precipitation Index, an index of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The Standardized Precipitation Index is computed for time scales ranging from one month to 24 months. Figure 7-5 shows the 24-month Standardized Precipitation Index map for July 2018 to June 2020.

7.1.3 Defined Drought Stages

During critically dry years, the California State Water Resources Control Board can mandate water entitlements on water right holders to address statewide water shortages. Table 7-1 shows the state drought management program stages mandated to water right holders.

Table 7-1. State Drought Management Program

Drought Stage	State Mandated Customer Demand Reduction	Rate Impacts
Stage 0 or 1	<10%	Normal rates
Stage 2	10 to 15%	Normal rates; Drought surcharge
Stage 3	15 to 20%	Normal rates; Drought surcharge
Stage 4	>20%	Normal rates, Drought surcharge

Source: NOAA, NWS. 2020

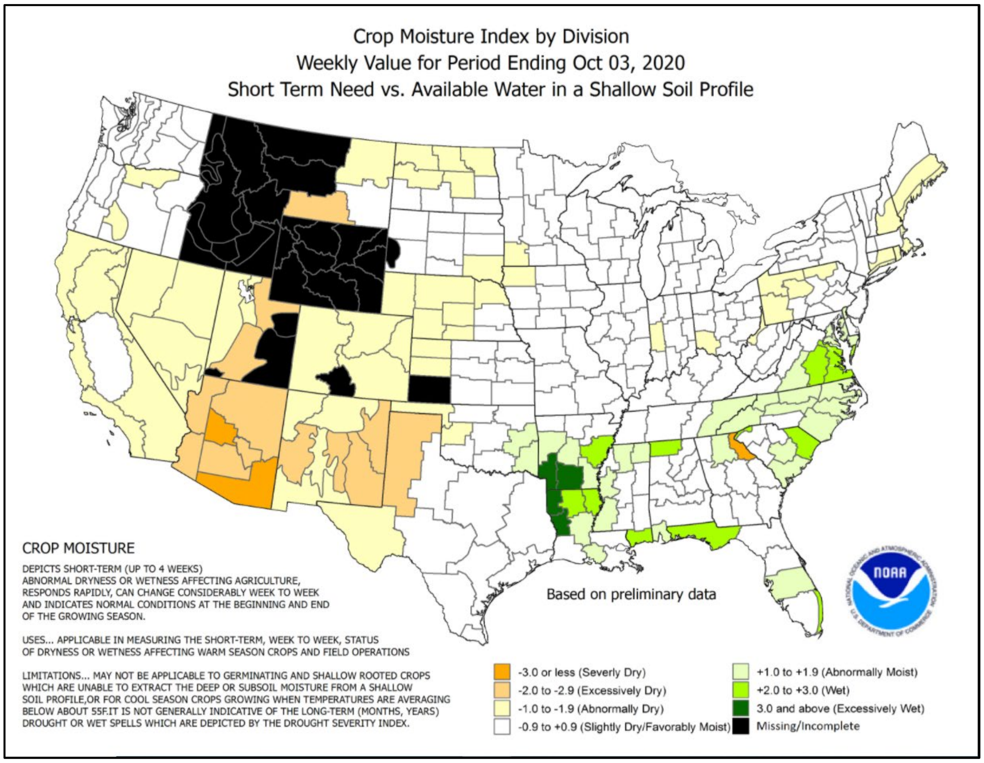


Figure 7-1. Crop Moisture Index for Week Ending October 3, 2020

Source: NOAA, NWS. 2020a

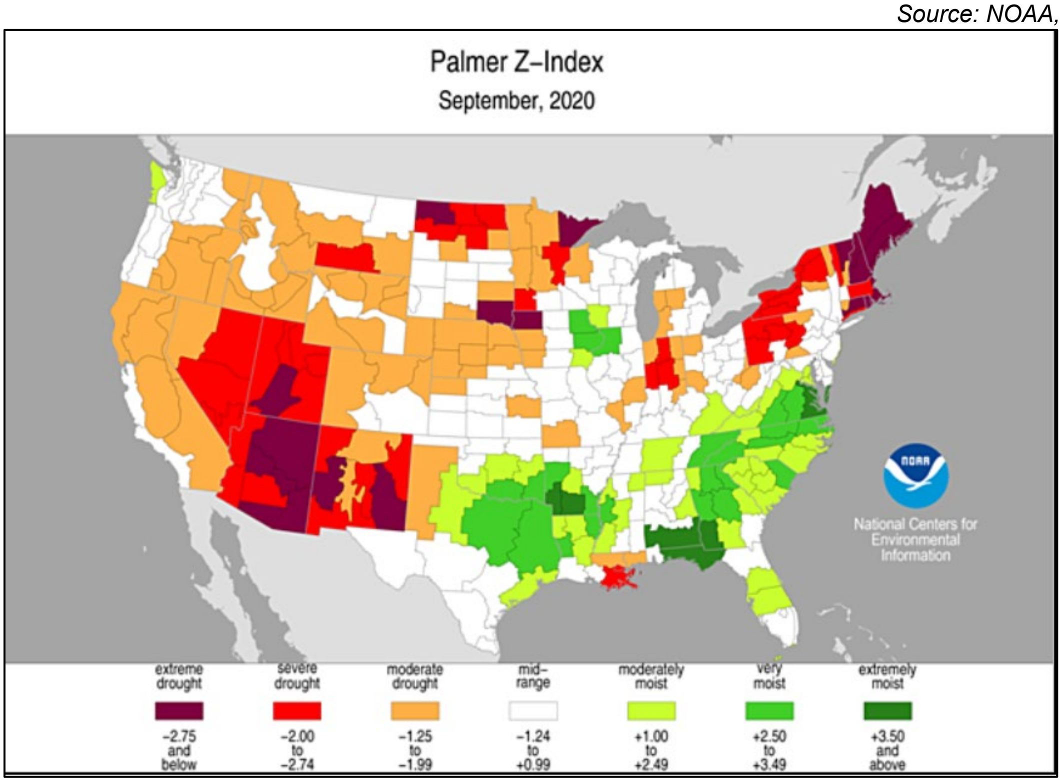


Figure 7-2. Palmer Z Index Short-Term Drought Conditions (September 2020)

Source: NOAA, NWS. 2020b

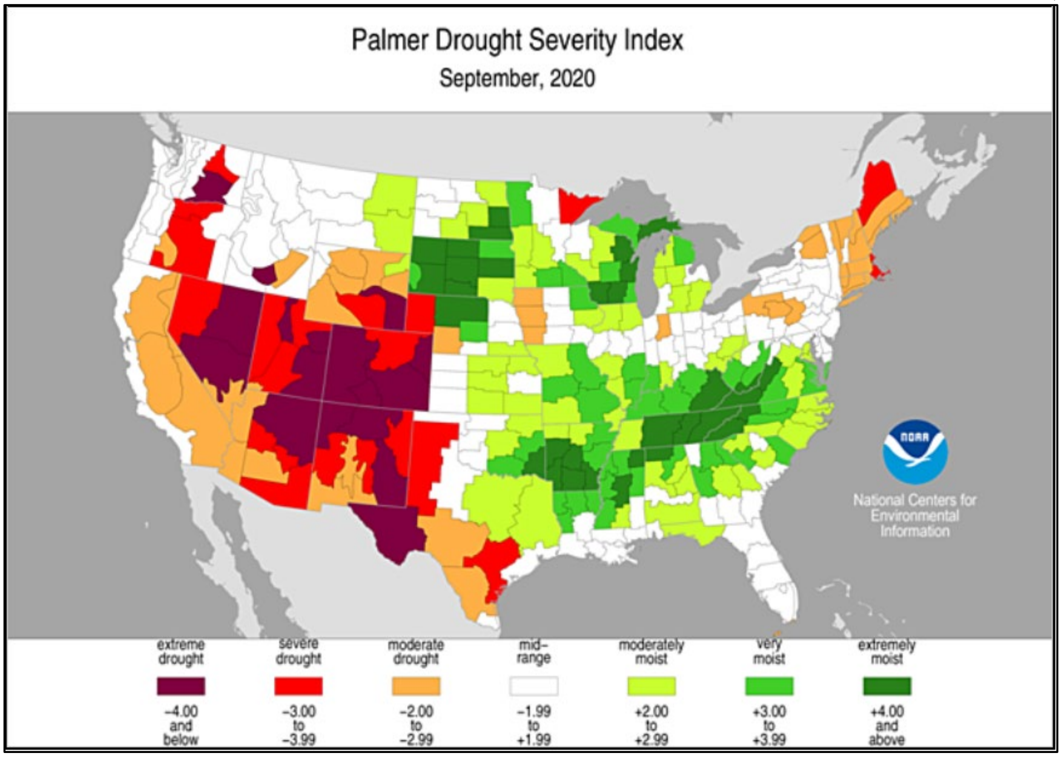


Figure 7-3. Palmer Drought Severity Index (September 2020)

Source: NOAA, NWS. 2020c

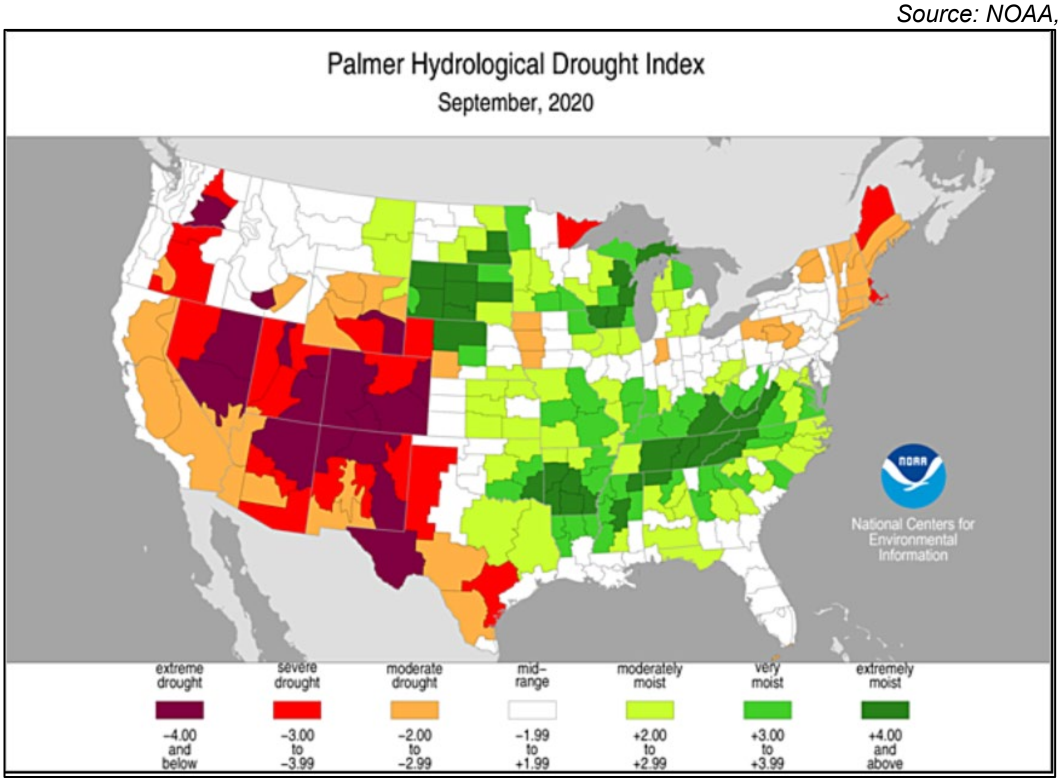


Figure 7-4. Palmer Hydrological Drought Index (September 2020)

Source: NOAA, NWS. 2020d

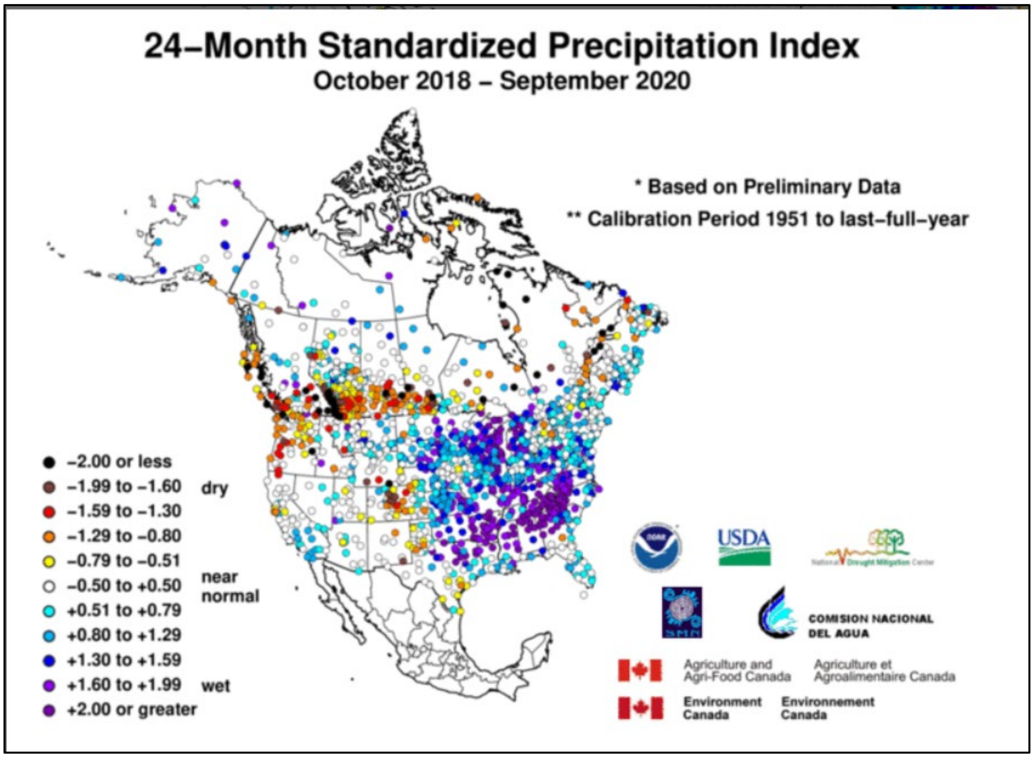


Figure 7-5. 24-Month Standardized Precipitation Index (October 2018 – September 2020)

7.1.4 Secondary Hazards

The secondary hazard most associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends.

7.2 LOCAL WATER SUPPLY

Over the last 10 years, local groundwater has supplied 55 percent of CVWD's source water. Most of CVWD's groundwater wells are along the Verdugo Wash, south of Honolulu Avenue. The remaining 45 percent of CVWD's source water is supplied by Foothill Municipal Water District (FMWD), which is a member agency of MWD. The sources of imported water supplies include the Colorado River and the State Water Project. MWD's 2015 Integrated Water Resources Plan update describes the core water resource strategy, which will be used to meet full-service demands at the retail level under all foreseeable hydrologic conditions from 2020 through 2040.

It is required that every urban water supplier assess the reliability to provide water service to its customers under normal, dry, and multiple dry water years. MWD's 2020 Urban Water Management Plan finds that MWD is able to meet full service demands of its member agencies with existing supplies from 2020 through 2040 during normal years, single dry year, and multiple dry years. CVWD is therefore capable of meeting the water demands of its customers in normal, single dry, and multiple dry years between 2020 and 2040.

CVWD completed construction of a new wellhead treatment facility for its Well No. 2 in 2019. The installation of the ARoNite biological nitrate removal treatment system allows CVWD to utilize Well No. 2, which had been out of service since 1976, thereby aiding in groundwater recovery. This treatment facility will increase CVWD’s ability to pump its adjudicated rights within the Verdugo Basin, utilize a local water source, reduce CVWD’s dependence on imported water from MWD purchased through FMWD, and reduce nitrates levels in the groundwater pumped from the Basin.

CVWD is working toward the development and installation of the Crescenta Valley County Park Stormwater Capture Project. This Project will allow CVWD to increase groundwater storage in the Basin by installation and maintenance of underground infiltration galleries underneath portions of the existing park. This will be accomplished by utilizing the existing Los Angeles County flood control channel, Verdugo Wash, and surface flow within the Crescenta Valley to divert storm water during the rainy season into underground infiltration basins within the recreational areas. The project will potentially increase the local groundwater supply by an annual average of 500 acre-feet per year, thus enhancing CVWD’s groundwater resource and reducing dependence on imported supplies. Also, through the process of capture, treatment, and reuse of storm water and dry weather flow, the project could potentially reduce the pollutant load from contaminating the Los Angeles River.

Through an emergency interconnection with the City of Los Angeles Department of Water and Power, CVWD is able to receive up to 2.2 cubic feet per second or 1.9 million gallons per day and to provide an emergency water supply to FMWD and its sub-agencies.

As funding permits, CVWD plans to rehabilitate its older groundwater wells with new technologies over the next 10-year period. The existing wells are between 55 to 80 years old and have reached the end of their useful life. CVWD’s current program is to perform at least two well rehabilitations a year, which include cleaning the well casing with chemical treatment and installation of a liner to extend the life of the well (CVWD, 2015).

7.3 HAZARD PROFILE

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple of months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

7.3.1 Past Events

Statewide Droughts

The California Department of Water Resources has state hydrologic data back to the early 1900s (CA DWR, 2017). The hydrologic data show multi-year droughts from 1912 to 1913, 1918 to 1920, 1922 to 1924 and 1928 to 1934. The following sections describe additional prolonged periods of drought in California since then, all of which impacted Los Angeles County to some degree.

1976 to 1977 Drought

California had one of its most severe droughts due to lack of rainfall during the winters of 1976 and 1977. 1977 was the driest period on record in California to that time, with the previous winter recorded as the fourth driest. The cumulative impact led to widespread water shortages and severe water conservation measures throughout the state. Only 37 percent of the average Sacramento Valley runoff was received, with just 6.6 million acre-feet recorded. A federal disaster declaration was declared, but it did not apply to Los Angeles County.

1987 to 1992 Drought

California received precipitation well below average levels for four consecutive years. During this drought, only 56 percent of average runoff for the Sacramento Valley was received, totaling just 10 million acre-feet. By February 1991, all 58 counties in California were suffering from drought conditions. Urban areas as well as rural and agricultural areas were impacted.

2007 to 2009 Drought

The governor issued an Executive Order that proclaimed a statewide drought emergency on June 4, 2008, after spring 2008 was the driest spring on record and snowmelt runoff was low. On February 27, 2009, the governor proclaimed a state of emergency for the entire state as the severe drought conditions continued widespread impacts and the largest court-ordered water restriction in state history (at the time).

2012 to 2017 Drought

California's latest drought set several records:

- The period from 2012 to 2014 ranked as the driest three consecutive years for statewide precipitation.
- 2014 set new climate records for statewide average temperatures and for record-low water allocations in the State Water Project and federal Central Valley Project.
- 2013 set minimum annual precipitation records for many communities.

On January 17, 2014, the governor declared a state of emergency for drought throughout California. This declaration followed release of a report that stated that California had had the least amount of rainfall in its 163-year history. Californians were asked to voluntarily reduce their water consumption by 20 percent. Drought conditions worsened into 2015. On April 1, 2015, following the lowest snowpack ever recorded, the governor announced actions to save water, increase enforcement to prevent wasteful water use, streamline the state's drought response, and invest in new technologies to make California more drought resilient. The governor directed the State Water Resources Control Board to implement mandatory water reductions in cities and towns across California to reduce water usage by 25 percent on average. The Crescenta Valley Water District's Retail Zone met its requirement to reduce its water usage by 36 percent.

The drought ended with a wet water year of 2017 — the second-wettest year on record in terms of statewide runoff, and wettest year of record in the Sacramento River Basin. Responding to the wet conditions, Executive Order B-40-17 in April 2017 terminated the statewide drought proclamation (California DWR, 2020).

Drought Impact Reporter

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Information comes from a variety of sources: on-line, drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media, and members of relevant government agencies.

The Drought Impact Reporter contains information on 2 impacts from droughts that specifically affected Los Angeles County from January 1970 through December 2020. The following are the categories and reported number of impacts (note that some impacts have been assigned to more than one category):

- Agriculture—34
- Business and Industry—11
- Energy—3
- Fire—30
- Plants and Wildlife—41
- Relief, Response, and Restrictions—87
- Society and Public Health—62
- Tourism and Recreation—9
- Water Supply and Quality—131

7.3.2 Location

Drought is a regional phenomenon. A drought that affects the planning area would affect the entirety of the area simultaneously and has the potential to adversely affect the local economy. Moreover, since the District relies on water imported from areas outside its region, droughts in Northern California or the basin states of the Colorado River could impact the District's water supply as well. In 2019, 48% of Crescenta Valley Water District's water was supplied by Foothill Municipal Water District (FMWD). Surface water supplied from FMWD has its origins in the State Water Project in Northern California and the Colorado River Aqueduct in Lake Havasu (CVWD, 2019). There is no clear way to map or define the extent and location of a drought, therefore any mapping for this hazard is very large scale, and risk assessments are qualitive in nature.

7.3.3 Frequency

Historical drought data for the planning area indicate there have been four significant multi-year droughts in the last 20 years (2000 to 2020). For approximately 12 of the last 20 years, Los Angeles County has been included in various levels of drought. This equates to a drought every 1.5 years on average, or a 60 percent chance of a drought in any given year. As temperatures increase, the probability of future droughts will likely increase as well.

7.3.4 Severity

Drought can have a widespread impact on the environment and the economy, although it typically does not result in loss of life or damage to property, as do other natural disasters. Nationwide, the impacts of drought occur in the following categories: agriculture; business and industry; energy; fire; plants and wildfire; relief, response, and restrictions; tourism and recreation; and water supply and quality sectors. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- **Economic Impacts**—These impacts of drought cost people or businesses money (i.e., farmers' crops are destroyed; water supply is too low, and money must be spent on irrigation or to drill new wells; businesses that sell boats and fishing equipment are not able to sell their goods; water companies must spend money on new or additional water supplies). Economic impacts on the District also could result if the regions from which the District receives its imported water were to be impacted by droughts to the point that they could not provide water to the District.
- **Environmental Impacts**—Plants and animals depend on water, just like people. When a drought occurs, their food supply can shrink, and their habitat can be damaged.
- **Social Impacts**—These impacts affect people's health and safety. Social impacts include public safety, health, conflicts between people when there is not enough water to go around, and changes in lifestyle.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts.

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Droughts can affect groundwater storage as reserves are drawn down in anticipation of drought impacts. Such conjunctive use assists in drought resilience, but it can take years to replenish the water that was stored. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest.

7.3.5 Warning Time

Droughts are climatic patterns that occur over long periods of time. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. Scientists do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depend upon interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

CVWD has developed a color-coded water conservation alert system that it will deploy under various stages of drought conditions that impact the service area. The 5 categories response are defined as follows (see Figure 7-6):

- Blue: STANDARD—Foothill can meet all Member Agency demands. Standard water conservation applies as defined in the District's rules and regulations. Outdoor watering is recommended to be no more than three days per week.
- Green: INCREASED—Some supplies have been impacted and customers should increase efforts to conserve by following strict water conservation practices indoors and limiting outdoor water use to odd or even days, based on ending number of customer address.

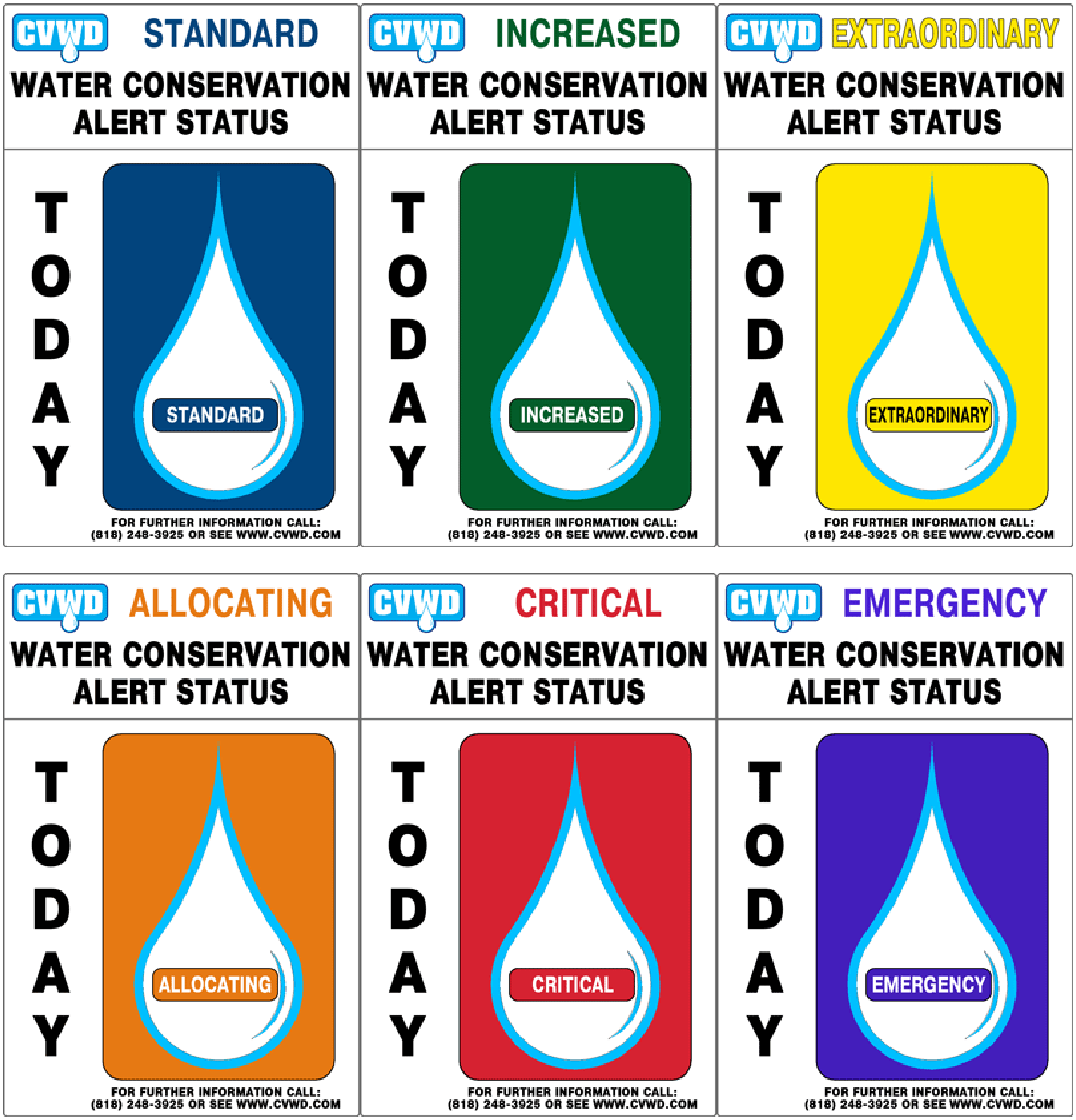


Figure 7-6. Water Conservation Alter System

- Yellow: EXTRAORDINARY—Metropolitan Water District of Southern California is pulling water from most of its storage programs to meet demand or the District's Groundwater Supplies have been reduced. Extraordinary conservation is called for from customers. Customers are requested to minimize indoor water use and water outdoors no more than three days per week. Outdoor irrigation will be permitted only on Tuesday, Thursday, and Saturday, before 9:00 am and after 5:00 pm, for a period of no more than 7 minutes per station.

- Orange: ALLOCATING—Metropolitan Water District of Southern California has implemented its allocation plan to its member agencies or the State of California has imposed mandatory water restrictions or reductions. Customers are requested to minimize indoor water use and severely limit outdoor water use as follows:
  - Residential and commercial landscape irrigation is limited to no more than two days per week. Outdoor irrigation will be permitted only on Tuesday and Saturday, before 9:00 am and after 5:00 pm.
  - The filling, refilling, or adding of water to indoor and outdoor pools, wading pools, or spas is prohibited.
  - The use of water to clean, maintain, fill, or refill decorative fountains or similar structures is prohibited.
  - Vehicle washing only at car wash with re-circulating system.
  - Fix leaks within 48 hours.
- Red: CRITICAL—Water supplies are reduced drastically. Customers are requested to minimize indoor water use and curtail all outdoor water use. Fix any leaks within 24 hours.
- Purple: EMERGENCY—Water supplies are only available for health and safety needs.

7.4 EXPOSURE AND VULNERABILITY

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental, and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand.

All CVWD assets would be exposed to some degree to the impacts of moderate to extreme drought conditions. No structures will be directly affected by drought conditions, though droughts can have significant impacts on landscapes. However, these impacts are not considered critical in planning for impacts from the drought hazard. Wells may need to be shut down in prolonged droughts if groundwater stores are depleted such that the wells cannot produce. Other CVWD critical facilities, including pipes and tanks, would not be impacted by drought conditions.

7.5 DEVELOPMENT TRENDS

While droughts typically do not impact physical structures and assets, they could impact the supply of water. The demand for critical District services may increase with growth in the surrounding area. The State of California's adoption of bills expanding property owners' rights to build accessory dwelling units will increase densities in most the District's service area; areas that, as recently as 2020, were thought to be built out.

Repair or replacement of District assets, if necessary, will be governed by codes and standards applied by the County of Los Angeles, the City of La Cañada Flintridge or the City of Glendale, depending upon the location of the asset.

7.6 SCENARIO

An extreme, multiyear drought associated with record-breaking rates of low precipitation and high temperatures—such as the most recent drought across the State of California——is the worst-case scenario. Combinations of low precipitation and high temperatures could occur over several consecutive years. Intensified by such conditions, extreme wildfires could break out throughout the planning area, increasing the need for water.

7.7 ISSUES

The Planning Team has identified the following drought-related issues:

- The application of the Drought Monitor can be a flawed characterization of when a region is coming or going out of drought, unrelated to actual water supply conditions
- Identification and development of alternative water supplies such as the capture and storage of stormwater runoff
- Utilization of groundwater recharge techniques to stabilize the groundwater supply
- The probability of increased drought frequencies and durations due to climate change
- The promotion of active water conservation even during non-drought periods
- Public education on water conservation

8. EARTHQUAKE

8.1 GENERAL BACKGROUND

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

California is seismically active because of movement of the North American Plate, on which everything east of the San Andreas Fault sits, and the Pacific Plate, which includes coast communities west of the fault. The planning area is on the Pacific Plate, which is constantly moving northwest past the North American Plate, at a relative rate of movement of about 2 inches per year.

Geologists have found that earthquakes tend to reoccur along faults, which are zones of weakness in the earth's crust. When a fault zone experiences an earthquake, it does not guarantee that all the stress has been relieved. Another earthquake could still occur. In fact, relieving stress on one part of a fault may increase it in another part.

Active faults have experienced displacement in historical time. However, inactive faults, where no such displacements have been recorded, also have the potential to reactivate or experience displacement along a branch sometime in the future. An example of a fault zone that has been reactivated is the Foothills Fault Zone. The zone was considered inactive until evidence of an earthquake (approximately 1.6 million years ago) was found near Spenceville, California. Then, in 1975, an earthquake occurred on another branch of the zone near Oroville, California (now known as the Cleveland Hills Fault). The State Division of Mines and Geology indicates that increased earthquake activity throughout California may cause movement along currently inactive fault systems.

8.1.1 Earthquake Classifications

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity.

Magnitude

An earthquake's magnitude is a measure of the energy released at the source of the earthquake. Magnitude is commonly expressed by ratings on the moment magnitude scale (M_W), the most common scale used today (USGS, 2017a). This scale is based on the total moment release of the earthquake (the product of the distance a fault moved, and the force required to move it). The scale is as follows:

- Great—Mw > 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Intensity

The most commonly used intensity scale is the modified Mercalli intensity scale. Ratings of the scale as well as the perceived shaking and damage potential for structures are shown in Table 8-1. The modified Mercalli intensity scale is generally represented visually using shake maps, which show the expected ground shaking at any given location produced by an earthquake with a specified magnitude and epicenter. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the variation of ground shaking in a region immediately following significant earthquakes (for technical information about shake maps see USGS, 2018).

Table 8-1. Mercalli Scale and Peak Ground Acceleration Comparison

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17% – 1.4%
IV	Light	None	None	1.4% – 3.9%
V	Moderate	Very Light	Light	3.9% – 9.2%
VI	Strong	Light	Moderate	9.2% – 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% – 34%
VIII	Severe	Moderate/Heavy	Heavy	34% – 65%
IX	Violent	Heavy	Very Heavy	65% – 124%
X – XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA measured in percent of g, where g is the acceleration of gravity
Sources: USGS, 2008; USGS, 2010

8.1.2 Ground Motion

Earthquake hazard assessment is also based on expected ground motion. During an earthquake when the ground is shaking, it also experiences acceleration. The peak acceleration is the largest increase in velocity recorded by a particular station during an earthquake. Estimates are developed of the annual probability that certain ground motion accelerations will be exceeded; the annual probabilities can then be summed over a time period of interest.

The most commonly mapped ground motion parameters are horizontal and vertical peak ground accelerations (PGA) for a given soil type. PGA is a measure of how hard the earth shakes, or accelerates, in a given geographic area. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. PGA is measured in multiples of "g" (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code and the California State Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage "short period structures" (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges).

8.1.3 Liquefaction and Soil Types

Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 8-2 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

Table 8-2. NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 meters (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 meters thick)	

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. In general, areas with NEHRP Soils D, E and F are also susceptible to liquefaction. If there is a dry soil crust, excess water will sometimes come to the surface through cracks in the confining layer, bringing liquefied sand with it, creating sand boils. This is a vital need for assessing seismic risk within the planning area. Liquefaction data tracks with where NEHRP soil data is available.

8.1.4 USGS Earthquake Mapping Programs

ShakeMaps

The USGS Earthquake Hazards Program produces maps called ShakeMaps that map ground motion and shaking intensity following significant earthquakes. ShakeMaps focus on the ground shaking caused by the earthquake, rather than on characteristics of the earthquake source, such as magnitude and epicenter. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust.

A ShakeMap shows the extent and variation of ground shaking immediately across the surrounding region following significant earthquakes. Such mapping is derived from peak ground motion amplitudes recorded on seismic sensors, with interpolation where data are lacking based on estimated amplitudes. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. In addition to the maps of recorded events, the USGS creates the following:

- Scenario ShakeMaps of hypothetical earthquakes of an assumed magnitude on known faults
- Probabilistic ShakeMaps, based on predicted shaking from all possible earthquakes over a 10,000-year period. In a probabilistic map, information from millions of scenario maps are combined to make a forecast for the future. The maps indicate the ground motion at any given point that has a given probability of being exceeded in a given timeframe, such as a 100-year (1-percent-annual chance) event.

National Seismic Hazard Map

National probabilistic maps of earthquake shaking hazards have been produced since 1948. The USGS last updated its National Seismic Hazard Maps in 2018, incorporating the best available seismic, geologic, and geodetic information on earthquake rates and associated ground shaking. The map produced for this update include maps of the PGA expected at various probability levels of different NEHRP soil types. Figure 8-1 shows the peak ground acceleration with 10 percent probability of exceedance in 50 years. This level of ground shaking has been used for designing buildings in high seismic areas.

Source: USGS, 2021

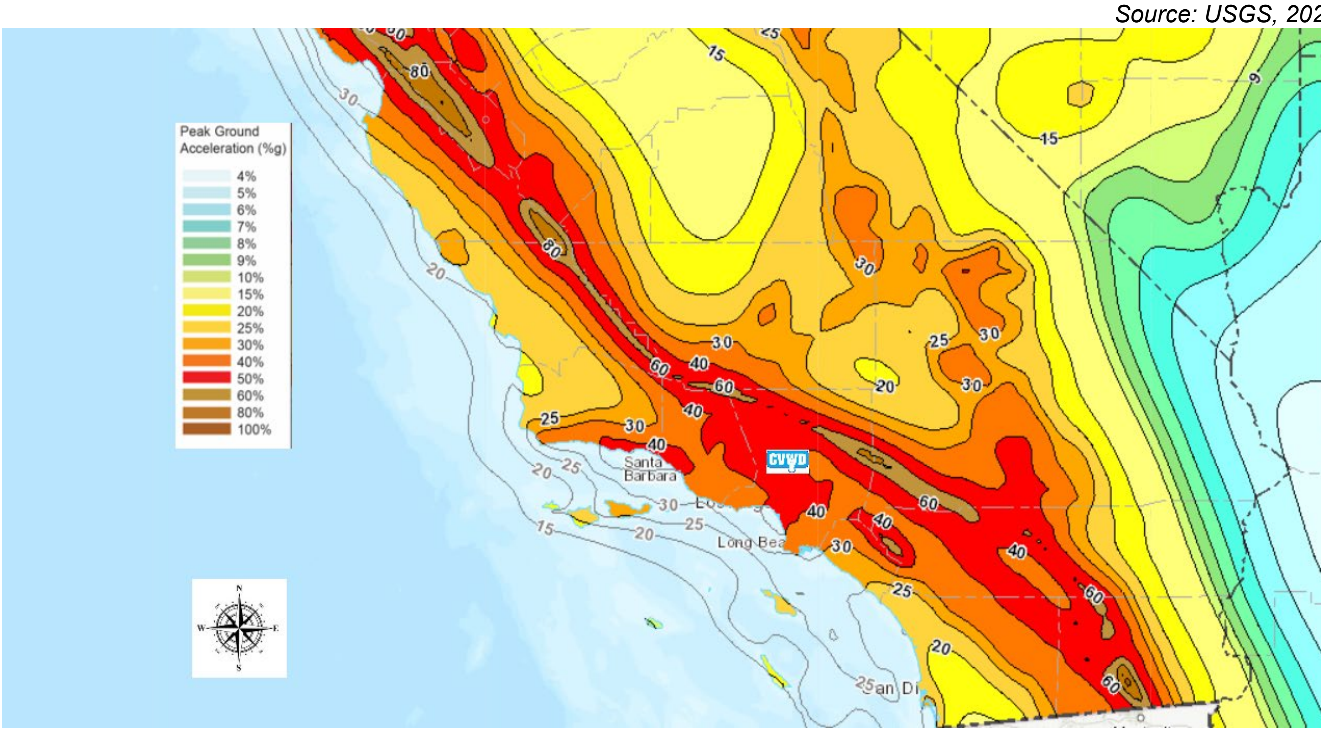


Figure 8-1. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years in Southern California

The National Seismic Hazard Maps provide information essential to creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning used in the U.S. Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways, and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damage and disruption. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown et al., 2001).

8.1.5 Secondary Hazards

Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often because of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

Additionally, fires can result from gas lines or power lines that are broken or downed during the earthquake. It may be difficult to control a fire, particularly if the water lines feeding fire hydrants are also broken.

8.2 HAZARD PROFILE

8.2.1 Past Events

Los Angeles County has been included in three FEMA declaration for earthquakes: the 1994 Northridge Earthquake (DR-1008); the 1987 Whittier Narrows earthquake (DR-799); and the 1971 San Fernando earthquake (DR-299). Table 8-3 lists earthquakes of magnitude 5.0 or greater within a 100-mile radius of the planning area.

The most recent damaging earthquake affecting Southern California was the Ridgecrest event, which included one strong earthquake (M6.4, July 4, 2019) and one major earthquake (M7.1 July 5, 2019). Maximum shaking was estimated to be MMI IX (violent) at the epicenter and MMI VII (very strong) over a surrounding region that included the city of Ridgecrest, which has a population of 28,000. Shaking was widely felt throughout California, including light to moderate ground shaking in Los Angeles and weak shaking in the San Francisco Bay Area (Southern California Seismic Network, 2019). Damage estimates for the Ridgecrest earthquakes exceeded $1 billion according to the U.S. Geological Survey. Long stretches of Highway 178 were visibly cracked (CEA, 2019).

The most recent damaging earthquake event affecting Los Angeles County was the 1994 Northridge Earthquake. At 4:31 a.m. on January 17, a moderate but very damaging earthquake with a magnitude of 6.7 struck the San Fernando Valley. In the following days and weeks, thousands of aftershocks occurred, causing additional damage to affected structures. Fifty-seven people were killed, and more than 1,500 people seriously injured. For days afterward, thousands of homes and businesses were without electricity, tens of thousands had no gas, and nearly 50,000 had little or no water.

Table 8-3. Earthquakes Magnitude 5.0 or Larger Within 100-Mile Radius of the Planning Area

Date	Magnitude	Epicenter Location
07/23/1923 Los Angeles Earthquake	6.0	3 miles north of Loma Linda, CA
02/18/1926 Channel Islands Earthquake	5.5	3 miles from Santa Cruz Island, CA
3/10/1933 Long Beach Earthquake	6.4	3 miles south of Huntington Beach, CA
03/25/1937 Oasis Earthquake	6.0	10 miles west southwest of Oasis, CA
12/04/1948 Desert Hot Springs Earthquake	6.0	10 miles east of Desert Hot Springs, CA
12/26/1951 San Clemente Island Earthquake	5.8	7 miles north northeast of San Clemente Island, CA
02/09/1971 Agua Dulce Sequence	6.6, 5.8, 5.8	6 miles south southwest of Agua Dulce, CA
07/08/1986 Morongo Valley Earthquake	6.0	4 miles south southwest of Morongo Valley, CA
10/01/1987 Rosemead Earthquake	5.9	1 mile south southwest of Rosemead, CA
02/28/1990 Claremont Earthquake	5.5	4 miles north northeast of Claremont, CA
06/28/1991 Sierra Madre Earthquake	5.8	8 miles north northeast of Sierra Madre, CA
04/23/1992 Thousand Palms Earthquake	6.1	11 miles north northeast of Thousand Palms, CA
06/28/1992 Landers Earthquake	7.3	In Landers, CA
06/28/1992 Yucca Valley Earthquake	5.8	2 miles northeast of Yucca Valley, CA
06/28/1992 Joshua Tree Earthquake	5.7	1 mile south southwest of Joshua Tree, CA
06/28/1992 Big Bear Lake Earthquake	5.5	7 miles south southeast of Big Bear Lake, CA
06/28/1992 Big Bear City Earthquake	6.3	4 miles south southeast of Big Bear City, CA
06/29/1992 Yucca Valley Earthquake	5.7	2 miles east southeast of Yucca Valley, CA
01/17/1994 Northridge Earthquake	6.7	1 mile south-southwest of Northridge
01/17/1994 Granada Hills Earthquake	5.9	Half-mile east northeast of Granada Hills, CA
01/17/1994 Simi Valley Earthquake	5.0	4 miles north northeast of Simi Valley, CA
10/16/1999 Running Springs Earthquake	5.6	4 miles east northeast of Running Springs, CA
07/29/2008 Chino Hills Earthquake	5.4	2 miles southwest of Chino Hills, CA
07/2019 Ridgecrest Sequence	6.4 and 7.1	Ridgecrest, CA

Source: Southern California Earthquake Data Center, 2020

Approximately 15,000 structures were moderately to severely damaged, which left thousands of people temporarily homeless. Of 66,500 buildings inspected, nearly 4,000 were severely damaged and over 11,000 were moderately damaged. Several collapsed bridges and overpasses created commuter havoc on the freeway system. Extensive damage was caused by ground shaking, and earthquake-triggered liquefaction and dozens of fires caused additional severe damage. This extremely strong ground motion resulted in record economic losses.

8.2.2 Location

Faults

Earthquakes are considered a major threat to Los Angeles County due to the proximity of several fault zones, notably including the Sierra Madre Fault Zone and the Verdugo Fault Zone. A significant earthquake along one of these major fault zones could cause substantial casualties, extensive damage to buildings, roads and bridges, fires, and other threats to life and property. The effects could be aggravated by aftershocks and by secondary effects such as fire, landslide, and dam failure. A major earthquake could be catastrophic in its effect on the population and could exceed the response capability of the local communities and even the State.

Large faults as shown in Figure 8-2 that could affect the planning area include the Sierra Madre Fault, the Verdugo Fault, the Puente Hills Fault, the Northridge Fault, and the Raymond Fault. Information on these fault zones is provided in the following sections.

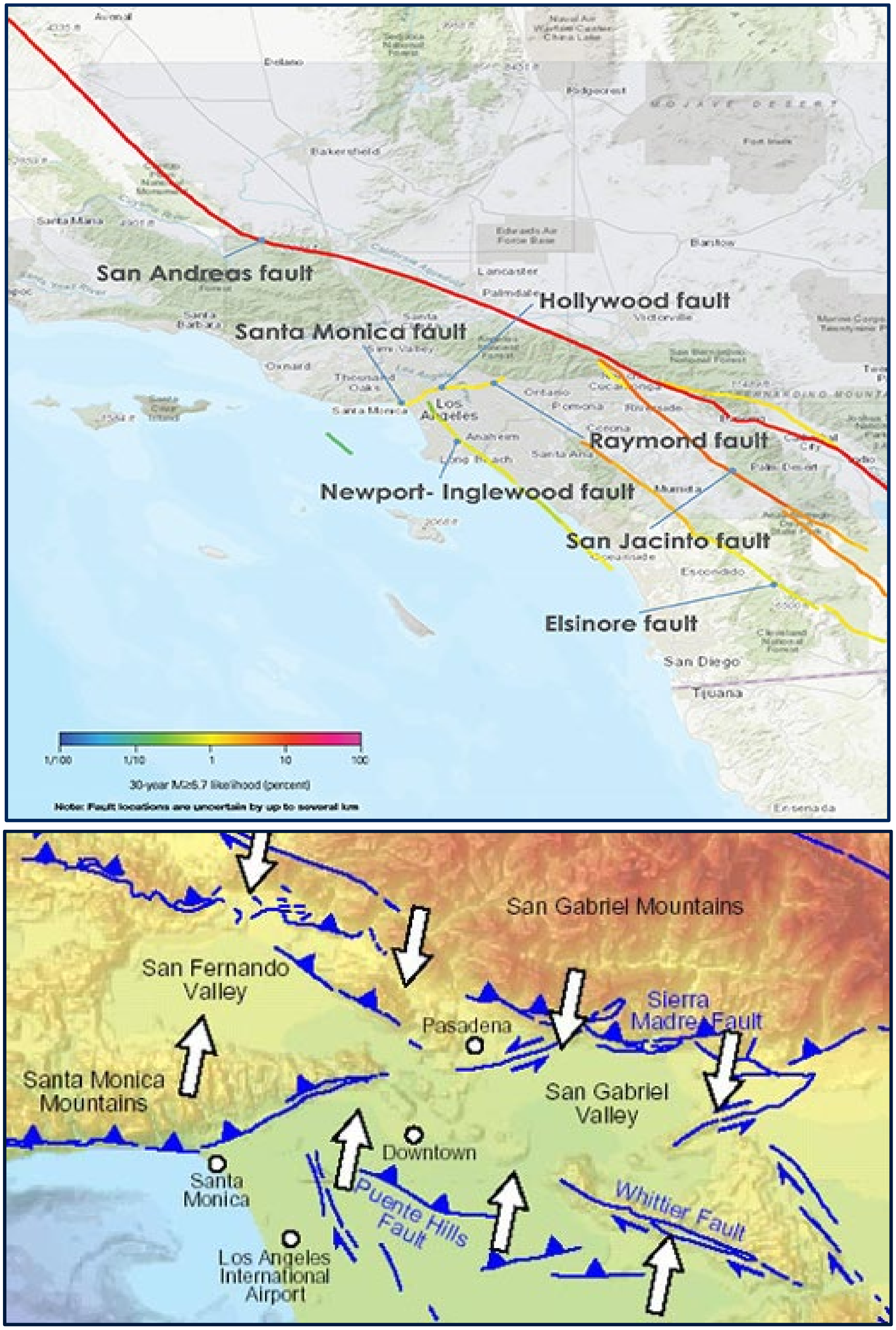


Figure 8-2. Earthquake Fault Zones in Los Angeles County

Sierra Madre Fault Zone

The Sierra Madre fault forms the southern tectonic boundary of the San Gabriel Mountains in the northern San Fernando Valley. It consists of a system of faults approximately 75 miles in length. Individual segments range up to 16 miles in length and display a reverse sense of displacement and dip to the north. The most recently active portions of the zone include the Mission Hills, Sylmar, and Lakeview segments, which produced an earthquake in 1971 of magnitude 6.4. Tectonic rupture along the Lakeview Segment during the San Fernando Earthquake of 1971 produced displacements of approximately 2½ to 4 feet upward and southwestward. It is believed that the Sierra Madre fault zone can produce an earthquake of up to magnitude 7.3.

Verdugo Fault

The Verdugo Fault is a reverse fault that runs for 21 kilometers along the Verdugo Mountains, between Verdugo Wash on the southeast and Big Tujunga Wash on the northwest. The fault displays a reverse motion. According to Weber, et. al., (1980) 2 to 3-meter-high scarps were identified in alluvial fan deposits in the Burbank and Glendale areas. Further to the northeast, in Sun Valley, a fault was reportedly identified at a depth of 40 feet in a sand and gravel pit. Although considered active by the County of Los Angeles, Department of Public Works (Leighton, 1990), and the United States Geological Survey, the fault is not designated with an Earthquake Fault Zone by the California Geological Survey. It is estimated that the Verdugo Fault can produce a maximum 6.9 magnitude earthquake.

Puente Hills Fault

The Puente Hills Fault, also known as the Puente Hills thrust system, is an active geological fault that is in the Los Angeles Basin in California. The thrust fault was discovered in 1999 and runs about 25 miles in three discrete sections from the Puente Hills region in the southeast to just south of Griffith Park in the northwest. The fault is known as a blind thrust fault, as the fault plane does not extend to the surface. Large earthquakes on the fault are relatively infrequent but computer modeling has indicated that a major event could have substantial impact in the Los Angeles area (Shaw et al., 2002). The fault is now thought to be responsible for the 1987 Whittier Narrows earthquake, causing 8 deaths, 200 injuries, and between $213-358 million in damages. The frequency of a major rupture in the Puente Hills Fault is on the order of once per several thousand years. Geologists have determined that the fault has ruptured at least four times in the past 11,000 years. The magnitudes of such earthquakes are considered to have been 7.2 to 7.5. The highest magnitude in that range would be about fifteen times stronger than the 1994 Northridge earthquake in terms of energy release.

Northridge Fault

The surface trace of the Northridge thrust forms a ridge to the south of its trace and is roughly paralleled by both the Santa Clara River and California State Highway 126, from the town of Piru to the coast, just southeast of Ventura. The Northridge thrust continues offshore out to a point about 20 kilometers due south of Santa Barbara, for a total length of 90 kilometers. The offshore segment is associated with a definite zone of active seismicity, though the only known Holocene surface rupture is found well onshore, between the towns of Bardsdale and Fillmore. At its eastern end, the Northridge thrust becomes progressively more difficult to trace, and appears to be overthrust by the Santa Susana fault, thus becoming a blind thrust fault. Indeed, the fault associated with the 1994 Northridge earthquake is probably part of the Northridge fault system, as it shares many of the characteristics of this fault. This blind thrust fault is known either as the **Pico Thrust**, named for the Pico Anticline (a geologic fold it is creating), or as the Oak Ridge, due to the fault’s ridge formation. The probable magnitudes on this fault are between 6.5 and 7.5.

Raymond Fault

The Raymond Fault runs for 26 kilometers near San Marino, Arcadia, and South Pasadena, dipping at about 75 degrees to the north. There is evidence that at least eight surface-rupturing events have occurred along this fault in the last 36,000 years. The exact nature of the slip along the Raymond fault has been a subject of debate for quite some time. The fault produces a very obvious south-facing scarp along much of its length, and this has made many favor reverse-slip as the predominant sense of fault motion. However, there are also places along this scarp where left-lateral stream offsets of several hundred meters can be seen. The matter will not be conclusively resolved until the Raymond fault ruptures at the surface, but some new light was shed on the debate in late 1988, when the Pasadena Earthquake occurred. Apparently located on the Raymond fault, the motion of this quake was predominantly left-lateral, with a reverse component only about 1/15th the size of the lateral component. If the Raymond fault is indeed primarily a left-lateral fault, it could be responsible for transferring slip southward from the Sierra Madre fault zone to other fault systems. It is estimated that the Raymond Fault can produce an earthquake between 6.0 – 7.0 magnitude.

Susceptible Areas

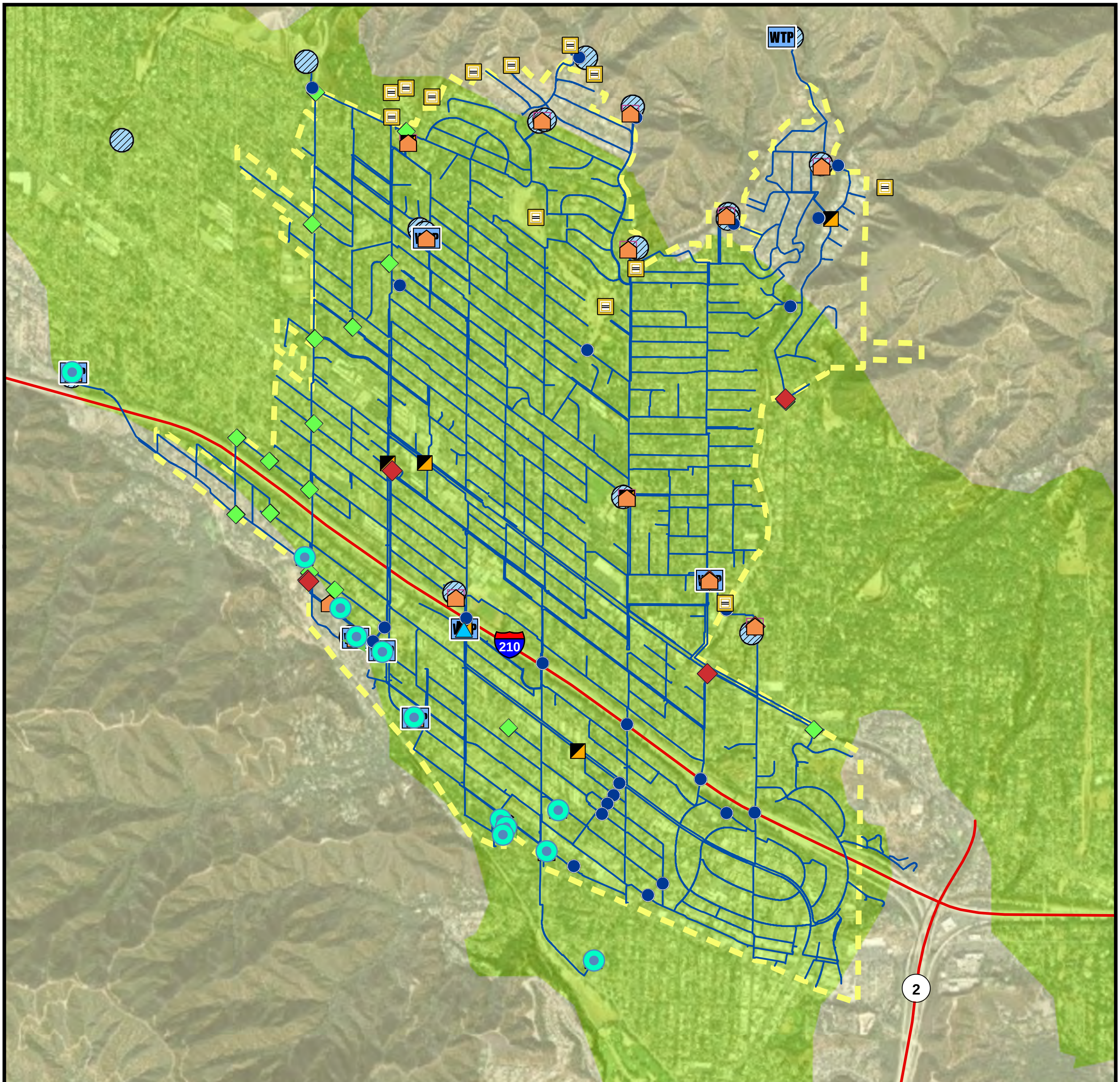
Although the intensity of an earthquake is not likely to vary significantly across the planning area, impacts can vary based on local soil characteristics. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. NEHRP soil classifications in the planning area relative to the water system facilities and wastewater system facilities are shown on Figure 8-3 and Figure 8-4, respectively. Risk is similarly increased in areas of mapped liquefaction susceptibility. These areas are shown relative to the water system facilities and wastewater system facilities on Figure 8-5 and Figure 8-6, respectively.

8.2.3 Frequency

California experiences hundreds of earthquakes each year, most with minimal damage and magnitudes below 3.0. Earthquakes that cause moderate damage to structures occur several times a year. According to the USGS, a strong earthquake measuring greater than 5.0 occurs every two to three years and major earthquakes of more than 7.0 occur once a decade. The State Hazard Mitigation Plan indicates that in the next 30 years there is over a 99 percent probability of a magnitude 6.7 earthquake in California and a 94 percent probability of a magnitude 7.0 earthquake.

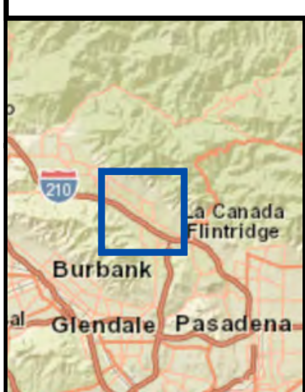
The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) predicts the probability of an earthquake of Magnitude 6.7 or greater over the next 30 years as shown in Figure 8-7. The UCERF3 also defined the following recurrence intervals for the five deterministic earthquake scenarios used for the risk assessment in this hazard mitigation plan:

- Sierra Madre M7.16 = 1,620.95 years
- Verdugo M6.90 = 4,337.10 years
- Raymond M6.71 = 1,174.42 years
- Puente Hills M6.95 = 3,094.92 years
- Northridge M6.89 = 1,460.41 years



Crescenta Valley Water District

Figure 8-3. Potable Water System - NEHRP Soil Class



C (Dense soil/soft rock)
D (Stiff soil)
Water District Boundary
Potable Water System Pipeline

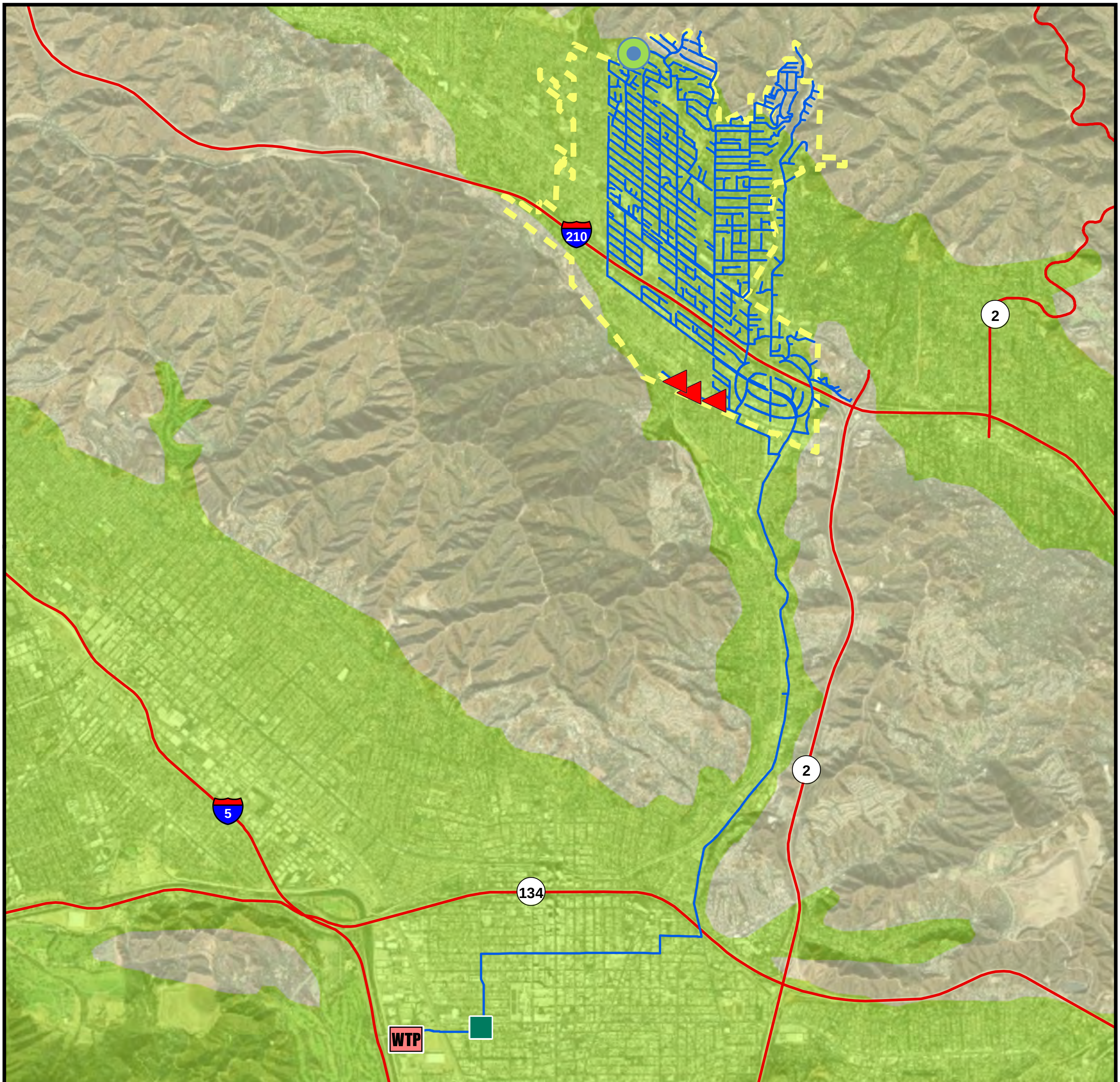
Aeration Tower
Debris Basin
Emergency Water Supply Interconnection
Interconnection

Mixing Station
Motor Control Center
Pipeline Crossing
Potable Water Treatment Plant

Pressure Reducing Station
Reservoir
Water Booster Pump Station
Well

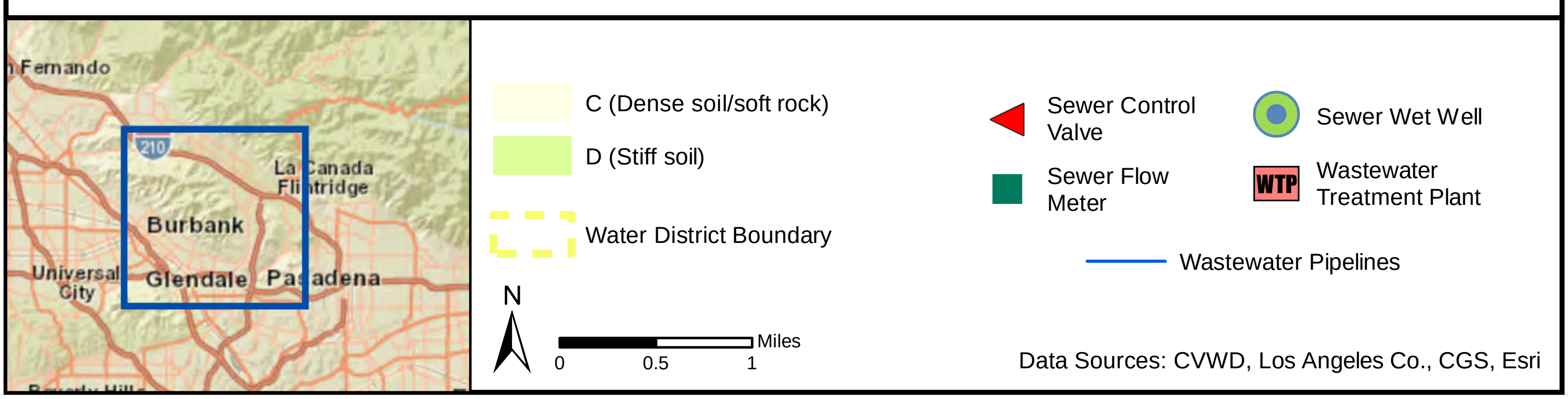
N
0 0.25 0.5 Miles

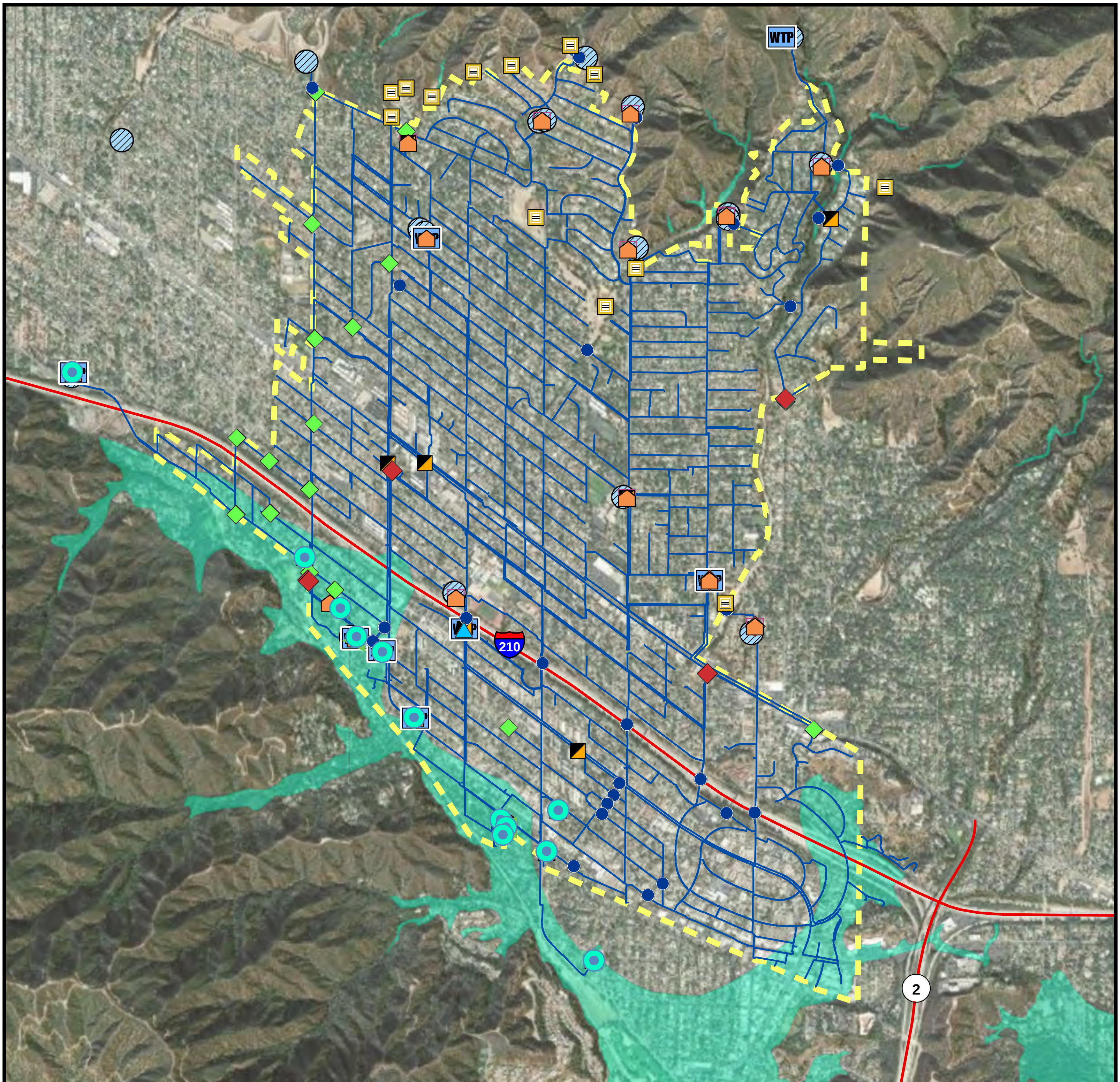
Data Sources: CVWD, Los Angeles Co., CGS, Esri



Crescenta Valley Water District

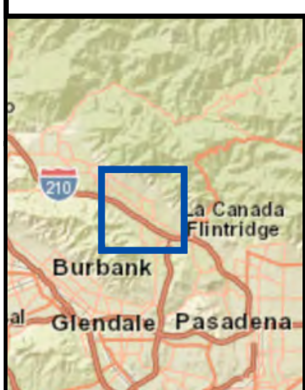
Figure 8-4. Wastewater System - NEHRP Soil Class





Crescenta Valley Water District

Figure 8-5. Potable Water System - Liquefaction



Liquefaction Zones

Water District Boundary

Potable Water System Pipeline

Aeration Tower

Debris Basin

Emergency Water Supply Interconnection

Interconnection

Mixing Station

Motor Control Center

Pipeline Crossing

Potable Water Treatment Plant

Pressure Reducing Station

Reservoir

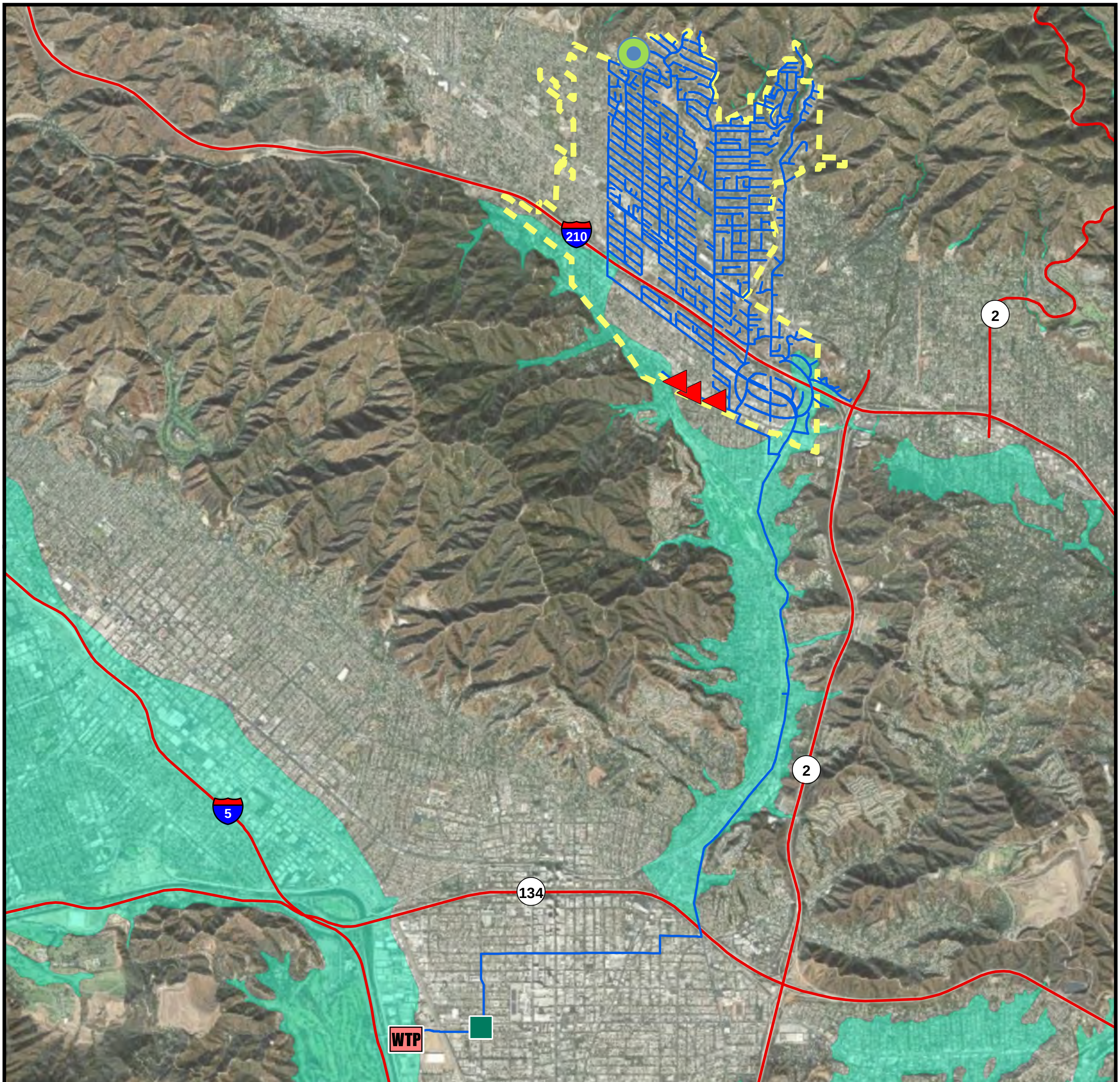
Water Booster Pump Station

Well

N

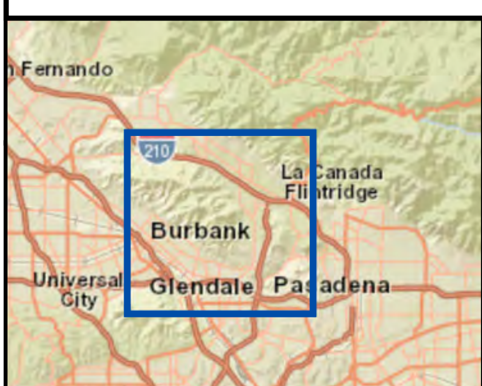
0 0.25 0.5 Miles

Data Sources: CVWD, Los Angeles Co., Esri



Crescenta Valley Water District

Figure 8-6. Wastewater System - Liquefaction



Liquefaction Zones

Water District Boundary

Sewer Control Valve

Sewer Flow Meter

Sewer Wet Well

WTP Wastewater Treatment Plant

Wastewater Pipelines

N

0 0.5 1 Miles

Data Sources: CVWD, Los Angeles Co., Esri

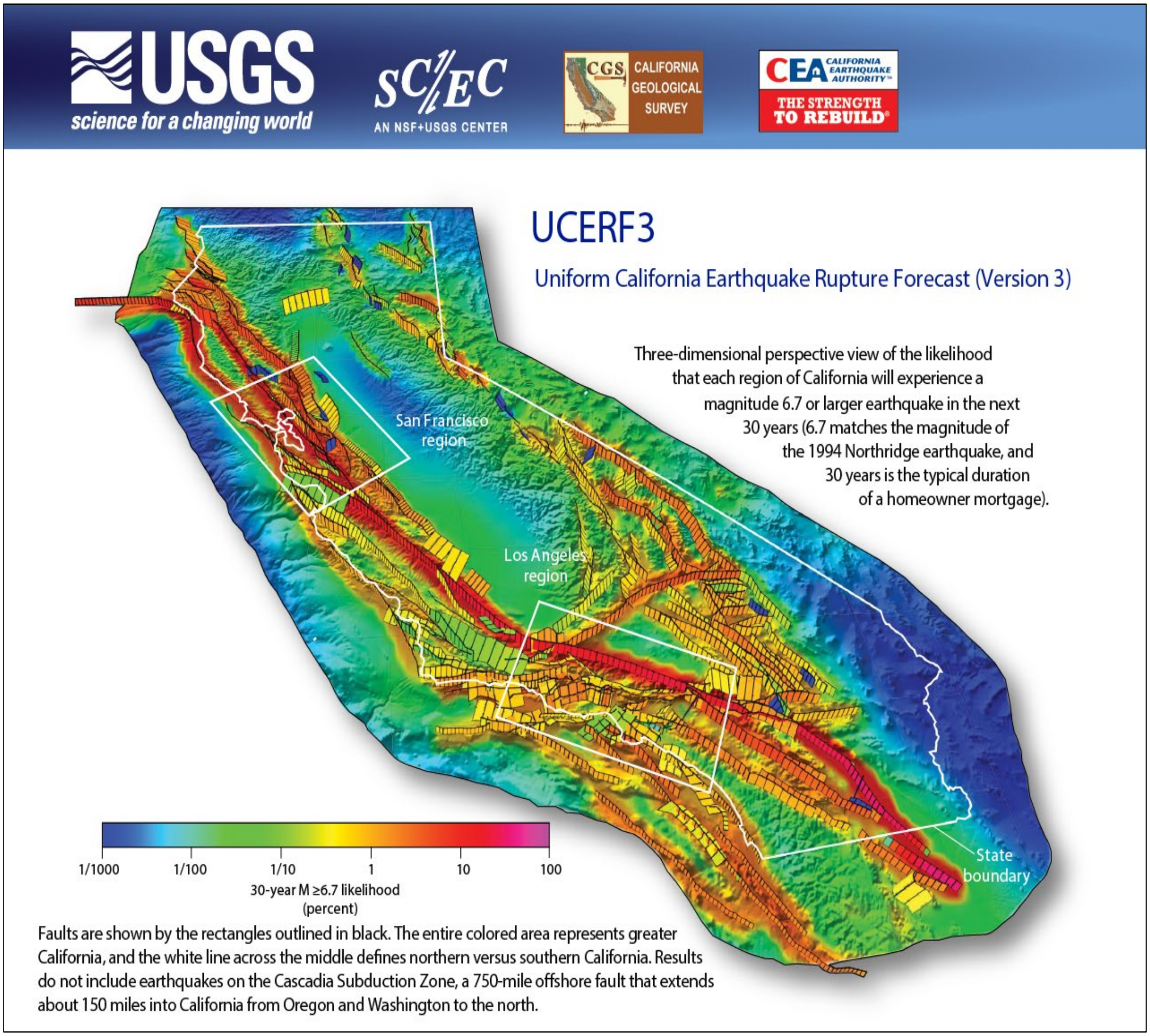


Figure 8-7. UCERF3 Forecast for Magnitude 6.7 or Larger Earthquake in the Next 30 Years.

Severity

Potential Earthquake Intensity in the Planning Area

USGS probabilistic mapping is an indication of potential earthquake intensity in an area. Figure 8-1 shows the intensity with a 10-percent exceedance chance in 50 years in Southern California. For the District service area, this PGA is in the approximate range of 0.3g.

Potential Damage

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris as the shocks shake buildings and other structures. Soil liquefaction can undermine building and road foundations.

Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

The severity of a seismic event is directly correlated to the stability of the ground close to the event's epicenter. A poorly built structure on a stable site is far more likely to survive a large earthquake than a well-built structure on an unstable site. Thorough geotechnical site evaluations should be the rule of thumb for new construction in the planning area until creditable soils mapping becomes available.

8.2.4 Warning Time

There is no current reliable way to predict the day or month that an earthquake will occur at any given location. Los Angeles County residents are being encouraged to download MyShake, the new statewide cell phone app from Earthquake Early Warning California that is powered by ShakeAlert and builds on lessons learned from the City of Los Angeles's two-year ShakeAlert pilot to deliver earthquake early warning alerts to people across L.A. County. ShakeAlertLA was retired on December 31, 2020. The MyShake app -- developed by the UC Berkeley Seismology Lab, sponsored by the State of California Office of Emergency Services -- is the first app powered by ShakeAlert® to provide statewide earthquake early warning alerts. The app is one of the delivery modes of the California Earthquake Early Warning System. MyShake is available in both English and Spanish.

8.3 EXPOSURE

The risk assessment for earthquake determined District assets that lie within mapped liquefaction areas or areas of high-risk NEHRP soils (soil classes C and D). Table 8-4 and Table 8-5 summarize the number of structures and the length of pipeline, respectively, within each of these hazard areas. Figure 8-8 and Figure 8-9 show these results as the percent of total planning area facilities of each type for potable water and wastewater systems, respectively.

Table 8-4. Number of District Structures Exposed to the Earthquake Hazard

	Total Structures	Number of Structures in Earthquake Hazard Areas		
		NEHRP Class C Soils	NEHRP Class D Soils	Mapped Liquefaction Areas
Potable Water Structures				
Building	4	0	4	1
Aeration Tower	2	1	1	2
Debris Basin	13	5	8	1
Emergency Interconnection	21	4	17	5
Fitting	1,924	176	1,748	206
Hydrant	695	60	635	58
Interconnection	8	2	6	2
Mixing Station	1	0	1	0
Motor Control Center	21	6	15	6
Pipeline Crossing	26	6	20	2
Potable Water Treatment Plant	10	3	7	2
Potable Water Valve	2,279	200	2,079	192
Pressure Reducing Station	7	1	6	0
Reservoir	19	8	11	2
Water Booster Pump Station	14	5	9	2
Well	12	0	12	8
Total	**5,056**	**477**	**4,579**	**489**
Wastewater Structures				
Sewer Control Valve	3	0	3	0
Sewer Fitting	6,482	620	5,862	206
Sewer Flow Meter	1	0	1	0
Sewer Manhole	1,270	114	1,156	112
Sewer Wet Well	1	0	1	0
Wastewater Lift Station	2	0	2	0
Wastewater Treatment Plant	1	0	1	1
Total	**7,760**	**734**	**7,026**	**319**

Table 8-5. Length of District Pipeline Within Earthquake Hazard Areas

	Total Length of Pipe (feet)	Length of Pipe in Earthquake Hazard Areas (feet)		
		NEHRP Class C Soils	NEHRP Class D Soils	Mapped Liquefaction Areas
Potable Water Pipelines				
Brittle (asbestos cement, concrete, cast iron, welded steel with gas-welded joints, and pre-1935 steel with unknown joint type)	538,793	47,616	491,177	49,333
Ductile (ductile iron, PVC, welded steel pipes with arc-welded joints, and post-1934 steel with unknown joint type)	6,899	120	6,779	698
Total	**545,692**	**47,736**	**497,956**	**50,031**
Wastewater Pipelines				
Brittle (clay, concrete)	356,466	28,027	328,438	33,330
Ductile (plastic)	7,261	1,155	6,106	757
Total	**363,727**	**29,182**	**334,544**	**34,087**

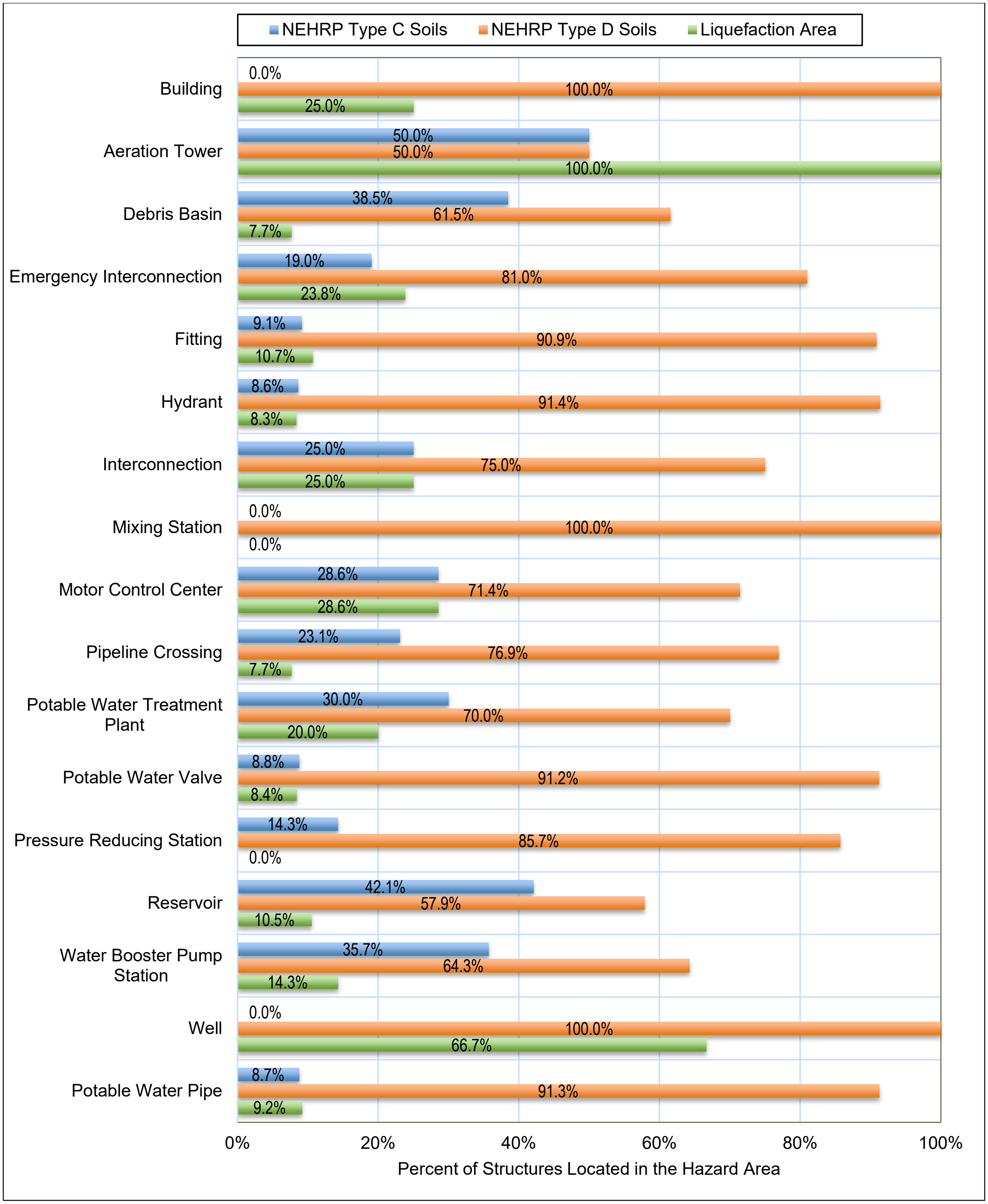


Figure 8-8. Percent of District Potable Water Structures Exposed to the Earthquake Hazard

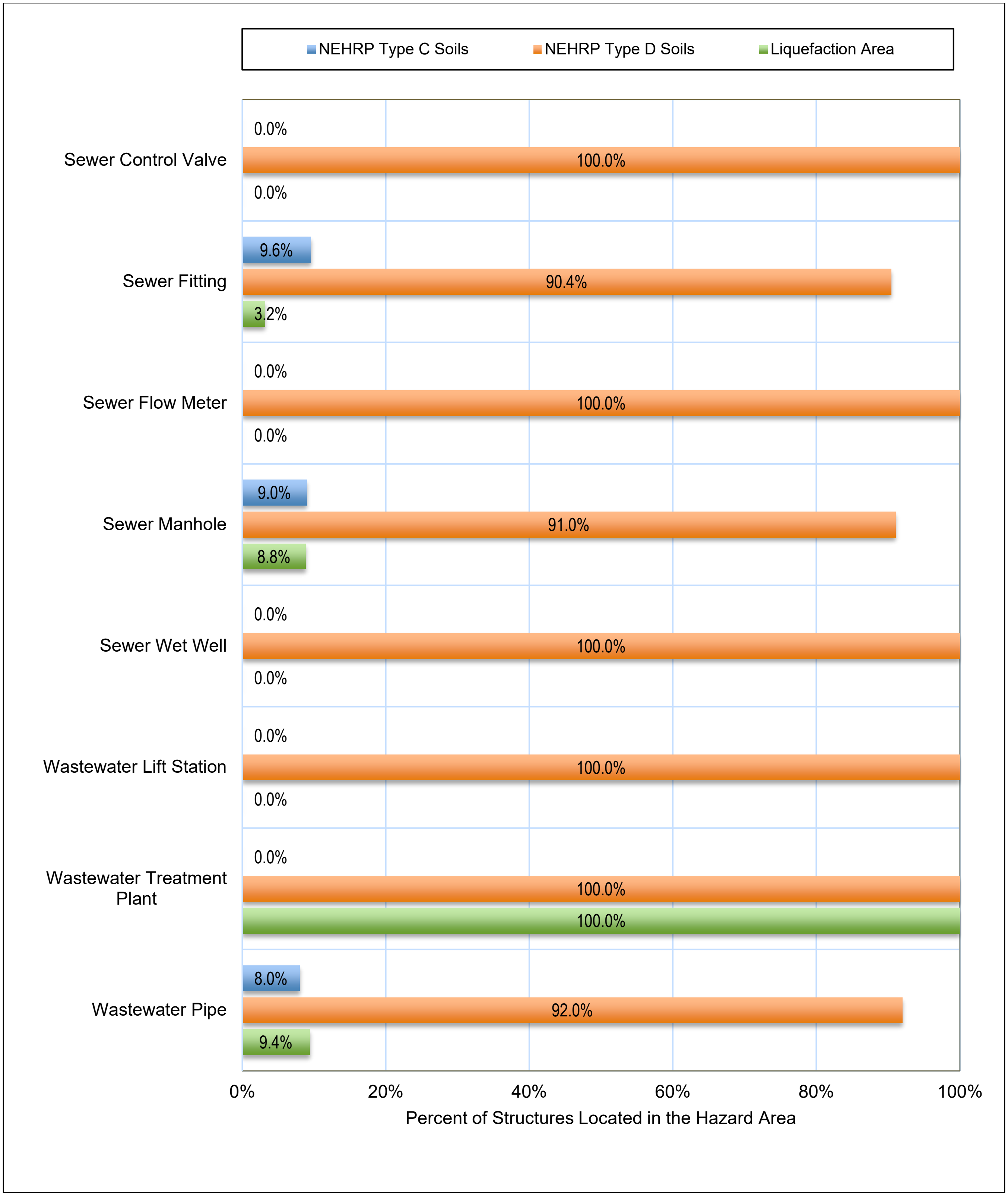


Figure 8-9. Percent of District Wastewater Structures Exposed to the Earthquake Hazard

8.4 VULNERABILITY

8.4.1 Scenarios Evaluated

After reviewing potential impact data provided by USGS ShakeMaps for the region, the Steering Committee identified the following earthquake scenarios to analyze for this assessment:

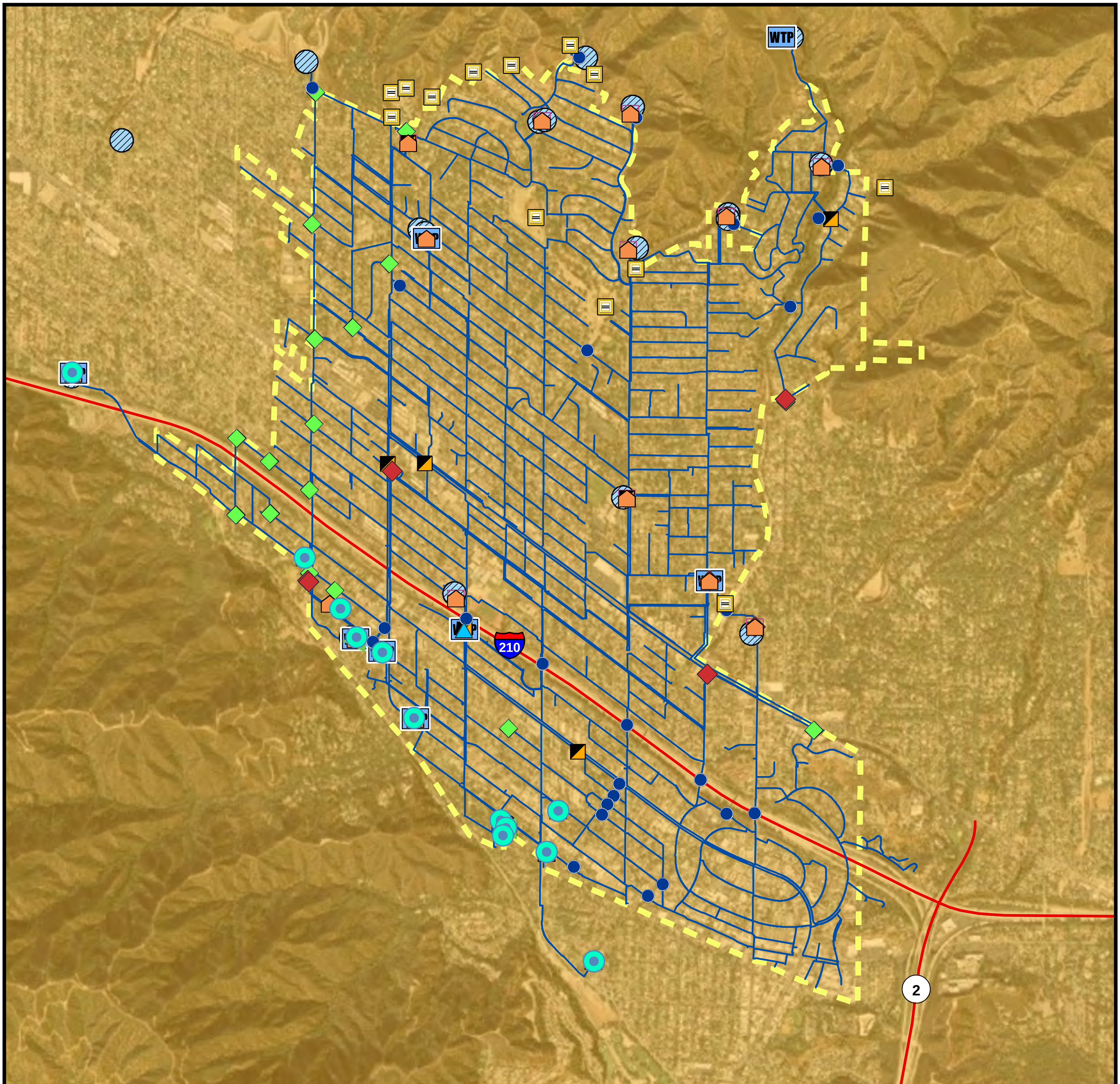
- A Magnitude-7.16 event on the Sierra Madre fault with an epicenter approximately 14 miles east of La Crescenta. (see Figure 8-10 and Figure 8-11)
- A Magnitude-6.9 event on the Verdugo fault with an epicenter located within La Crescenta. (see Figure 8-12 and Figure 8-13)
- A Magnitude-6.95 event on the Puente Hills fault with an epicenter approximately 8 miles south-southeast of La Crescenta. (see Figure 8-14 and Figure 8-15)
- A Magnitude-6.89 event on the Northridge fault with an epicenter approximately 20 miles west-northwest of La Crescenta. (see Figure 8-16 and Figure 8-17)
- A Magnitude-6.71 event on the Raymond fault with an epicenter approximately 9.5 miles southeast of La Crescenta. (See Figure 8-18 and Figure 8-19)
- The standard Hazus 100-year probabilistic event (see Figure 8-20 and Figure 8-21)

8.4.2 Level of Damage to Structures

Hazus classifies the vulnerability of structures to earthquake damage in five categories: no damage, slight damage, moderate damage, extensive damage, or complete damage. The model was used to assign a vulnerability category to each district asset. The estimates of damage level were then used to estimate the dollar cost of damage to structures and their contents. Detailed results for each facility are provided in Appendix C. Table 8-6 summarizes the results for structures.

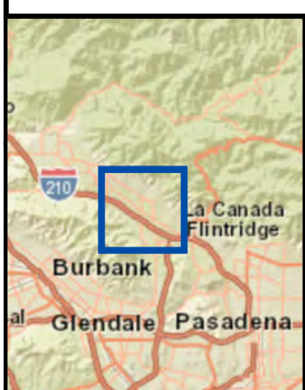
Table 8-6. Earthquake Scenario Loss Estimates for District Structures

	Average Probability of Damage to Structure					
	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Total Damage
Potable Water Facilities						
Sierra Madre M7.1	8.07%	27.65%	28.75%	23.93%	11.58%	$42,287,519
Verdugo M6.9	5.76%	24.97%	33.16%	24.69%	11.40%	$44,298,868
Puente Hills M6.95	7.68%	27.26%	31.90%	24.77%	8.37%	$39,328,636
Northridge M6.89	48.65%	29.30%	12.72%	7.86%	1.45%	$11,550,512
Raymond M6.71	41.50%	30.58%	15.19%	10.60%	2.10%	$15,357,719
100-Year Probabilistic	54.84%	19.28%	12.85%	10.63%	2.38%	$15,294,107
Wastewater Facilities						
Sierra Madre M7.1	23.30%	39.56%	21.69%	12.43%	3.01%	$357,502
Verdugo M6.9	12.12%	39.66%	32.35%	12.84%	3.01%	$375,478
Puente Hills M6.95	8.75%	36.80%	38.12%	13.30%	3.02%	$367,494
Northridge M6.89	56.40%	29.10%	4.28%	8.16%	2.04%	$178,033
Raymond M6.71	30.78%	37.06%	17.58%	11.70%	2.85%	$267,366
100-Year Probabilistic	59.33%	20.79%	8.09%	9.44%	2.34%	$198,536



Crescenta Valley Water District

Figure 8-10. Potable Water System - Sierra Madre M7.16 Earthquake Scenario



Water District Boundary
Potable Water System Pipeline
Mercalli Intensity Scale
VIII (Severe/Moderate-Heavy)
Intensity scale described as:
(perceived shaking / potential damage)

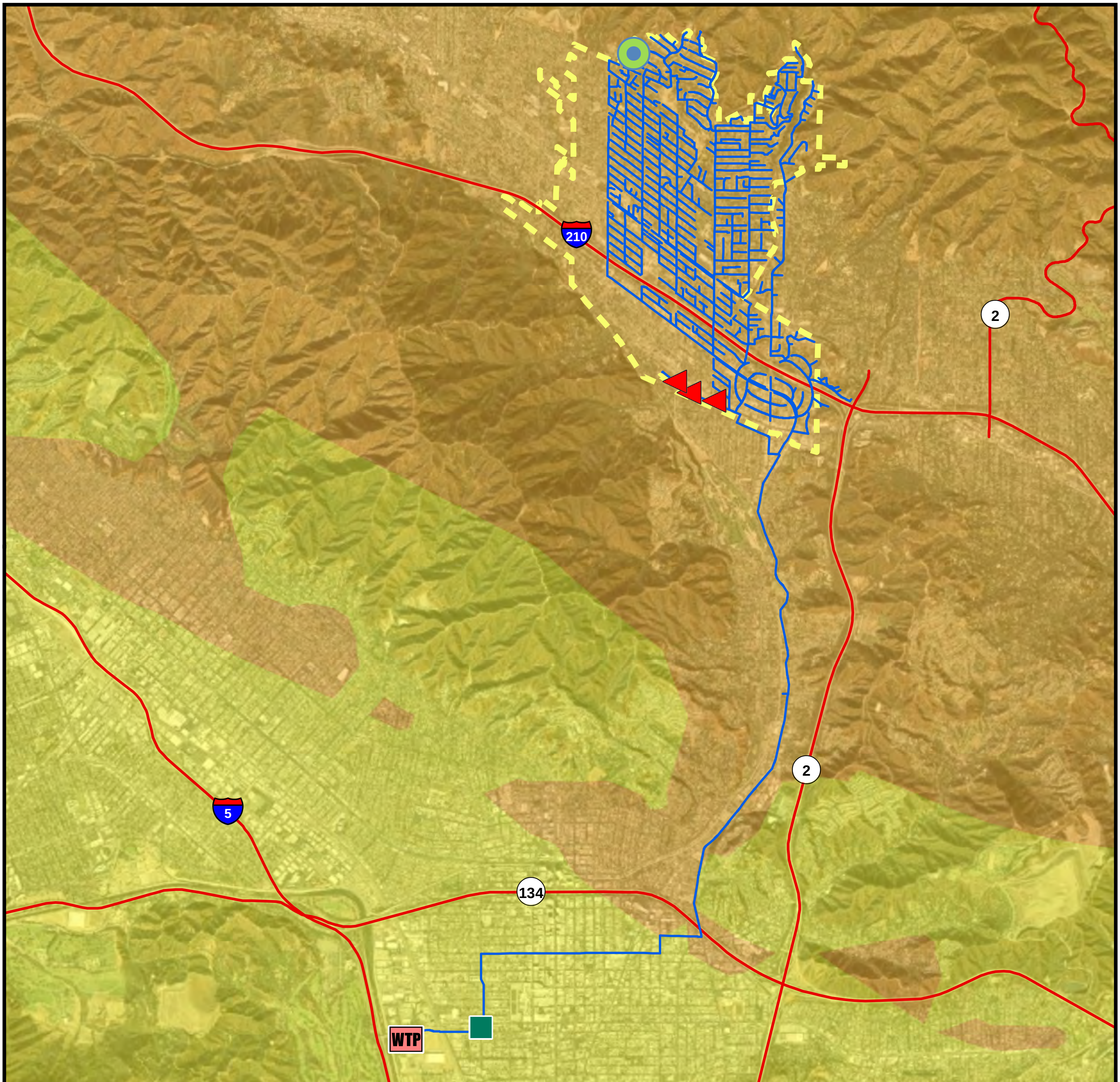
Aeration Tower
Debris Basin
Emergency Water Supply Interconnection
Interconnection

Mixing Station
Motor Control Center
Pipeline Crossing
Potable Water Treatment Plant

Pressure Reducing Station
Reservoir
Water Booster Pump Station
Well

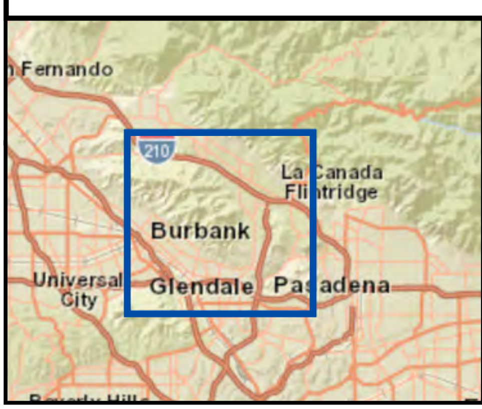
N
0 0.25 0.5 Miles

Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-11. Wastewater System - Sierra Madre M7.16 Earthquake Scenario



Mercalli Intensity Scale

VII (Very Strong/Moderate)

VIII (Severe/Moderate-Heavy)

Intensity scale described as:
(perceived shaking / potential damage)

N

0 0.5 1 Miles

Water District Boundary

Wastewater Pipelines

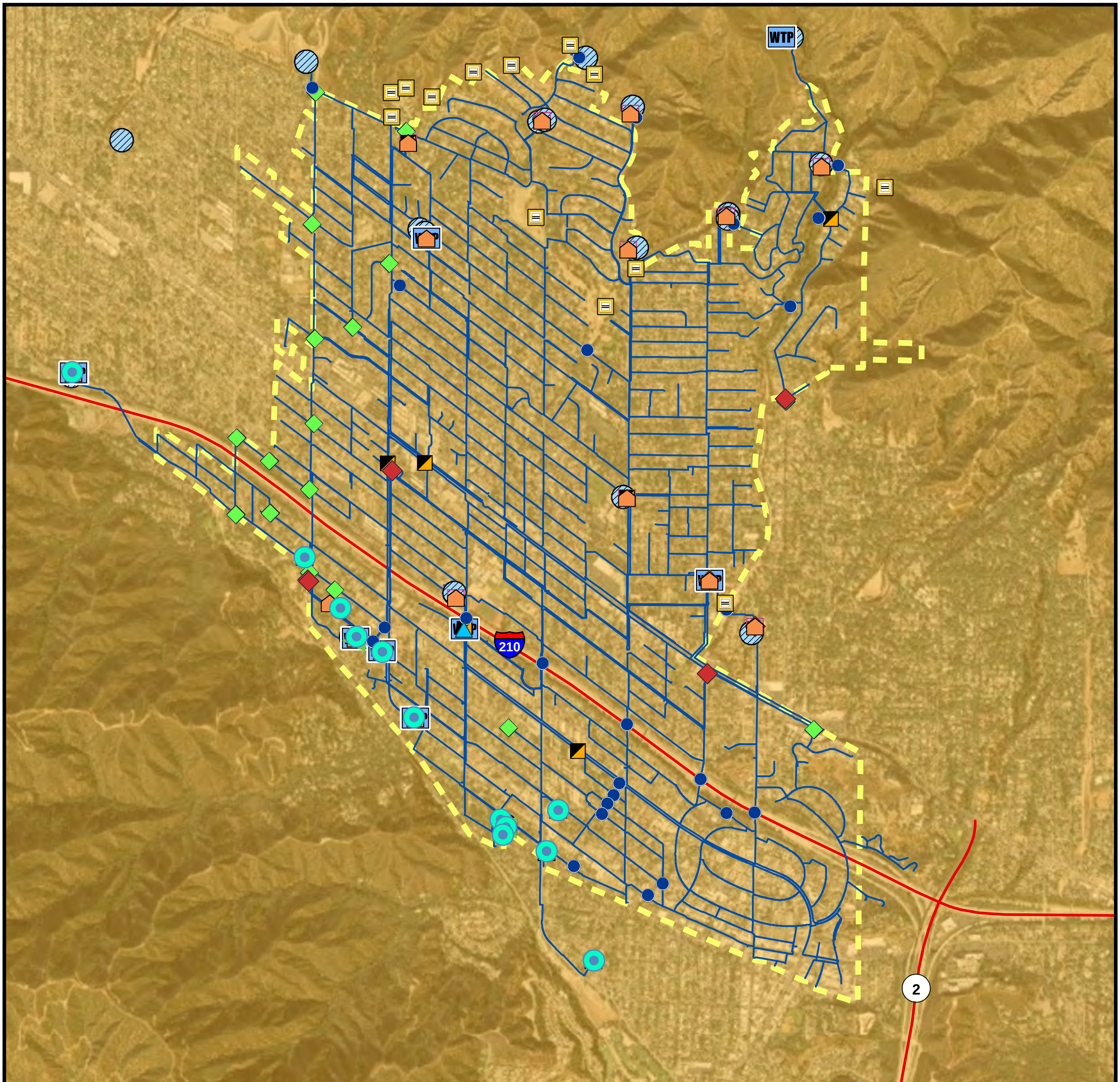
Sewer Control Valve

Sewer Wet Well

Sewer Flow Meter

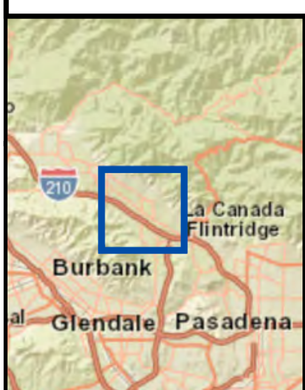
WTP Wastewater Treatment Plant

Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-12. Potable Water System - Verdugo M6.9 Earthquake Scenario



Water District Boundary

Potable Water System Pipeline

Mercalli Intensity Scale

VIII (Severe/Moderate-Heavy)

Intensity scale described as:
(perceived shaking / potential damage)

Aeration Tower

Debris Basin

Emergency Water Supply Interconnection

Interconnection

Mixing Station

Motor Control Center

Pipeline Crossing

Potable Water Treatment Plant

Pressure Reducing Station

Reservoir

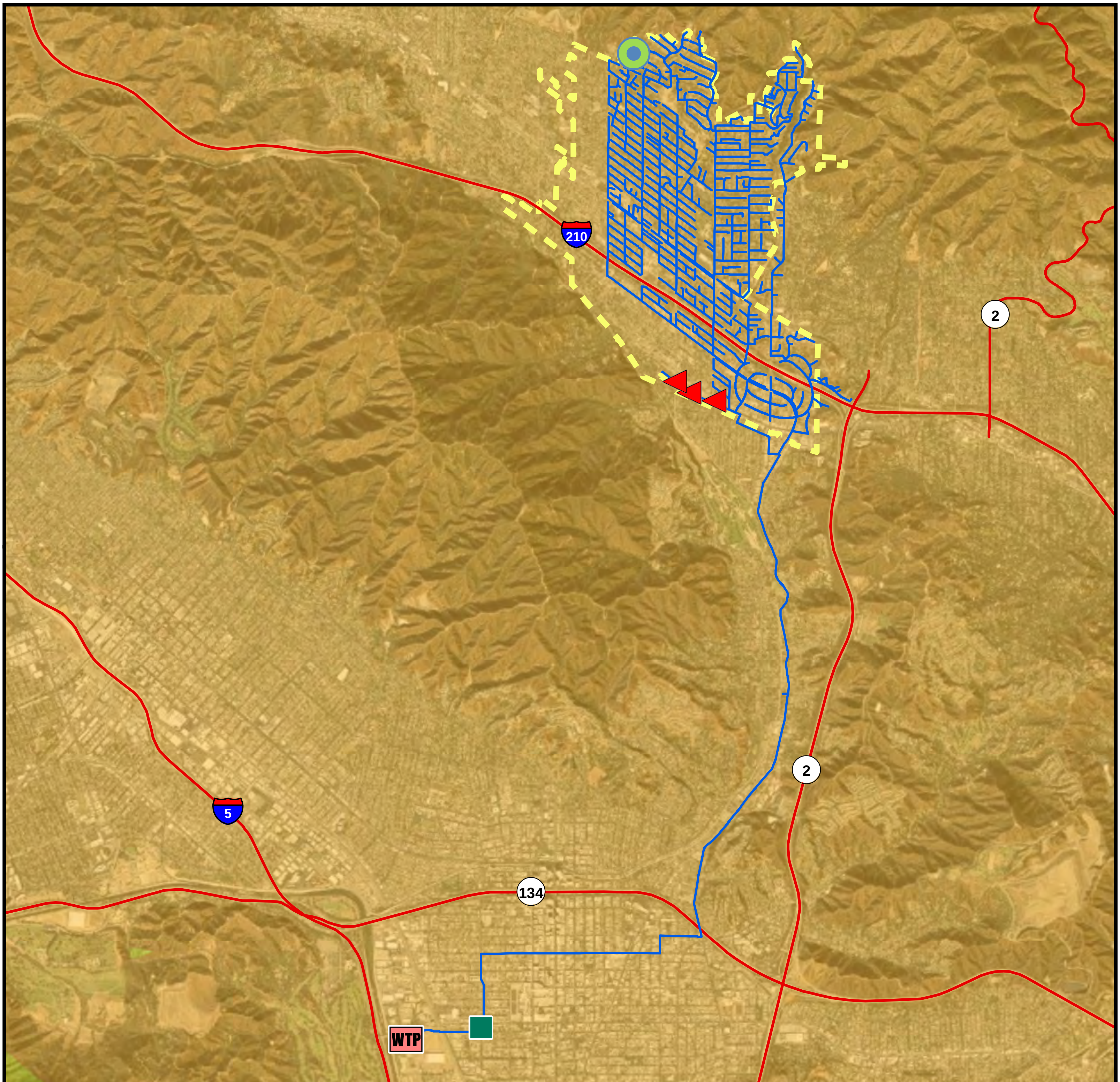
Water Booster Pump Station

Well

N

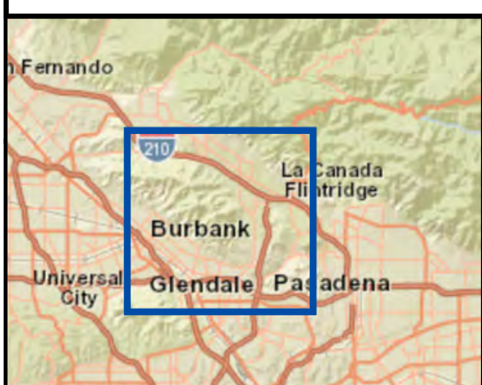
0 0.25 0.5 Miles

Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-13. Wastewater System - Verdugo M6.9 Earthquake Scenario



Mercalli Intensity Scale

VII (Very Strong/Moderate)

VIII (Severe/Moderate-Heavy)

Intensity scale described as:
(perceived shaking / potential damage)

N

0 0.5 1 Miles

Water District Boundary

Wastewater Pipelines

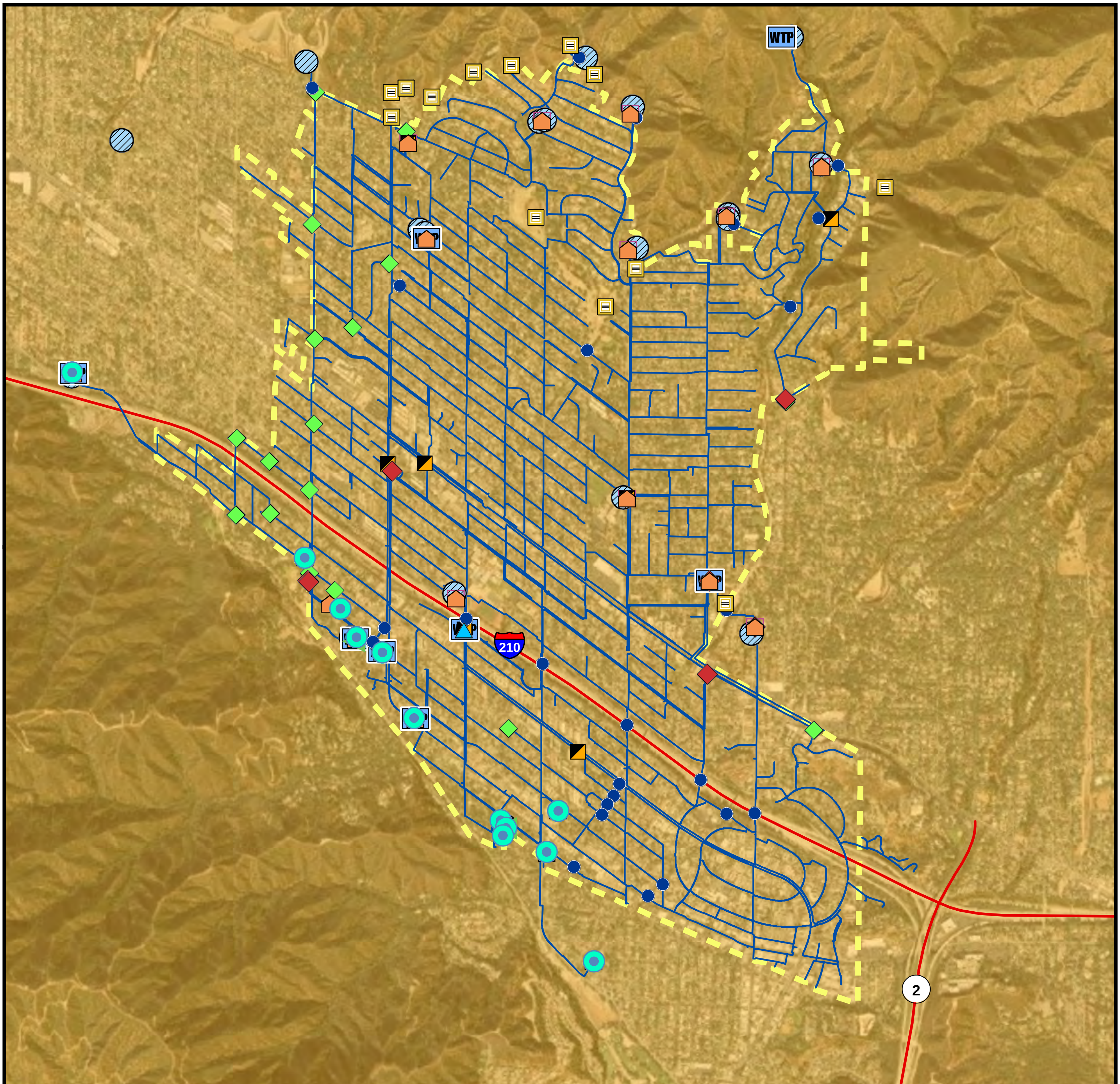
Sewer Control Valve

Sewer Wet Well

Sewer Flow Meter

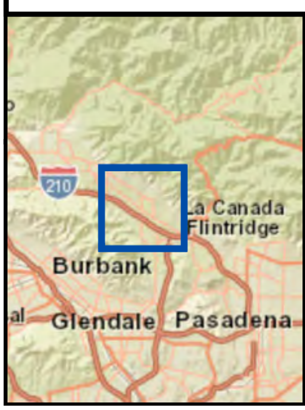
WTP Wastewater Treatment Plant

Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-14. Potable Water System - Puente Hills M6.95 Earthquake Scenario



Water District Boundary

Potable Water System Pipeline

Mercalli Intensity Scale

VIII (Severe/Moderate-Heavy)

Intensity scale described as:
(perceived shaking / potential damage)

Aeration Tower

Debris Basin

Emergency Water Supply Interconnection

Interconnection

Mixing Station

Motor Control Center

Pipeline Crossing

Potable Water Treatment Plant

Pressure Reducing Station

Reservoir

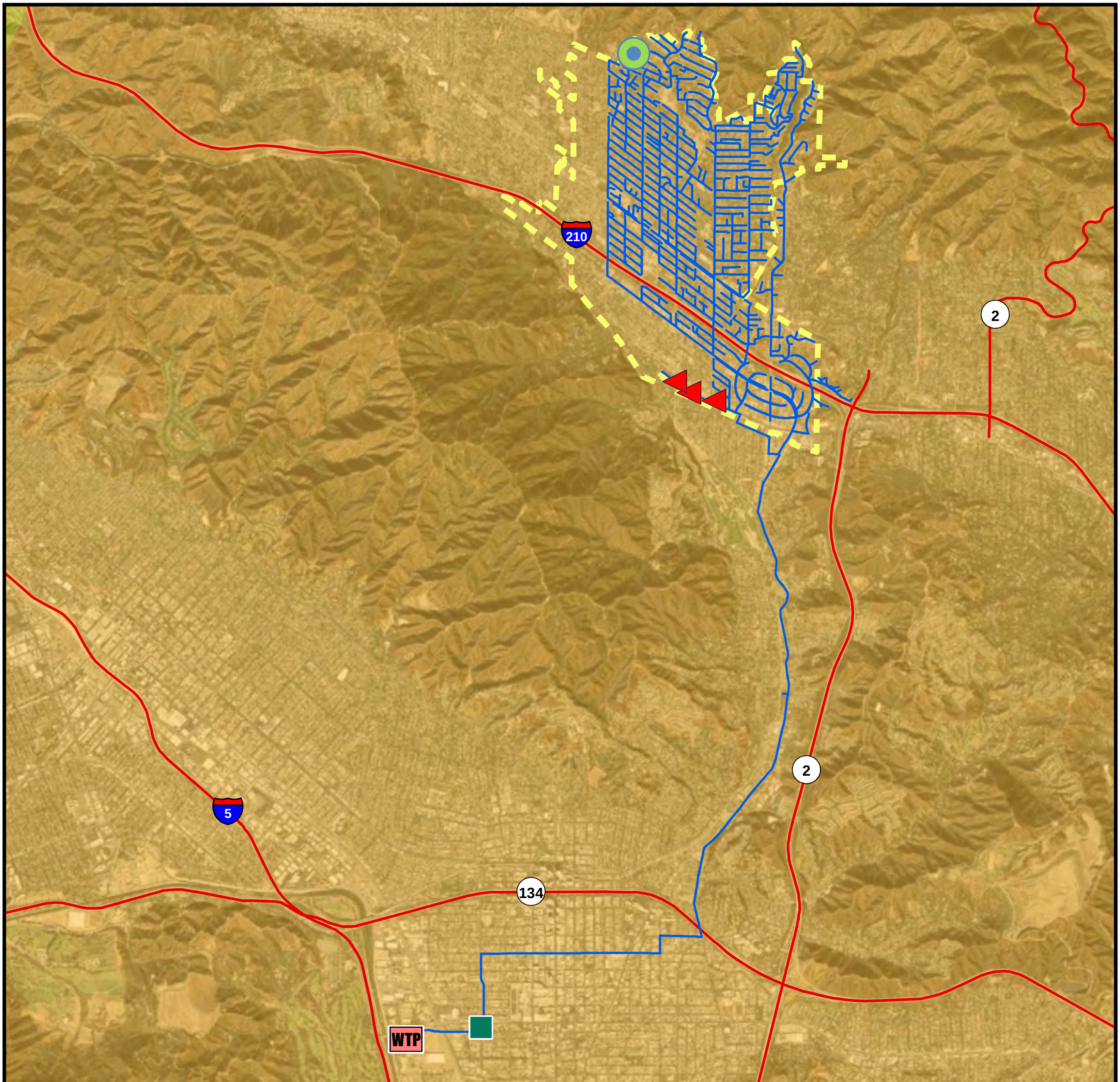
Water Booster Pump Station

Well

N

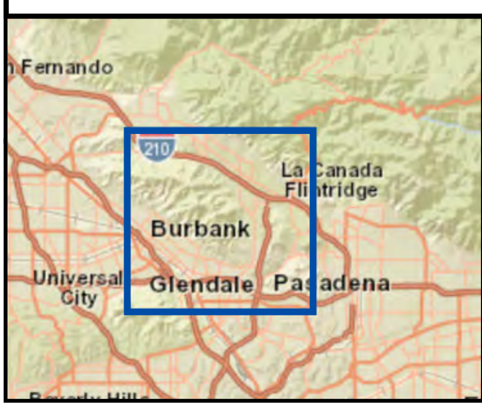
0 0.25 0.5 Miles

Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-15. Wastewater System - Puente Hills M6.95 Earthquake Scenario



Mercalli Intensity Scale

- VII (Very Strong/Moderate)
- VIII (Severe/Moderate-Heavy)

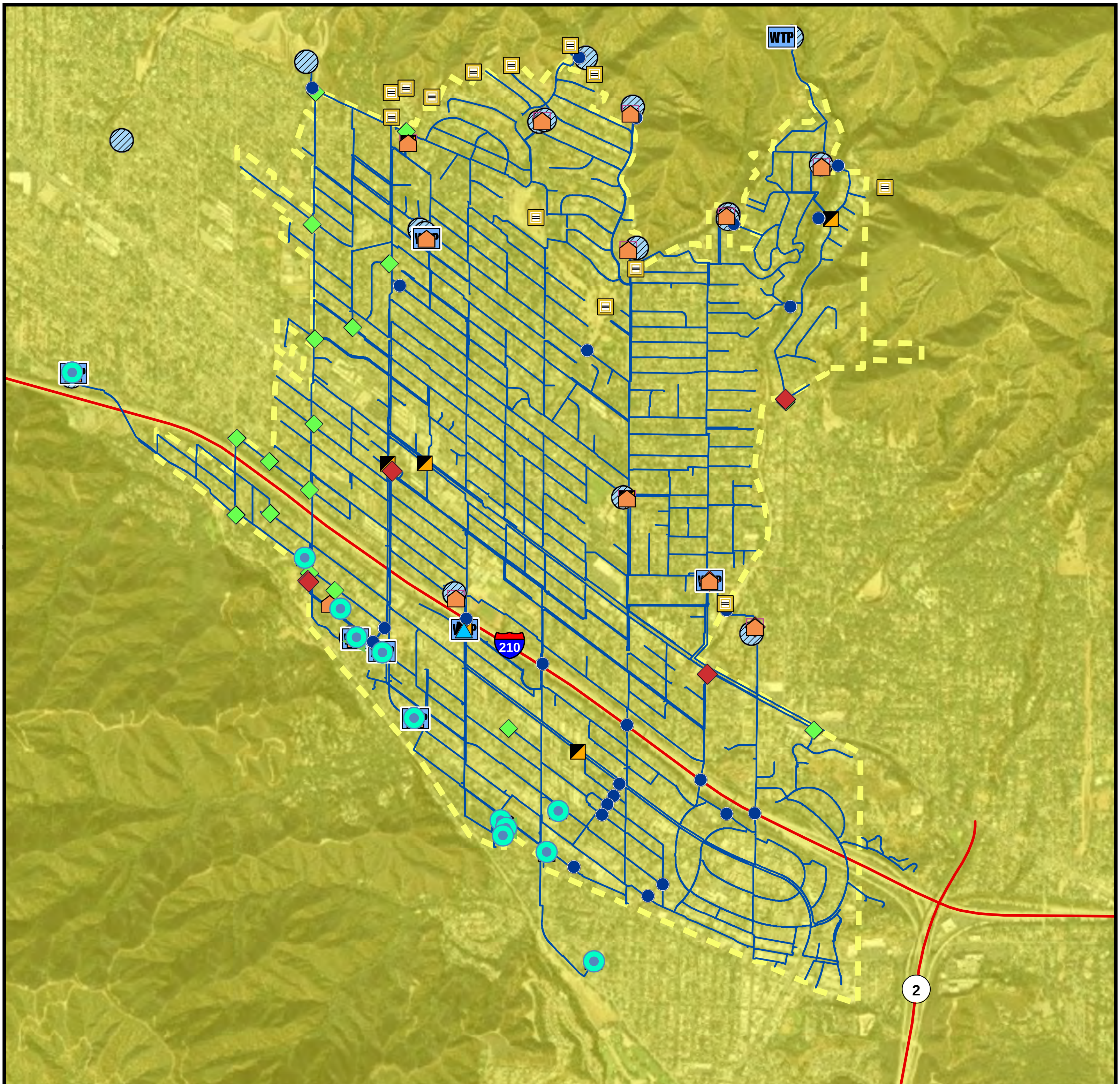
Intensity scale described as:
(perceived shaking / potential damage)

N

0 0.5 1 Miles

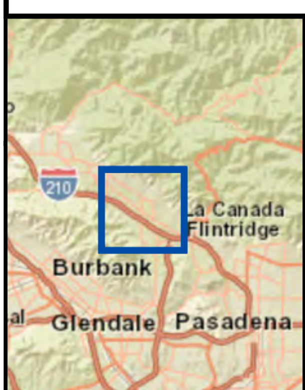
- Water District Boundary
- Wastewater Pipelines
- Sewer Control Valve
- Sewer Wet Well
- Sewer Flow Meter
- WTP Wastewater Treatment Plant

Data Sources: CVWD, Los Angeles Co., USGS, Esri

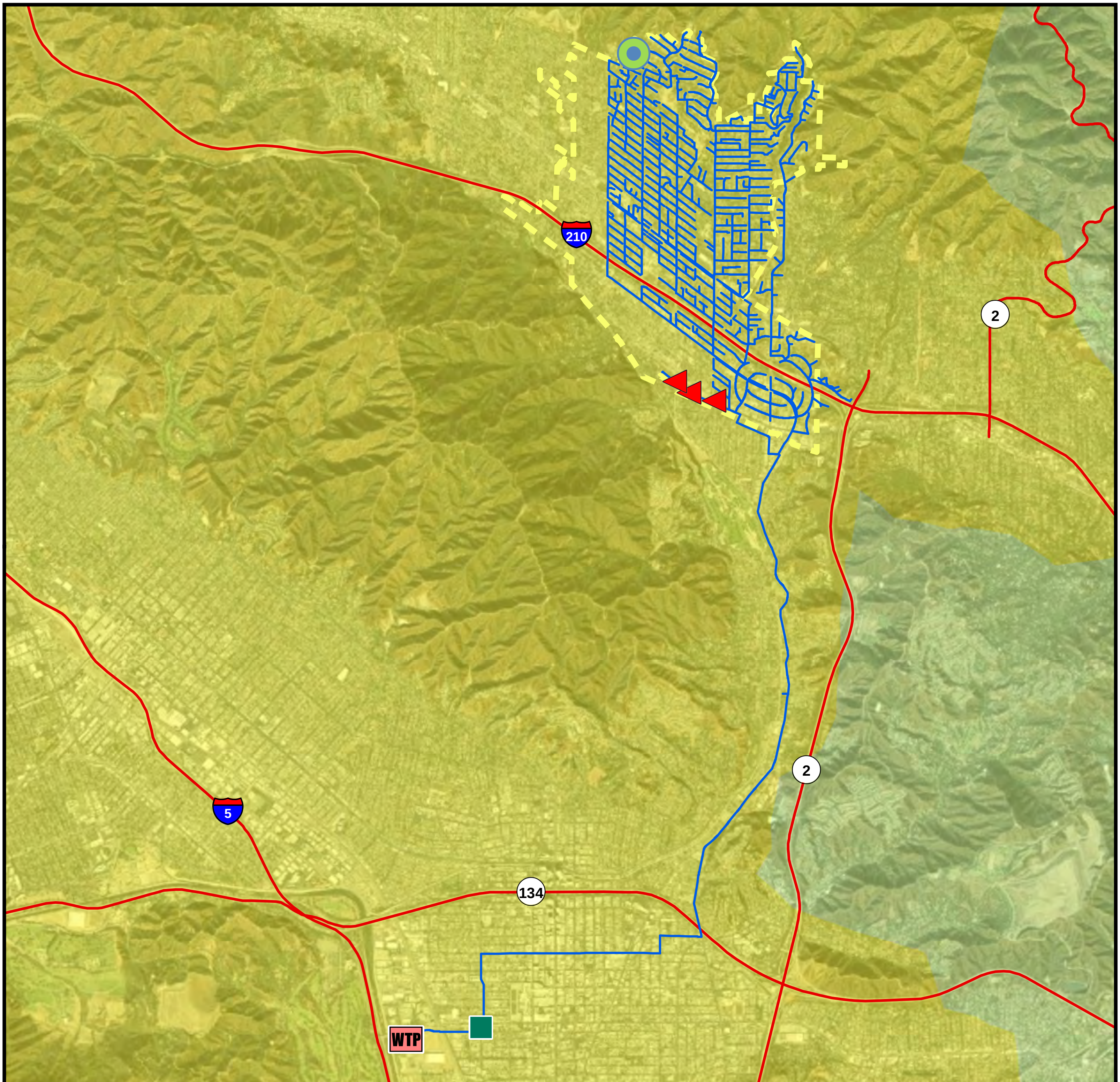


Crescenta Valley Water District

Figure 8-16. Potable Water System - Northridge M6.89 Earthquake Scenario

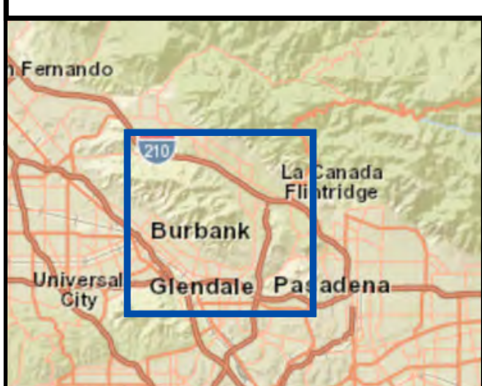


Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-17. Wastewater System - Northridge M6.89 Earthquake Scenario



Mercalli Intensity Scale

VI (Strong/Light)

VII (Very Strong/Moderate)

Intensity scale described as:
(perceived shaking / potential damage)

N

0 0.5 1 Miles

Water District Boundary

Wastewater Pipelines

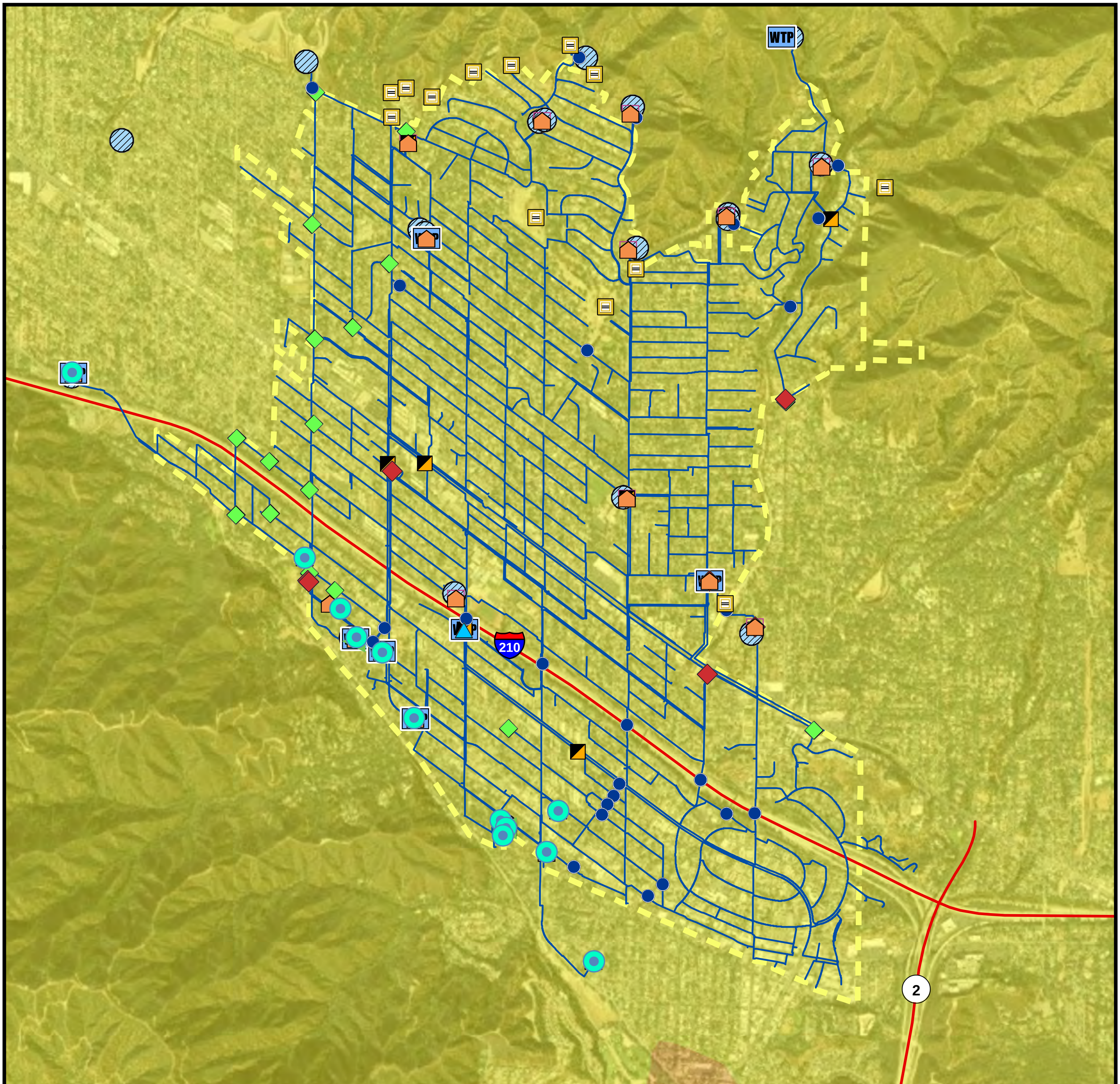
Sewer Control Valve

Sewer Wet Well

Sewer Flow Meter

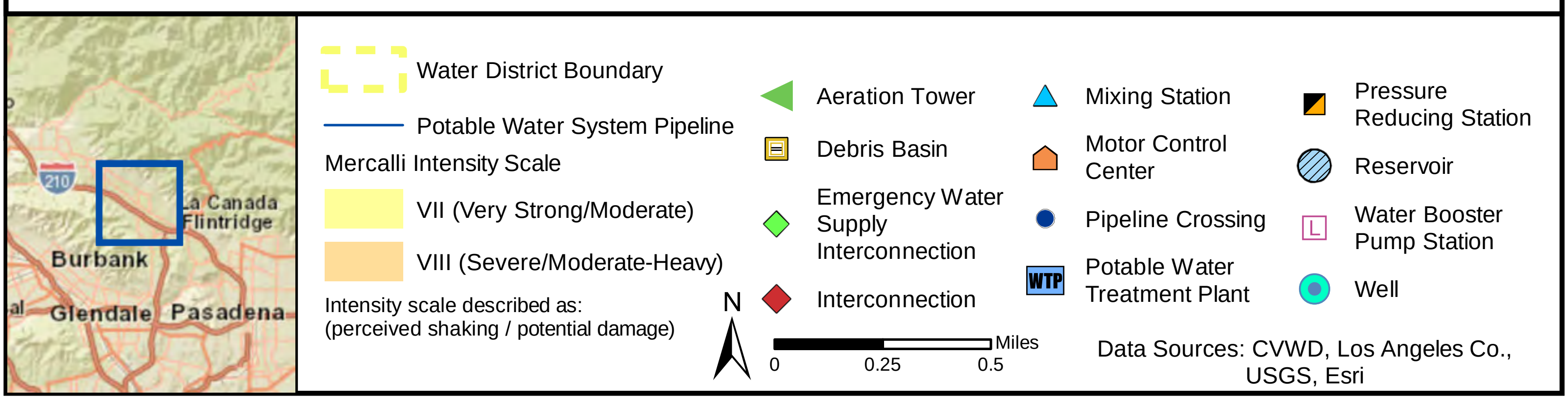
WTP Wastewater Treatment Plant

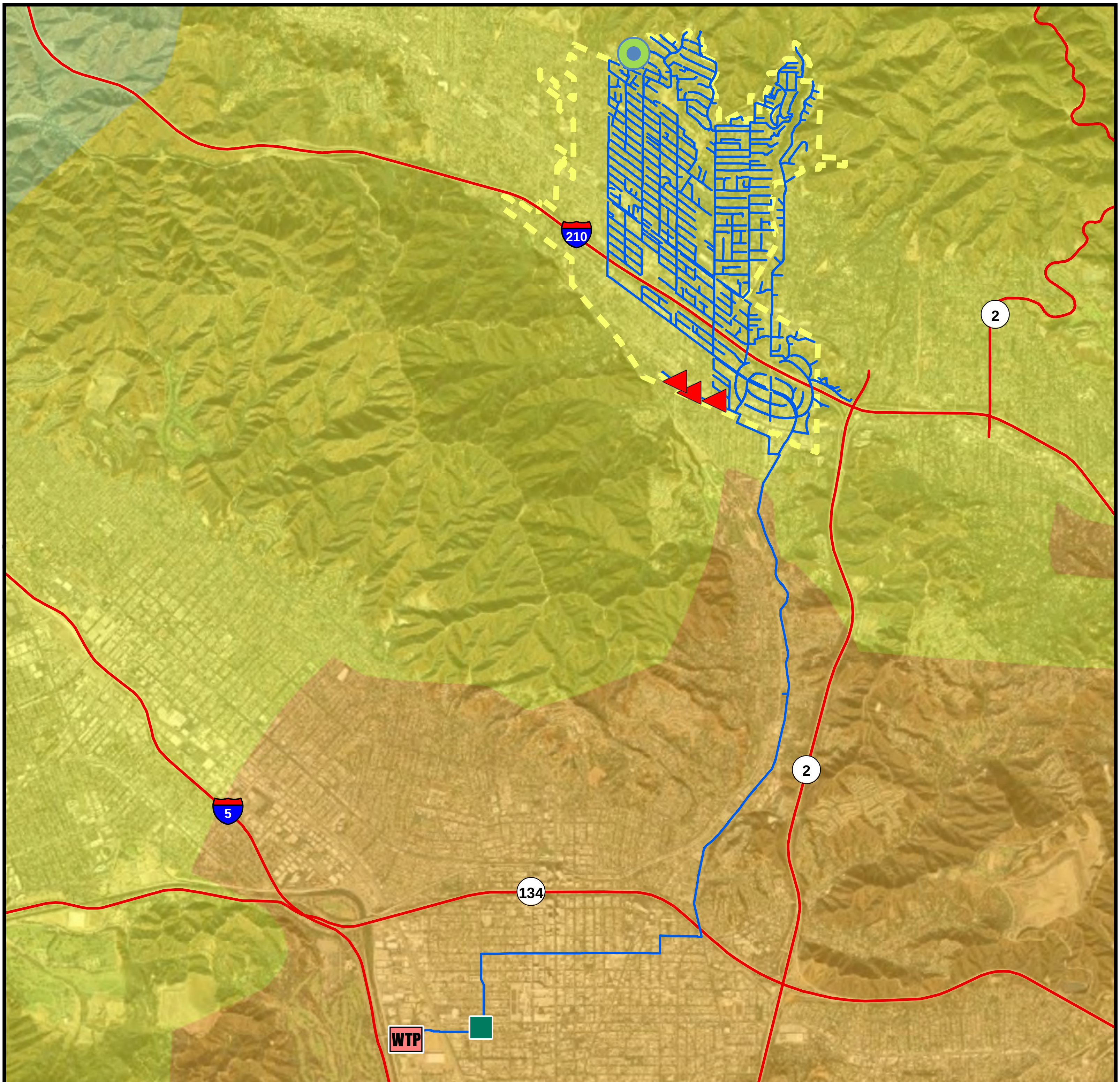
Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

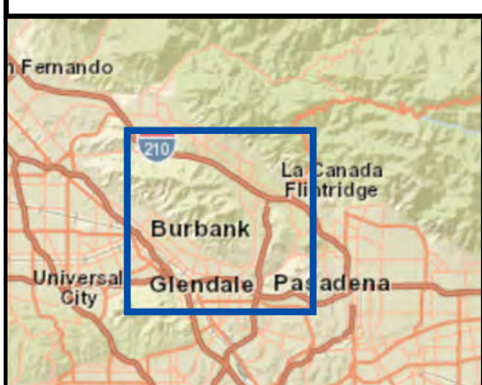
Figure 8-18. Potable Water System - Raymond M6.71 Earthquake Scenario





Crescenta Valley Water District

Figure 8-19. Wastewater System - Raymond M6.71 Earthquake Scenario



Mercalli Intensity Scale

- VI (Strong/Light)
- VII (Very Strong/Moderate)
- VIII (Severe/Moderate-Heavy)

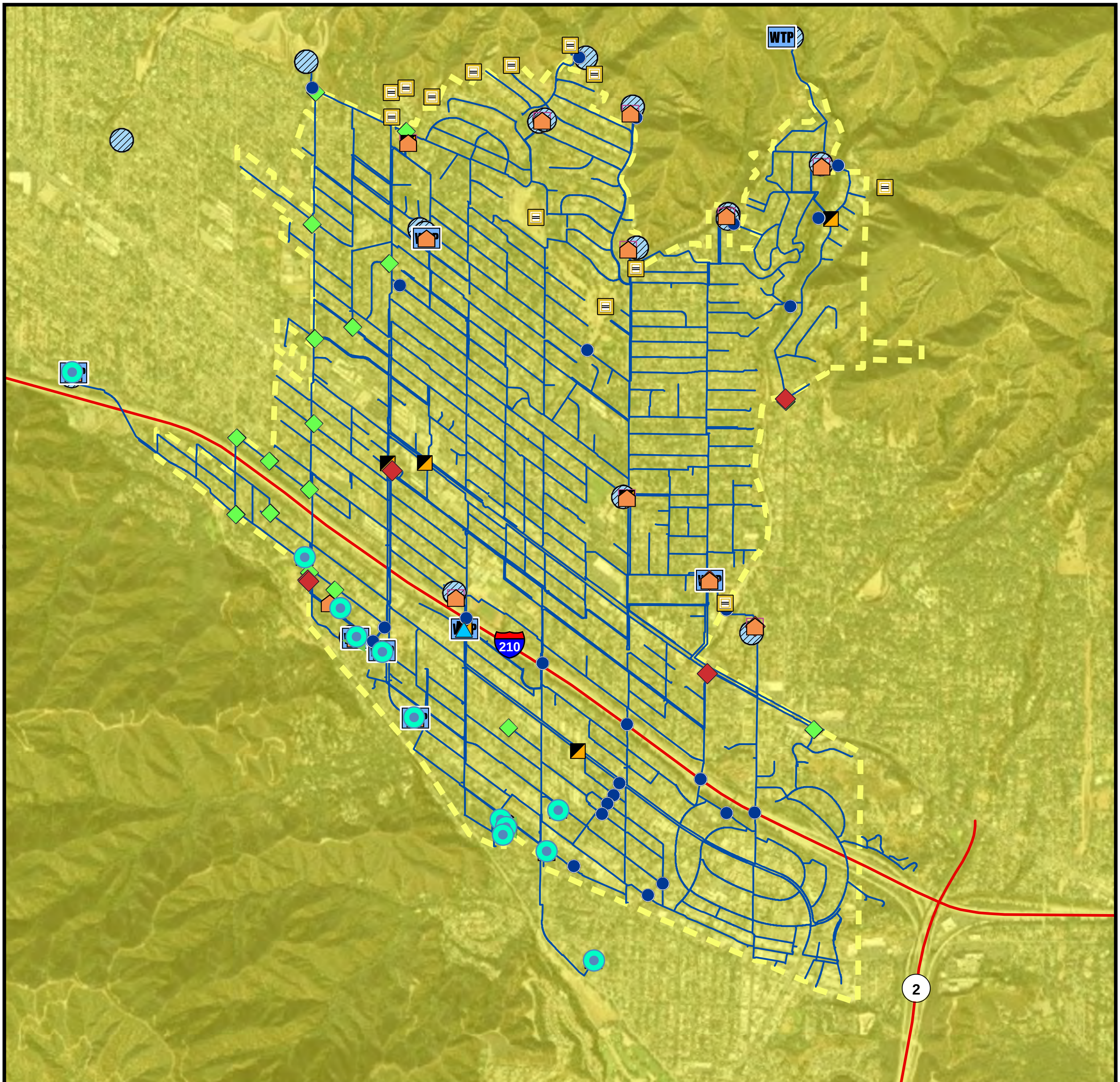
Intensity scale described as:
(perceived shaking / potential damage)

- Water District Boundary
- Wastewater Pipelines
- Sewer Control Valve
- Sewer Wet Well
- Sewer Flow Meter
- WTP Wastewater Treatment Plant

N

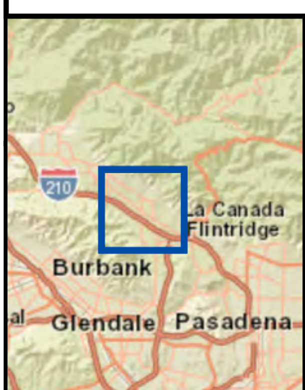
0 0.5 1 Miles

Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-20. Potable Water System - 100-Year Probabilistic Earthquake Scenario



Water District Boundary

Potable Water System Pipeline

Mercalli Intensity Scale

VII (Very Strong/Moderate)

Intensity scale described as:
(perceived shaking / potential damage)

Aeration Tower

Debris Basin

Emergency Water Supply Interconnection

Interconnection

Mixing Station

Motor Control Center

Pipeline Crossing

Potable Water Treatment Plant

Pressure Reducing Station

Reservoir

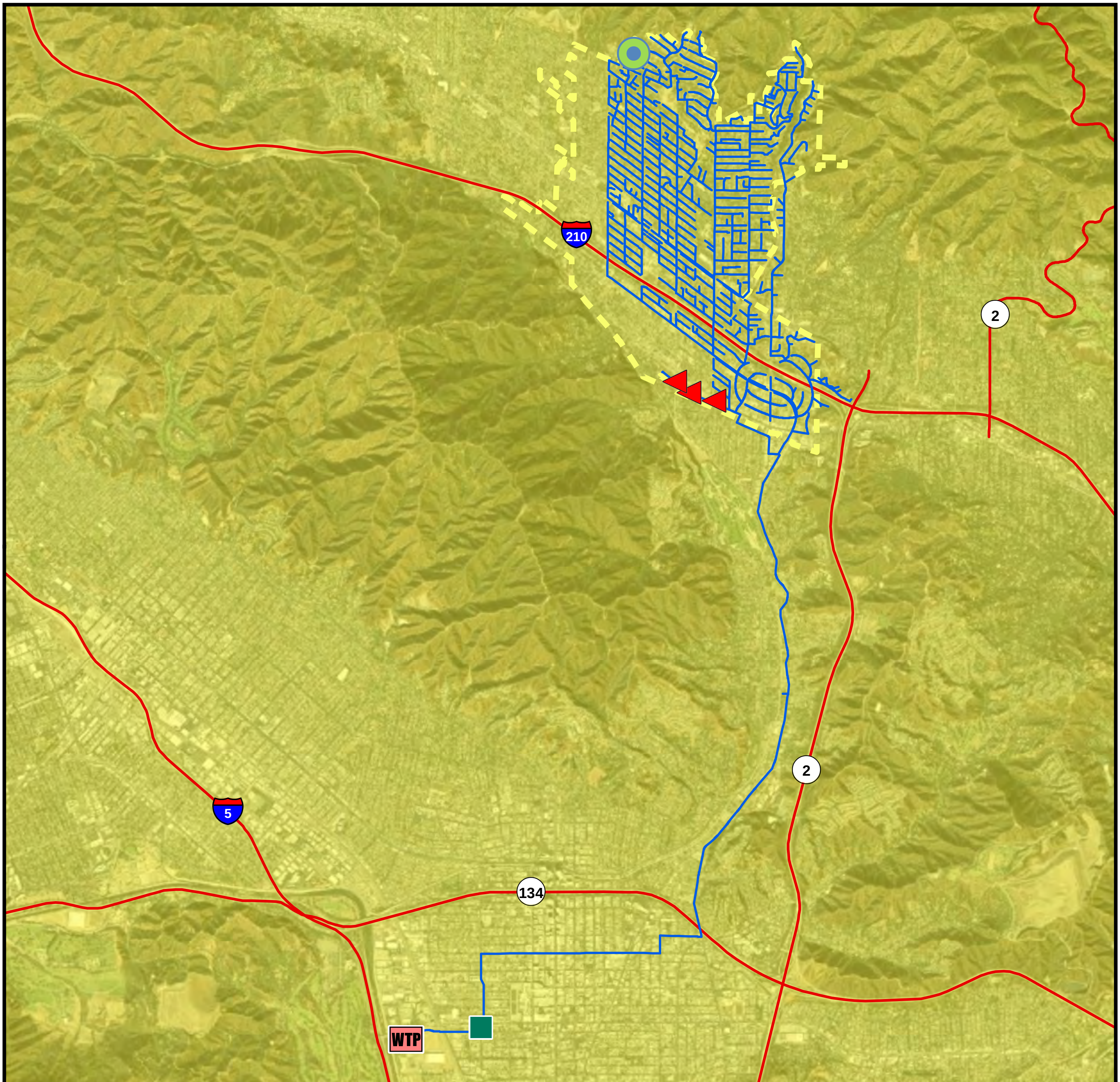
Water Booster Pump Station

Well

N

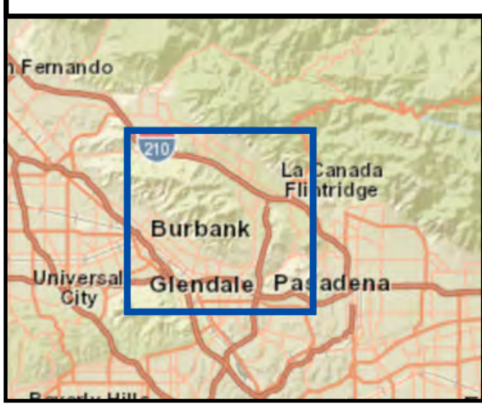
0 0.25 0.5 Miles

Data Sources: CVWD, Los Angeles Co., USGS, Esri



Crescenta Valley Water District

Figure 8-21. Wastewater System - 100-Year Probabilistic Earthquake Scenario



Mercalli Intensity Scale

VII (Very Strong/Moderate)

Intensity scale described as:
(perceived shaking / potential damage)

N

0 0.5 1 Miles

Water District Boundary

Wastewater Pipelines

Sewer Control Valve

Sewer Flow Meter

Sewer Wet Well

Wastewater Treatment Plant

Data Sources: CVWD, Los Angeles Co., USGS, Esri

8.4.3 Level of Damage to Pipelines

For pipelines, Hazus estimates earthquake damage in several categories: number of repairs needed (leaks and breaks), days required to implement repairs, and economic loss. Table 8-7 summarizes the results for pipelines.

Table 8-7. Earthquake Scenario Loss Estimates for District Pipelines

	Total Number of Leaks	Total Number of Breaks	Total Number of Repairs	Days to Repair Leaks	Days to Repair Breaks	Total Days of Repairs	Economic Loss
Sierra Madre- M7.16							
Potable Water Pipelines	168.7	49.9	218.6	48.2	28.5	76.7	$1,592,008
Wastewater Pipelines	108.4	31.8	140.3	31.0	18.2	49.2	$1,019,510
Verdugo M6.9							
Potable Water Pipelines	143.3	46.5	189.8	40.9	26.6	67.5	$1,414,099
Wastewater Pipelines	93.6	30.8	124.5	26.8	17.6	44.4	$930,592
Puente Hills-M6.95							
Potable Water Pipelines	72.7	27.9	100.6	20.8	16.0	36.7	$782,375
Wastewater Pipelines	49.7	19.8	69.5	14.2	11.3	25.5	$545,426
Northridge-M6.89							
Potable Water Pipelines	17.4	5.7	23.1	5.0	3.2	8.2	$172,249
Wastewater Pipelines	11.2	3.5	14.7	3.2	2.0	5.2	$107,913
Raymond- M6.71							
Potable Water Pipelines	25.8	9.1	34.9	7.4	5.2	12.6	$265,379
Wastewater Pipelines	21.3	8.5	29.7	6.1	4.8	10.9	$233,037
100-year Probabilistic							
Potable Water Pipelines	18.2	6.3	24.5	5.2	3.6	8.8	$185,378
Wastewater Pipelines	12.2	4.5	16.6	3.5	2.6	6.0	$127,972

8.4.4 Time to Return Structures to Functionality

Hazus estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments: 1, 3, 7, 14, 30 and 90 days after the event. For example, Hazus may estimate that a facility has 5 percent chance of being fully functional at Day 3, and a 95-percent chance of being fully functional at Day 90. The analysis of CVWD structures was performed for all modeled earthquake scenarios for each individual facility found to be damaged. Detailed results for each facility are provided in Appendix C. Table 8-8 summarizes the results for structures.

8.5 DEVELOPMENT TRENDS

The demand for critical District services may increase with growth in the surrounding area. The State of California's adoption of bills expanding property owners' rights to build accessory dwelling units will increase densities in most the District's service area; areas that, as recently as 2019, were thought to be built out.

Repair or replacement of District assets, if necessary, will be governed by codes and standards applied by the County of Los Aneles, the Cities of Glendale and La Cañada -Flintridge, depending upon the location of the asset. These jurisdictions have adopted codes and standards that include adoption of the 2019 California State Building Code, which is based on the 2018 International Building Code. Applications of these codes and standards to any new or redeveloped District assets will reduce the risk of potential impacts from earthquakes.

Table 8-8. Time to Return Structures to Functionality

	% Functionality					
	At Day 1	At Day 3	At Day 7	At Day 14	At Day 30	At Day 90
Potable Water Facilities						
Sierra Madre M7.1	36.46	58.88	67.44	70.56	77.33	87.57
Verdugo M6.9	33.58	57.46	66.82	70.12	77.17	87.76
Puente Hills M6.95	36.12	59.83	69.56	72.82	79.55	89.34
Northridge M6.89	69.46	85.14	91.34	92.87	94.70	97.36
Raymond M6.71	64.19	81.33	88.49	90.57	93.25	96.98
100-Year Probabilistic	70.39	83.29	88.51	90.27	92.51	96.07
Wastewater Facilities						
Sierra Madre M7.1	38.72	72.18	85.07	87.08	91.83	98.38
Verdugo M6.9	29.02	65.60	83.93	86.75	91.57	98.38
Puente Hills M6.95	25.80	61.75	82.80	86.27	91.05	98.32
Northridge M6.89	66.50	86.55	90.20	91.30	94.18	98.75
Raymond M6.71	45.43	74.22	85.13	87.70	91.98	98.40
100-Year Probabilistic	67.27	83.38	88.57	89.93	93.13	98.53

8.6 SCENARIO

With the abundance of fault exposure in southern California, the potential scenarios for earthquake activity are many. An earthquake does not have to occur within the planning area to have a significant impact on the people, property, and economy of the planning area.

Any seismic activity of 6.0 or greater on faults within the planning area would have significant impacts throughout the planning area. Potential warning systems could give approximately 40 seconds notice that a major earthquake is about to occur. This would not provide adequate time for preparation. Earthquakes of this magnitude or higher would lead to massive structural failure of property on NEHRP C, D, E, and F soils. Levees and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. River valley hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction would occur in water-saturated sands, silts, or gravelly soils.

8.7 ISSUES

Important issues associated with an earthquake include the following:

- The District has numerous critical assets with a high degree of vulnerability to earthquake.
- Approximately 10% of the District's potable water facilities and 4% of its wastewater facilities are exposed to potential impacts from liquefaction.
- The average damage from the scenario earthquakes represents 22% of the replacement cost of all identified critical assets for the District.
- On the average, it could take the District up to 3 days following a scenario event to restore at least 70% functionality of its critical potable water and wastewater facilities.

- On the average, the District could need to perform up to 78 pipeline repairs (leaks and breaks) resulting in up to 28 days of functional down time to make those repairs. The average cost to make these repairs could be up to $586,108.
- Based on the modeling of critical facility performance performed for this plan, a high number of facilities in the planning area are expected to have complete or extensive damage from scenario events. These facilities are prime targets for structural retrofits.
- The District should consider the enhancement continuity of operations plans to use the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Earthquakes could trigger other natural hazard events such as dam failures and landslides, which could severely impact the planning area.

9. FLOOD

9.1 GENERAL BACKGROUND

9.1.1 River Flooding

River flooding occurs when a river rises to overflow its natural banks due to causes such as prolonged, general rainfall, locally intense thunderstorms, snowmelt, or ice jams.

Measuring Floods on Rivers

River flooding is measured using a discharge probability, which is the probability that a certain river discharge (flow) will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for different discharge levels. The flow that historical data show to have a 1 percent chance of being equaled or exceeded in any given year is called the 1-percent-annual-chance flood (commonly called the 100-year flood). Also called the "base flood," this flood event is a regulatory standard used in assessing flood risk, regulating new development, and setting requirements for purchasing flood insurance.

Discharge probabilities have an inverse relationship to river flows—that is, a lower probability indicates a higher flow. The 0.2-percent-annual chance flood represents (commonly called the 500-year flood) a higher river flow than a 1-percent-annual-chance flood. These probabilities reflect statistical averages only; it is possible for two or more low-probability floods to occur in a short time period. The probabilities also can vary along a single river: the same storm event can cause a 1-percent-annual-chance flood at one location on a river and only a 10-percent-annual-chance flood at a point further upstream or downstream.

River Floodplains

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon. When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce, and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive, and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick growing compared to non-riparian trees.

Floodplain Mapping

The extent of the floodplain during a 1-percent-annual-chance flood is called the special flood hazard area and is used as a regulatory boundary by many agencies. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream’s capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities’ adverse impacts on floodplain functions.

9.1.2 Urban Flooding

Drainage facilities in urbanized areas consists of series of pipes, roadside ditches, and channels. Urban flooding occurs when these conveyance systems lack the capacity to convey rainfall runoff to nearby creeks, streams, and rivers. As drainage facilities are overwhelmed, roads and transportation corridors become conveyance facilities. The key factors that contribute to urban flooding are rainfall intensity and rainfall duration. Topography, soil conditions, urbanization and groundcover also play an important role.

Urban floods can be a great disturbance of daily life in urban areas. Roads can be blocked, and people may be unable to go to work or school. Economic damage can be high, but the number of casualties is usually limited, because of the nature of the flood. On flat terrain, the flow speed can be low, and people may still be able drive through the flood. The water may rise relatively slowly and usually does not reach life endangering depths.

Urban floods can occur suddenly as flash floods after a brief but intense downpour. In these cases, they can move rapidly, end suddenly, and occur in areas not generally associated with flooding (such as subdivisions not adjacent to a water body). Although the duration of these events is usually brief, the damage they cause can be severe. It is this type of flooding that provides the greatest risk to CVWD facilities.

9.1.3 Secondary Hazards

The most problematic secondary hazard for riverine flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers, or storm sewers.

9.2 HAZARD PROFILE

Low-lying areas near the coast are prone to flooding. In Los Angeles County, this includes the ports of Los Angeles and Long Beach, as well as Marina del Rey. Other low-lying areas prone to flooding from heavy rains include communities in the Santa Monica Mountains Coastal Zone and in the Antelope Valley. Communities in the lower reaches of rivers are also at risk of flooding from breaches in upstream levees during heavy storms. This includes communities near the Los Angeles and San Gabriel Rivers (Los Angeles County, 2021). Although there is a countywide flood control system, the system is often inadequate for dealing with runoff from major storms.

Flooding in the planning area is typically caused by high-intensity, short-duration (1 to 3 hours) storms concentrated on a stream reach with already saturated soil. Flooding is predominantly confined within traditional riverine valleys. Locally, some natural or manmade levees separate channels from floodplains and cause independent overland flow paths. Occasionally, railroad, highway, or canal embankments form barriers, resulting in ponding or diversion of flows. Some localized flooding not associated with stream overflow can occur where there are no drainage facilities to control flows or when runoff volumes exceed the design capacity of drainage facilities.

9.2.1 Principal Flooding Sources

In Southern California, most flooding is the result of heavy precipitation over one or two days. Short streams and steep watersheds emptying onto lowlands that may be heavily populated produce large volumes of water in short periods, and damage is often severe. The problem is sometimes compounded by the denuding of large areas of watershed by fire during the previous season.

The Federal Emergency Management Agency (FEMA) has created Flood Insurance Rate Maps to show areas at high risk of flooding. High risk areas have at least a 1% annual chance of flooding. These areas are also called “a 100-year floodplain”. Similarly, an area that has at least a 0.2% annual chance of flooding is also called “a 500-year floodplain.” Properties within the 100-year floodplain are required to have flood insurance as a prerequisite for federally backed mortgages; properties within the 500-year floodplain are not required to have flood insurance to qualify for federally backed mortgages. The CVWD service area has no areas mapped by FEMA as 100-year of 500-year floodplain.

Heavy rains in areas affected by wildfire can result in mud and debris flows. As wildfire season lengthens and extends into California’s wet season when begins in October, heavy rains that follow wildfires are becoming more common. These post-wildfire rains may create a new hazard as they wash debris from damaged and destroyed properties, burnt vegetation, and soil from landscapes down canyons.

These mudflows are more likely to occur after wildfires because hillsides are more likely to erode; vegetation roots that held the soil on hillsides in place are no longer present. As an example, the Station Fire in 2009 experienced these cascading effects of wildfire and heavy rains in the form of mudflows after the devastating fire (Los Angeles County, 2021).

9.2.2 Past Events

Los Angeles County has experienced seven flooding events since 1969 for which federal disaster declarations were issued, as summarized in Table 9-1. Review of these events helps identify targets for risk reduction and ways to increase a community’s capability to avoid large-scale events in the future. Many flood events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for flooding. The sections below describe significant recent flood events in Los Angeles County.

Table 9-1. History of Flood Events

Date	Declaration #	Type of event
1/18 – 1/23/2017	DR-4305	Severe winter storms, flooding, and mudslides
1/5 – 3/20/1993	DR-979	Severe storm, winter storm, mud & landslides, flooding
2/10 – 2/18/1992	DR-935	Snowstorm, heavy rain, high winds, flooding, and mudslide
1/17 – 1/22/1988	DR-812	Severe storms, high tides, and flooding
1/8/1980	DR-615	Severe storms, mudslides, and flooding
2/15/1978	DR-547	Coastal storms, mudslides, and flooding
1/26/1969	DR-253	Severe storms and flooding

Source: FEMA, 2020

January 18 – 23, 2017 Winter Storms

A series of storms pounded Southern California, dropping about 4 inches of rain on Los Angeles. Flash flood watches and warnings were in effect for swaths of greater Los Angeles and across Southern California where multiple roads were closed Sunday or blocked by fallen trees. Traffic was diverted off Interstate 110 south of downtown Los Angeles because of water flowing across lanes. The 710 Freeway was also closed because of flooding (Associated Press, 2017).

January – March 1993 Winter Storms

From January 6 to February 28, 1993, a series of storms produced 20 to 40 inches of rain over much of the southern California coastal and mountain areas and more than 52 inches at some stations in the San Bernardino Mountains. These storms, which coincided with a reappearance of weak “El Nino” conditions, were driven by an atmospheric low-pressure system off the coast of northern California and Oregon. In southern California, precipitation intensified because a high-pressure area that extended over Alaska, the Gulf of Alaska, and the Western States concentrated this low-pressure system farther south than usual and held it in place just offshore. Tropical moisture was supplied to the arriving storms from the southern jet stream, which crossed the coast from the southwest at about the latitude of San Diego (USGS, 1993). Floods during this period caused $14 million in damages to Los Angeles County (US Deadly Events, 2020).

February 10 – 18, 1992 Storm

During February 1992, a series of relatively warm storms passed eastward across southern California, yielding intense precipitation that triggered widespread landslides, flooding, property damage, and loss of life. These storms were triggered by an intense low-pressure system off northern California that deepened as its eastward progress was initially blocked by a high-pressure ridge across western North America. Debris flows occurred where cumulative precipitation exceeded 12 inches and when sustained intensities exceeded an inch per hour. Stream response was rapid, particularly in urban areas where impermeable surfaces and storm drains fed concrete stream channels. Some streams saw recurrence intervals for peak discharge of between 8 and 24 years (Taylor and Francis Online, 2020).

January 17 – 22, 1988 Severe Storms

In January 1988, a winter storm swept away miles of sand, leaving in its place a swath of destruction along the shore. Breakers 25 feet high pounded a 135-mile stretch of coast from Santa Barbara to San Diego counties. High tides combined with 20-foot waves and strong winds to whisk away as much as 10 feet of sand from beachfront homes north of Laguna Beach. The storm was blamed for eight deaths and $68 million in property damage in Southern California, including $16 million in Redondo Beach (Armstrong and Flick, 1989). Orange, Los Angeles, and San Diego Counties were declared emergency areas (Los Angeles Times, 1993).

January 8, 1980 Severe Storms

Flooding was caused by two severe storms in January 1980 that soaked soils, decreased unfilled reservoir capacities, and caused extensive damage along coastal streams of Southern California (USGS, 1991).

February 15, 1978 Coastal Storms

During February 8 – 10, 1978, heavy rains fell on the southern San Joaquin Valley and Los Angeles Basin and surrounding mountains. The resultant flooding, flash flooding, and mudslides caused widespread damage and 20 deaths. Property damage from the storm totaled $43 million in the Los Angeles area and $40 million in the southern San Joaquin Valley—the latter mostly due to flooding of agricultural lands. Eight counties, including Orange, were declared federal disaster areas (NWS, 1978).

January 26, 1969 Severe Storms

Intense floods in central and southern California due to storms that occurred between January 18 and February 25 caused severe damage over a large area. The major flood-affected area includes the basins of many streams that have their sources in the central and south-coastal ranges, in the southern part of the San Joaquin Valley, and the southern Sierra Nevada foothills from the Kern River basin on the south to the Mariposa Creek basin north of Fresno (USGS, 1975).

Historical Flooding in Los Angeles County

Flood events that occurred between 1914 and 1934 were some of the most economically devastating floods the Los Angeles area historically experienced. The damages are estimated to have cost over $1.1 billion in 2020 dollars. These flood events prompted the Federal Government to allocate funds in the Flood Control Act of 1936 to assist Los Angeles County in developing and expanding flood control infrastructure, including channelizing 52 miles of the Los Angeles River (LAR). Construction of the channel occurred between 1936 and 1959 (Army Corps of Engineers, 2021).

9.2.3 Location

The April 26, 2018, Los Angeles County Digital Flood Insurance Rate Maps are FEMA's official delineation of special flood hazard areas for all of Los Angeles County. Based on these maps, no portion of the CVWD service area have any mapped 100-year or 500-year floodplain. While there are occurrences of urban drainage flooding within the service area, there are no available maps of the extent and/or location of this type of flooding. With no available spatial data on extent and location of the flood hazard, all components of this hazard profile are qualitative. Figure 9-1 shows the FEMA Mapped Special Flood Hazard Areas within LA County within Proximity to the CVWD Service Area.

9.2.4 Frequency

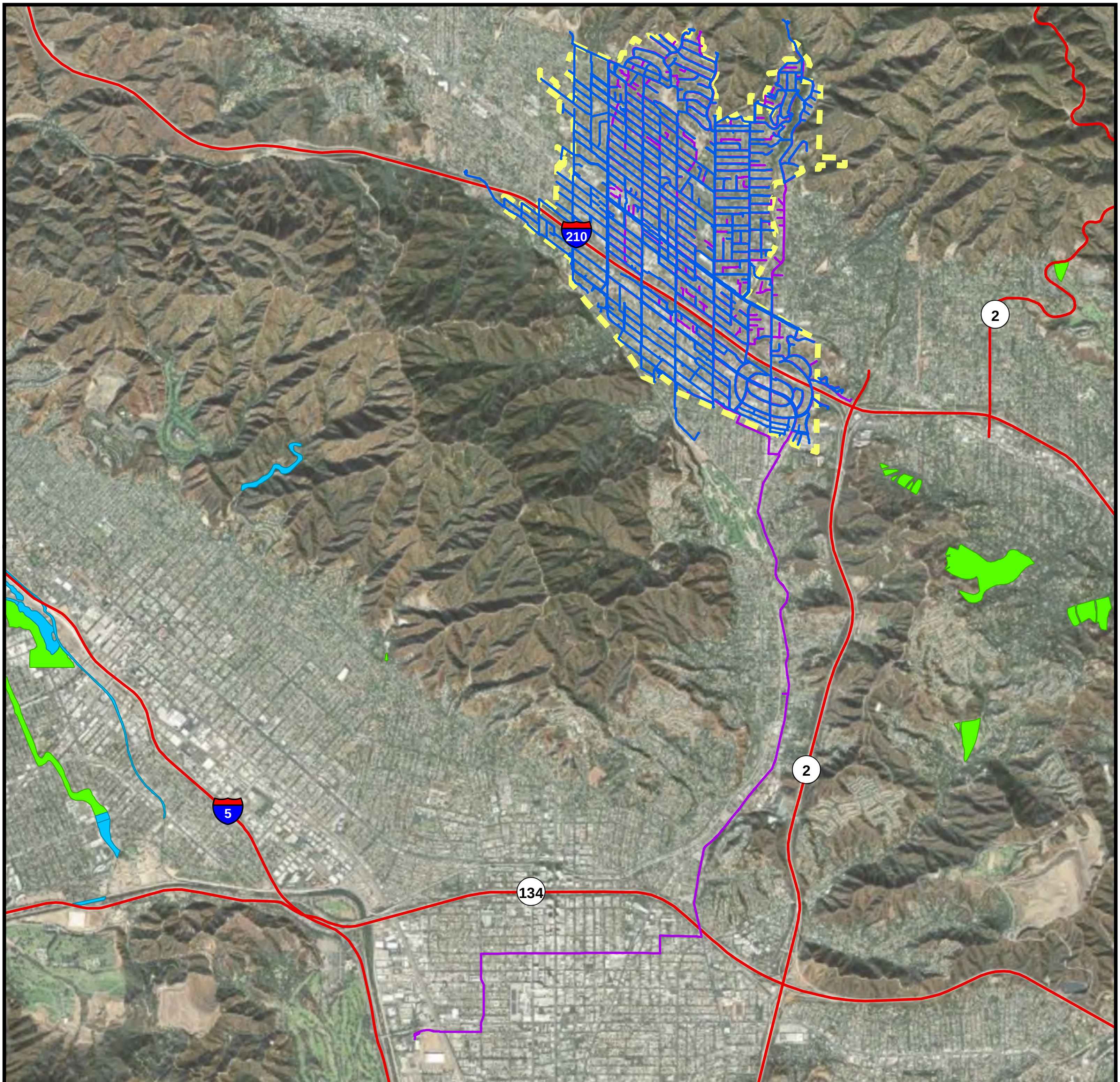
Los Angeles County has experienced seven flood events that triggered a federal disaster declaration since 1969, and average of one such flood event every 7.4 years. Records show that that the County can expect to experience some degree of localized flooding annually. For the risk ranking scenario in this plan, the District chose to assign a probability value of "high" (an event to likely occur within 25 years) as the appropriate frequency probability for the flood hazard. This is representative of the probability for the urban drainage flooding that can occur within the CVWD Service Area.

9.2.5 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges. For urban drainage flooding, slope (gradient) and impervious surfaces can increase the velocities of surface water flows. As an illustration of the power of water, 6 inches of flood water moving at a velocity of 3 Ft/Sec or greater can mover a standard sized passenger vehicle.

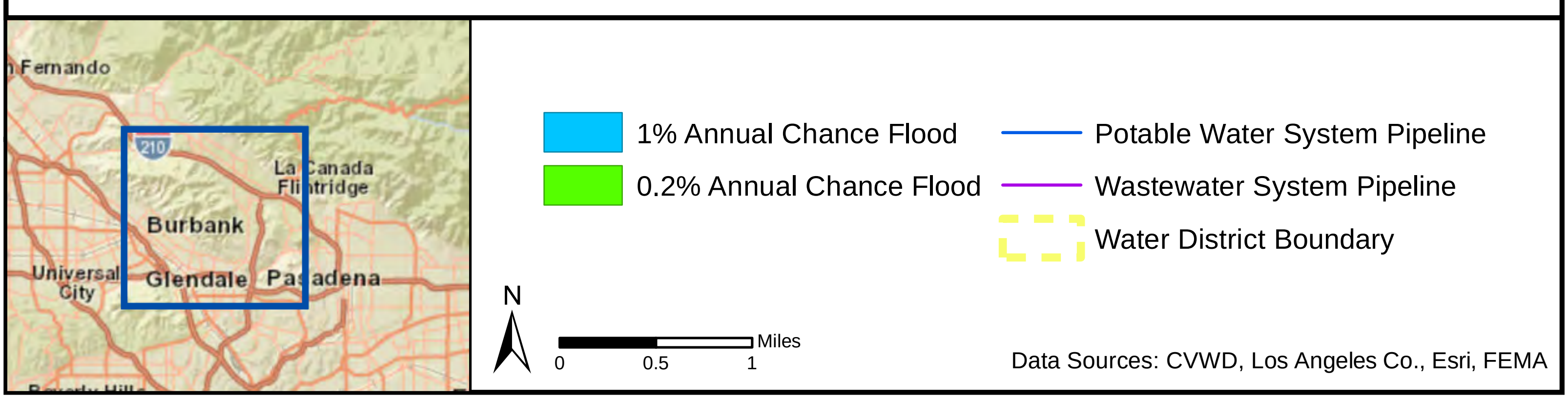
9.2.6 Warning Time

The warning time that a community has to take action to protect lives and property from a flooding threat is a function of the time between the first predictions of heavy rainfall, the first rainfall, and the first occurrence of flooding. Each watershed has unique qualities that affect its response to rainfall. A hydrograph, which is a graph or chart of stream flow in relation to time (see Figure 9-2), is a useful tool for examining a stream's response to rainfall. Once rainfall starts falling over a watershed, runoff begins, and the stream begins to rise. Water depth in the stream channel (stage of flow) will continue to rise in response to runoff even after rainfall ends. Eventually, the runoff will reach a peak and the stage of flow will crest. At this peak, the stream stage remains at a constant level until it begins to fall and eventually subside to a level below flooding stage. The length of time that floodwaters remain above flood stage is an important characteristic of the flood hazard.



Crescenta Valley Water District

Figure 9-1. Surrounding FEMA Flood Zones



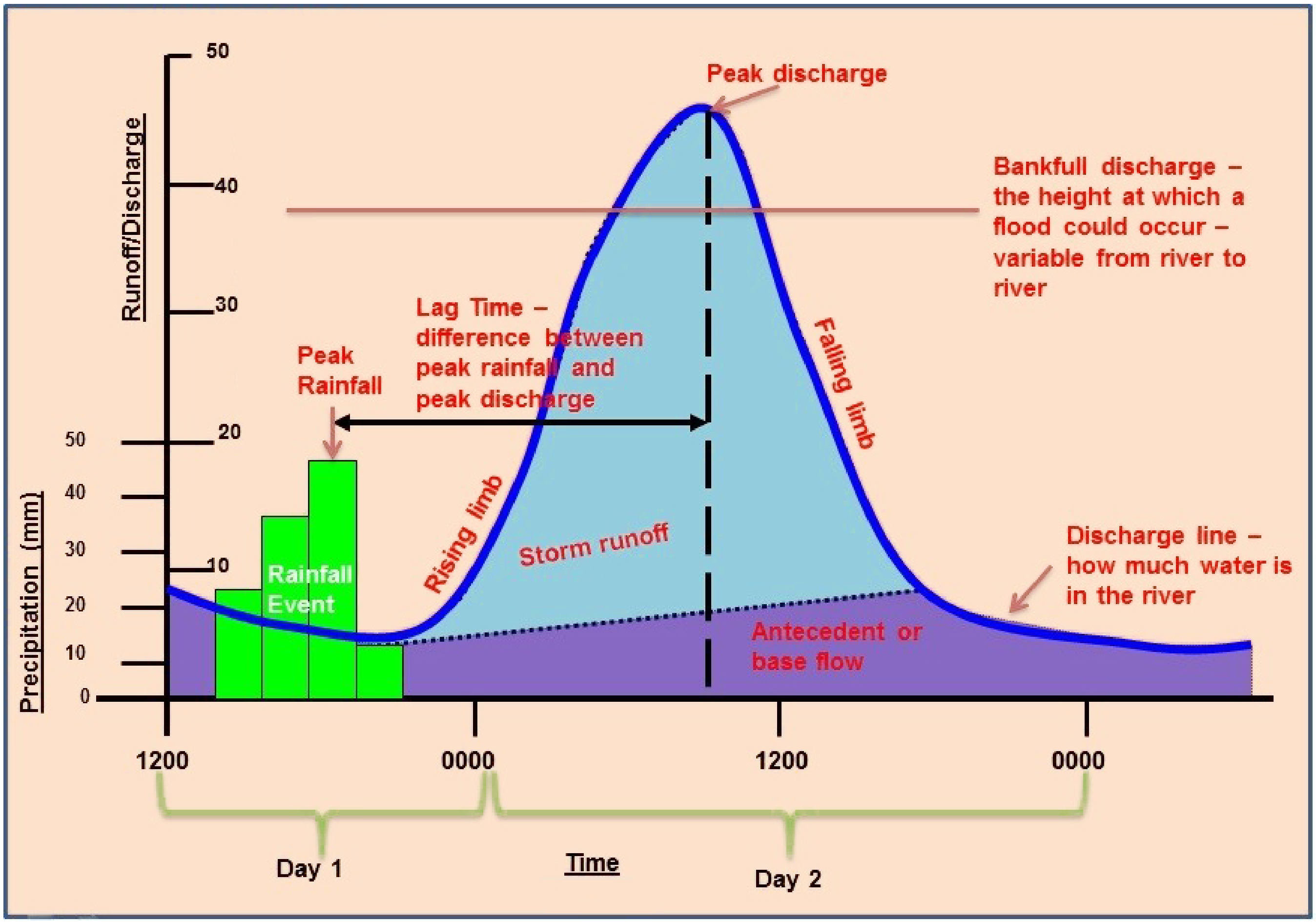


Figure 9-2. Example Hydrograph

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for river and stream floods can be between 24 and 48 hours. Flash flooding can be less predictable, but communities can be warned of the potential for flash flooding to occur.

Within the Greater Los Angeles County Basin, the Los Angeles County Flood Control District and U.S. Army Corps of Engineers share a joint responsibility in managing flood risk. The Flood Control District is the main regional agency able to address large regional drainage needs and uses available funds to operate and maintain the existing flood control facilities and systems that transect the various cities. During years of heavy rainfall, the existing flood control system has largely prevented serious flooding that once plagued the Los Angeles area many years ago. The District's municipal flood protection and water conservation system is one of the largest in the world and includes 14 major dams and reservoirs, 487 miles of open channels, 162 debris dams, 2,919 miles of underground storm drain and more than 80,000 catch basins. The District boundaries encompass 2,752 square miles, 6 major watersheds and 85 cities. Planning efforts to rehabilitate flood control facilities also considers other potential beneficial uses of those facilities which include environmental ecosystem restoration, enhancement of water quality, and recreation amenities.

Warning Notification Systems within CVWD

CVWD currently uses the platform Nixle to provide alerts to customers about any service disruptions. Alert LA County is a free mass notification system for Los Angeles County residents and businesses. The Sheriff's Department uses Alert LA County to contact residents if there is an emergency or disaster in the community. The system sends shelter-in-place instructions, evacuation, and other emergency messages. It has accessibility features for people with disabilities and others with access and functional needs. Users can also select your preferred language for notifications (Los Angeles County, 2021).

9.3 EXPOSURE AND VULNERABILITY

None of the CVWD service area or District critical assets are exposed or vulnerable to any mapped flood hazard. However, the absence of mapped flood inundation areas does not mean there is no flood risk. While District assets that are sub-terranean (pipes) are not typically considered too vulnerable to flooding, they can be exposed by erosion and scour caused by high velocity stormwater flows. Above ground assets can become inundated by flood waters and become inoperable, especially assets that rely of electricity to operate (wells, pump stations, treatment facilities, etc.). Power interruption associated with flooding could be s significant source of vulnerability for CVWD assets.

9.4 DEVELOPMENT TRENDS

The demand for critical District services may increase with growth in the surrounding area. The State of California's adoption of bills expanding property owners' rights to build accessory dwelling units will increase densities in most the District's service area; areas that, as recently as 2019, were thought to be built out.

Repair or replacement of District assets, if necessary, will be governed by codes and standards applied by the County of Los Angeles, the City of La Cañada -Flintridge, or the City of Glendale, depending upon the location of the asset. These jurisdictions have adopted codes and standards that include adoption of the 2019 California State Building Code, which is based on the 2018 International Building Code. The County and cities of La Cañada -Flintridge and Glendale also participate in the National Flood Insurance Program (NFIP) and have adopted floodplain management standards pursuant to that program's requirements. Applications of these codes and standards to any new or redeveloped District assets will reduce the risk of potential impacts from flood.

9.5 SCENARIO

The major flooding causes in the District are short-duration, high-intensity storms that would cause urban stormwater runoff that exceed the capacity of the stormwater management infrastructure within the CVWD Service area. Water courses in the service area can flood in response to a succession of intense winter rainstorms, usually between early November and late March. A series of such weather events can cause severe flooding in the District due to the large percentage of impervious area and the age and capacity of the drainage system. The worst-case scenario is a series of storms that flood numerous drainage basins in a short time. The debris basins upstream of the District service area could be overtopped if they are full of debris and sediments, acting like small dam failure events. This could overwhelm response and floodplain management capabilities within the District. Major roads could be blocked, preventing critical access to District assets by District personnel, resulting in interruption of critical functions. In the case of multi-basin flooding, floodplain management resources would not be able to make repairs quickly enough to restore critical facilities and infrastructure.

9.6 ISSUES

The Planning Team has identified the following flood-related issues relevant to the planning area:

- There is currently no extent/location flood hazard mapping available for the CVWD service area from any source.
- Debris basins in the District service area could overtop if they become filled with debris and sediment.
- Due to the lack of flood hazard mapping, the understanding of the risk from urban drainage flooding within the CVWD Service area is low.
- Planning tools whose use depends on flood hazard mapping are less effective due to the deficiencies in the currently available mapping.
- There needs to be a sustained effort to gather historical damage data, such as high-water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.
- Indirect impacts from flooding outside the CVWD Service Area such as power interruption could impact District operations.
- Residents need to continue to be educated about flood preparedness and the resources available during and after floods ("*If it can rain, it can flood*").
- The potential impact of climate change on flood conditions needs to be better understood.

10. LANDSLIDE AND DEBRIS FLOW

10.1 GENERAL BACKGROUND

Ground saturation by water, steepening of slopes by erosion or construction, alternate freezing and thawing, and earthquake shaking are all factors that contribute to landslides. These factors can all be exacerbated following wildfires that denature hillsides and bake the soils, making them prone to debris flows. Landslides are typically associated with periods of heavy rainfall or rapid snow melt. Rain-saturated hill slopes and increased groundwater pressure on porous hillsides are triggering agents of slope failure. In areas burned by forest and brushfires, a lower threshold of precipitation may initiate landslides.

10.1.1 Landslide and Debris Flow Types

Landslides are commonly categorized by the type of initial ground failure. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

Debris flows—sometimes referred to as mudslides or mud flows—are rivers of rock, earth, organic matter, and other soil materials saturated with water. Debris flows develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud. The consistency of debris flows ranges from watery mud to thick sludge that can carry large items such as boulders, trees, and cars. Debris flows from many sources can combine into channels that, with the addition of water, sand, mud, boulders, trees, and other materials, can become greatly more destructive. The debris carried by a debris flow has the potential to spread over a broad area, wreaking havoc in developed communities.

A debris avalanche is a fast-moving debris flow that travels faster than about 10 miles per hour (mph). Speeds of more than 20 mph are not uncommon, and speeds of more than 100 mph, although rare, can occur. Debris avalanches can travel many miles from their source, picking up large objects in their path and they can have many times the hydraulic force of water due to the mass of material included in them. They can be among the most destructive events in nature.

Landslides also include the following:

- Rock Falls—Blocks of rock that fall away from a bedrock unit without a rotational component
- Rock Topples—Blocks of rock that fall away from a bedrock unit with a rotational component
- Rotational Slumps—Blocks of fine-grained sediment that rotate and move down slope

- Transitional Slides—Sediments that move along a flat surface without a rotational component
- Earth Flows—Fine-grained sediments that flow downhill and typically form a fan structure
- Creep—A slow-moving landslide often only noticed through crooked trees and disturbed structures
- Block Slides—Blocks of rock that slide along a slip plane as a unit down a slope

10.1.2 Landslide and Debris Flow Modeling

Two characteristics are essential to conducting an accurate risk assessment of the landslide hazard:

- The type of initial ground failure that occurs, as described above
- The post-failure movement of the loosened material ("run-out"), including travel distance and velocity

All current landslide models—those in practical applications and those more recently developed—use simplified hypothetical descriptions of landslide behavior to simulate the complex behavior of actual flow. The models attempt to reproduce the general features of the moving mass of material through measurable factors, such as base shear, that define a system and determine its behavior. Due to the lack of experimental data and the limited current knowledge about the behavior of the moving flows, landslide models use simplified parameters to account for complex aspects that may not be defined. These simplified parameters are not related to specific physical processes that can be directly measured, and there is a great deal of uncertainty in their definition. Some, but not all, models provide estimates of the level of uncertainty associated with the modeling approach.

Run-out modeling is further complicated because the movement of materials may change over the course of a landslide event, depending on the initial composition, the extent of saturation by water, the ground shape of the path traveled and whether there is additional material incorporated during the event (Savage and Hutter 1991; Rickenmann & Weber, 2000; Iverson, 2004).

10.1.3 Landslide and Debris Flow Causes

Landslides are caused by a combination of geological and climate conditions, as well as the encroaching influence of urbanization. In general, landslides are most likely during periods of higher than average rainfall. The ground must be saturated prior to the onset of a major storm for significant landslide to occur. Water is involved in nearly all cases; and human influence has been identified in more than 80 percent of reported slides. The following human-caused factors can contribute to landslide: change in slope of the terrain, increased load on the land, shocks, and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes.

Excavation and Grading

Slope excavation is common in the development of home sites or roads on sloping terrain. Grading can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill. Landslides occurring below new construction sites are indicators of the potential impacts stemming from excavation.

Drainage and Groundwater Alterations

While permeable soils soak up rain and irrigation water, proper grading and drainage systems can collect water to protect slopes from oversaturation and slippage. Water flowing through or above ground is often the trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. Even lawn irrigation and minor alterations to small streams in landslide prone locations can result in damaging landslides. Drainage can be affected naturally by the geology and topography of an area. Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, flooding, and erosion on slopes all indicate potential slope problems. Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.

Changes in Vegetation

Following major brushfires, federal or state agencies typically seed denuded areas with wild plant seeds. This encourages vegetation growth, thereby stabilizing the barren soil and protecting the watershed from erosion. Areas that have experienced wildfire and land clearing for development may have long periods of increased landslide hazard.

10.1.4 Landslide and Debris Flow Management

While small landslides and flows are often a result of human activity, the largest are often naturally occurring phenomena with little or no human contribution. The sites of large landslides and debris flows are typically areas of previous landslide movement that are periodically reactivated by significant precipitation or seismic events. Such naturally occurring landslides can disrupt roadways and other infrastructure lifelines, destroy private property, and cause flooding, stream bank erosion and rapid stream channel migration.

Landslides and debris flows can create immediate, critical threats to public safety. Engineering solutions to protect structures on or near large active landslides are often expensive. In spite of their destructive potential, landslides can serve beneficial functions to the natural environment. They supply sediment and large wood to stream channel networks and can contribute to stream complexity and dynamic channel behavior critical for aquatic and riparian ecological diversity. Effective landslide management should include the following elements:

- Continuing investigation to identify natural landslides, understand their mechanics, assess their risk to public health and welfare, and understand their role in ecological systems
- Regulation of development in or near existing landslides or areas of natural instability through codes and ordinances.
- Preparation for emergency response to landslides to facilitate rapid, coordinated action among local, state, and federal agencies, and to provide emergency assistance to affected or at-risk residents
- Evaluation of options including landslide stabilization or structure relocation where landslides are identified as a threat to critical public structures or infrastructure

10.1.5 Secondary Hazards

Landslides are not generally known to result in secondary hazards. A landslide that blocks a river or stream does have the potential to cause flooding due to channel relocation.

10.2 HAZARD PROFILE

10.2.1 Past Events

Table 10-1 lists known landslide events that occurred in the vicinity of the planning area between 1970 and December 2020.

Location

The best predictor of where landslides might occur is the location of past landslides. These can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small portion of them may become active in any given year. Ancient dormant landslide sites can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding. As development has spread into the hillsides, unstable soil and erosion often contributes to landslides.

Factors that characterize landslide hazard areas include significant slope, weak rocks, and heavy rains. California's state geologist maps hazardous landslide areas for use by municipalities in planning and decision-making on grading and building permits. This program focuses on urban areas that experience heavy rainfall and that exhibit significant slopes and weak rocks. Figure 10-1 and Figure 10-2 show mapped landslide hazard areas.

Frequency

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards. According to the National Centers for Environmental Information storm events database and the Southern California Earthquake Data Center, the planning area has been impacted by earthquakes, wildfires, and/or severe storms at least once every other year since 1960, representing an annual probability of 50 percent. Given the preponderance of steep slopes and the frequency of contributory sources to landslides in the planning area, the probability of future occurrence can be considered equal to this 50-percent annual probability. Until better data is generated specifically for landslide hazards, this frequency is appropriate for the purpose of ranking risk.

Table 10-1. Landslide Events in and near the District Planning Area

Event Date	Event Type	FEMA Number	Description
12/6/2018	Debris Flow		Heavy rain over the Woolsey Fire burn scar resulted in a significant mud and debris flow across the Pacific Coast Highway. California Highway Patrol (CHP) reported Highway 1 (the Pacific Coast Highway) was closed around Leo Carrillo Beach due to a mud and debris flow.
1/9/2018	Debris Flow		In Burbank, heavy rain produced a significant debris flow which overflowed a debris basin. In all, three cars and one recreational vehicle were destroyed.
1/18 – 1/23/2017	Severe winter storms, flooding, and mudslides	4305	Storms flooded roads, triggered mudslides, and submerged vehicles.
1/17- 2/6/2010	Severe Winter Storms, Flooding, and Debris and Mud Flows	1884	A rainstorm triggered a mudslide along Ocean View Boulevard in the La Canada Flintridge burn area and others throughout the region.
10/21/2007 – 3/31/2008	Wildfires, Flooding, Mud Flows, and Debris Flows	1731	
2/16 – 2/23/2005	Severe Storms, Flooding, Landslides	1585	
12/27/2004-01/11/2005	Severe Storms, Flooding, Debris Flows, and Mudslides	1577	
10/21/2003 – 3/31/2004	Wildfires, Flooding, Mud Flow and Debris Flow	1498	
2/13 – 4/19/1995	Severe Winter Storms, Flooding, Landslides,	1046	
1/3 – 2/10/1995	Severe Winter Storms, Flooding, Landslides, Mudflows	1044	
1/17/1994	Northridge Earthquake	1008	The earthquake caused more than 11,000 landslides throughout the region. The landslides led to several deaths.
10/26/1993 – 4/22/1994	Fires, Mud/Landslides, Flooding, Soil Erosion	1005	
1/5 – 3/20/1993	Severe Winter Storm, Landslides, & Flooding	979	
2/10 – 2/18/1992	Rain/Snow/Windstorms, Flooding, Mudslides	935	
10/1 – 11/20/1987	Earthquake and Aftershocks	799	
1/21 – 3/30/1983	Coastal Storms, Floods, Slides and Tornadoes	677	
1/08/1980	Severe Storms, Mudslides, Flooding	615	
2/15/1978	Coastal Storms, Mudslides and Flooding	547	Water and debris flowing down canyons led to 21 deaths and $50 million in damage.
2/9/1971	San Fernando Earthquake	299	

Sources: FEMA 2021; California Department of Conservation, Division of Mines and Geology 2021; NOAA, 2021

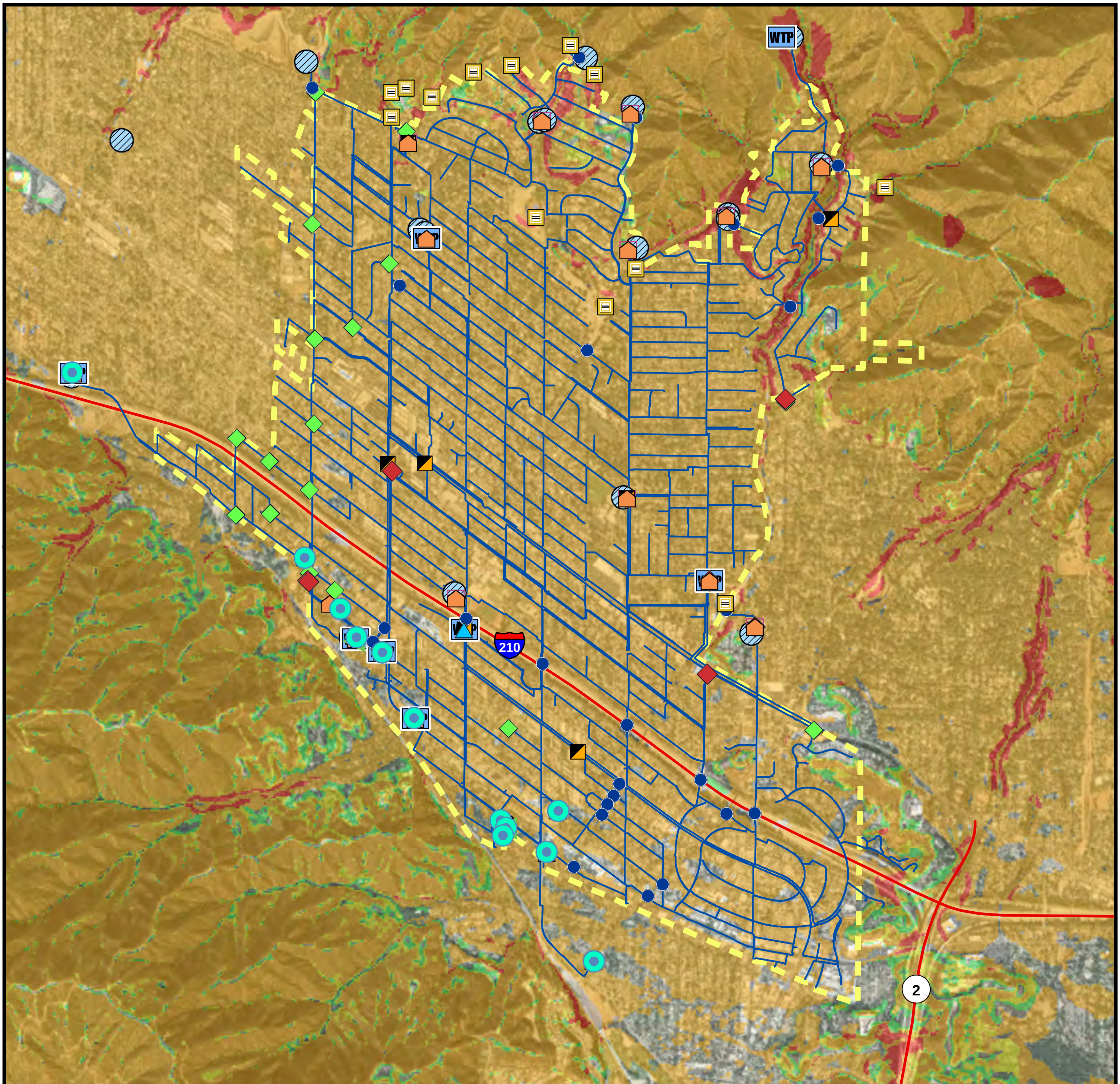


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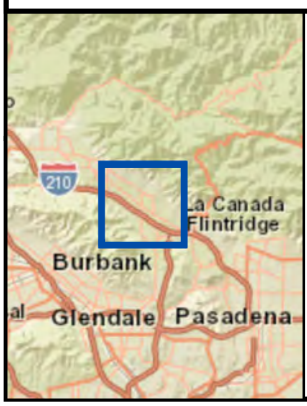
Figure 10-1. Potable Water System - Susceptibility to Deep-Seated Landslides



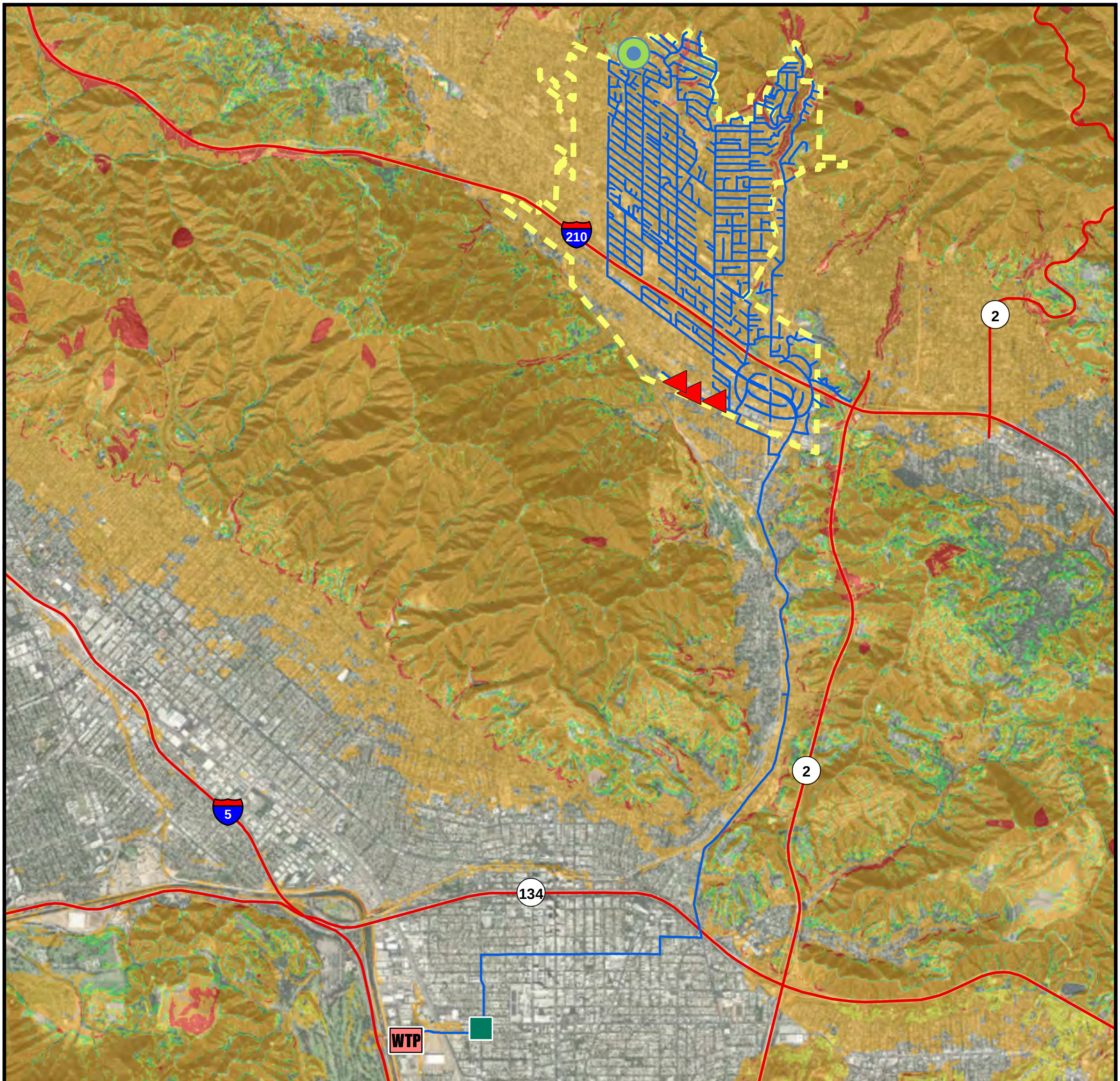
Low
High
Moderate
Very high
Water District Boundary
Potable Water System Pipeline

Aeration Tower
Debris Basin
Emergency Water Supply Interconnection
Interconnection
Mixing Station
Motor Control Center
Pipeline Crossing
WTP Potable Water Treatment Plant
Pressure Reducing Station
Reservoir
Water Booster Pump Station
Well

N

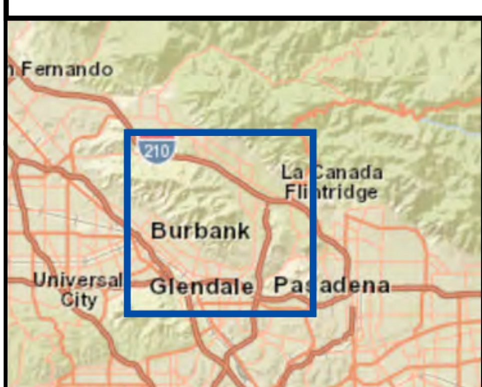
0 0.25 0.5 Miles

Data Sources: CVWD, Los Angeles Co., CGS, Esri



Crescenta Valley Water District

Figure 10-2. Wastewater System - Susceptibility to Deep-Seated Landslides



Data Sources: CVWD, Los Angeles Co., CGS, Esri

10.2.2 Severity

Landslides destroy property and infrastructure and can take the lives of people. They can pose a serious hazard to properties on or below hillsides. Landslides directly damage structures in two ways: disruption of structural foundations caused by differential movement/deformation of the ground upon which the structure sits, and the physical impact of debris moving down-slope against structures located in the debris flow's path. As a landslide breaks away from a slope, it deforms the ground into an undulating surface broken up by fissures and scarps. This deformation distresses foundations and structures situated on top of a landslide by settlement, cracking, and tilting. This can occur slowly, over years, or rapidly within days or hours. A water-saturated, fast-moving debris flow can destroy all in its path, collapsing walls and shifting structures off their foundations.

Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. Landslides and debris flows cause millions of dollars in cumulative damage to Southern California's homes, businesses, and infrastructure every year.

10.2.3 Warning Time

Landslides can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Landslides and debris flows can be initiated by severe storms, earthquakes, wildfires, or human modification of the land. They can move rapidly down slopes or through channels and can strike with little or no warning at avalanche speeds. Some methods used to monitor landslides can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis and respond after the event has occurred.

When atmospheric river weather patterns occur, the risk and dangers of landslides and debris flows increase. Improved forecasting of such events could allow advanced warning to better prepare for and respond to potential slope failures and flood events. According to the USGS (website, 2021), landslide warning signs can include but are not limited to:

- Springs, seeps, or saturated ground in areas that have not typically been wet before.
- New cracks or unusual bulges in the ground, street pavements or sidewalks.
- Soil moving away from foundations.
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house.
- Tilting or cracking of concrete floors and foundations.
- Broken water lines and other underground utilities.
- Leaning telephone poles, trees, retaining walls or fences.
- Offset fence lines.
- Sunken or down-dropped road beds.
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content).
- Sudden decrease in creek water levels though rain is still falling or just recently stopped.

- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb.
- A faint rumbling sound that increases in volume is noticeable as the landslide nears.
- Unusual sounds, such as trees cracking or boulders knocking together, might indicate moving debris.

10.3 EXPOSURE

The risk assessment for landslide determined District assets that lie within each landslide susceptibility zone. Table 10-2 and Table 10-3 summarize the length of pipeline and number structures, respectively, in each mapped landslide susceptibility zone. Figure 10-3 and Figure 10-4 show the results for potable water and wastewater systems, respectively, as the percent of total planning area assets.

Transportation infrastructure in landslide susceptibility areas can see significant impacts from landside activity; however, this risk assessment does not evaluate transportation infrastructure because CVWD does not have the responsibility or ownership of the infrastructure that would be exposed, with the exception of access to its facilities.

10.4 VULNERABILITY

Loss estimation modeling is not available for the landslide hazard. Although complete historical documentation of the landslide threat in the planning area is lacking, the available history of landslides in the region suggests a significant vulnerability to such hazards.

Damage attributable to landslides has the potential to affect any exposed District assets. At this time all assets exposed to the landslide hazard are considered vulnerable until more information becomes available. A more in-depth analysis of mitigation measures taken to protect these facilities in the event of landslides should be done to determine if they could withstand the potential impacts. In the District's potable water and wastewater pipeline systems, pipes made of more brittle materials, such as clay or concrete, are more likely to be damaged by landslide movements than pipes of more ductile materials, such as steel, ductile iron, or PVC. Damage to access roads would hinder the District's ability to access critical assets that had sustained damage for repair.

10.5 FUTURE TRENDS IN DEVELOPMENT

The demand for critical District services may increase with growth in the surrounding area. The State of California's adoption of bills expanding property owners' rights to build accessory dwelling units will increase densities in most the District's service area; areas that, as recently as 2019, were thought to be built out.

Repair or replacement of District assets, if necessary, will be governed by codes and standards applied by the County of Los Angeles, the City of La Cañada -Flintridge, or the City of Glendale, depending upon the location of the asset. These jurisdictions have adopted codes and standards that include adoption of the 2019 California State Building Code, which is based on the 2018 International Building Code. The building code includes provisions for geotechnical analyses in steep slope areas that have soil types that are susceptible to landslide hazards. These provisions ensure that new construction is built to standards that reduce the vulnerability to landslide risk. Applications of these codes and standards to any new or redeveloped District assets will reduce the risk of potential impacts from landslides.

Table 10-2. Length of District Pipeline Within Landslide Hazard Areas

	Length of Pipe in Landslide Hazard Areas (feet)			
	Very High Susceptibility	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Potable Water Pipeline				
Brittle Pipe	6,003	493,879	2,507	2,193
Ductal Pipe	1	6,350	0	0
Total	**6,004**	**500,229**	**2,507**	**2,193**
Wastewater Pipeline				
Brittle Pipe	5,703	309,772	2,488	1,814
Ductal Pipe	620	5,404	0	37
Total	**6,323**	**315,176**	**2,488**	**1,851**

Table 10-3. Number of District Structures Exposed to the Landslide Hazard

	Number of Exposed Structures in Landslide Susceptibility Zone			
	Very High Susceptibility	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Potable Water Structures				
Building	0	3	0	0
Aeration Tower	0	2	0	0
Debris Basin	0	5	1	2
Emergency Interconnection	0	19	0	0
Fitting	18	1,738	8	8
Hydrant	7	624	7	3
Interconnection	0	8	0	0
Mixing Station	0	1	0	0
Motor Control Center	1	18	0	1
Pipeline Crossing	2	21	0	0
Potable Water Treatment Plant	0	8	2	0
Potable Water Valve	19	2,075	9	8
Pressure Reducing Station	0	7	0	0
Reservoir	1	14	1	2
Water Booster Pump Station	1	11	0	1
Well	0	9	0	0
Total	**49**	**4,563**	**28**	**25**
Wastewater Structures				
Sewer Control Valve	0	2	0	0
Sewer Fitting	85	6,015	41	27
Sewer Flow Meter	0	0	0	0
Sewer Manhole	25	1,100	8	5
Sewer Wet Well	0	1	0	0
Wastewater Lift Station	1	1	0	0
Wastewater Treatment Plant	0	0	0	0
Total	**111**	**7,119**	**49**	**32**

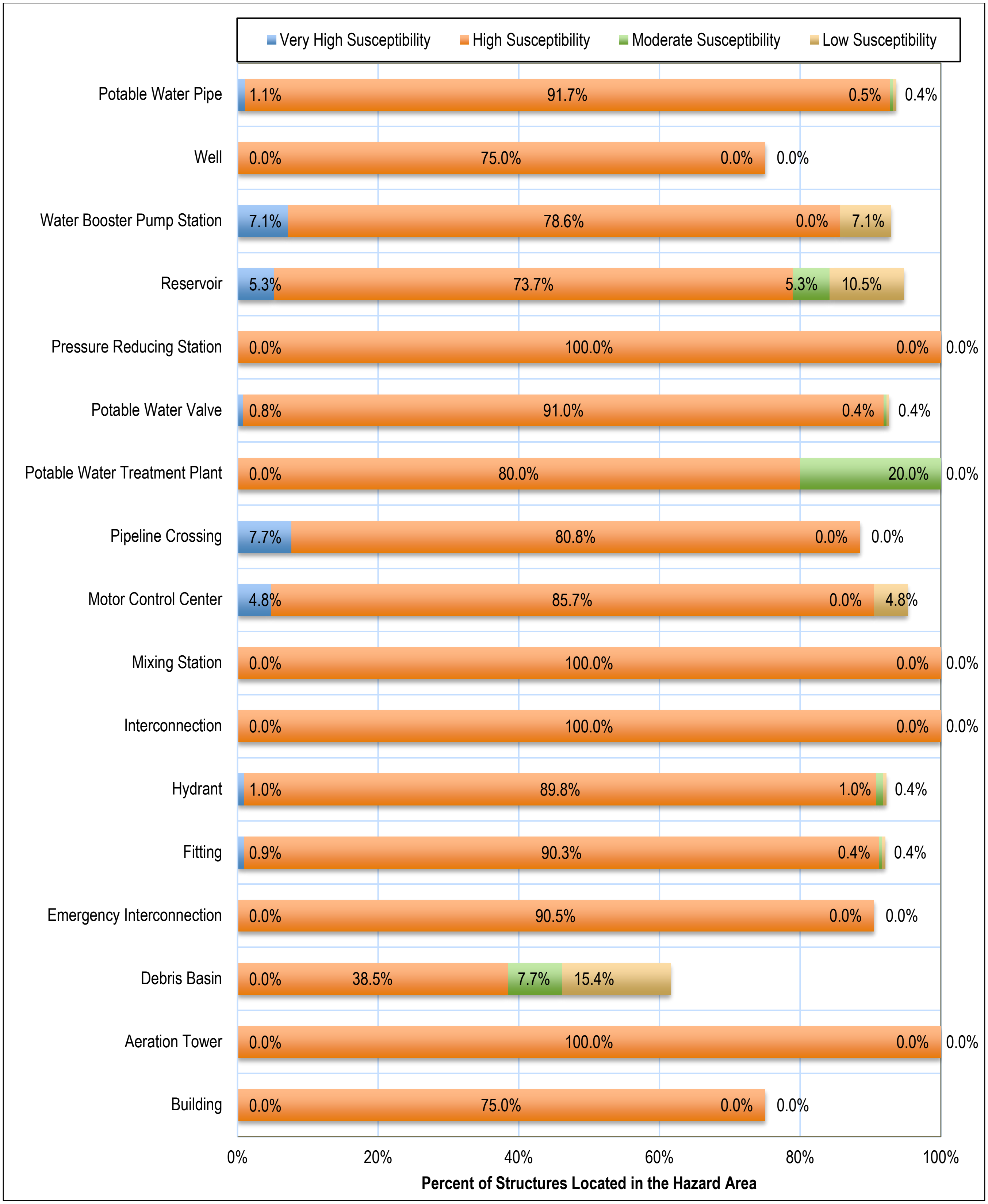


Figure 10-3. Percent of District Potable Water Facilities Exposed to the Landslide Hazard

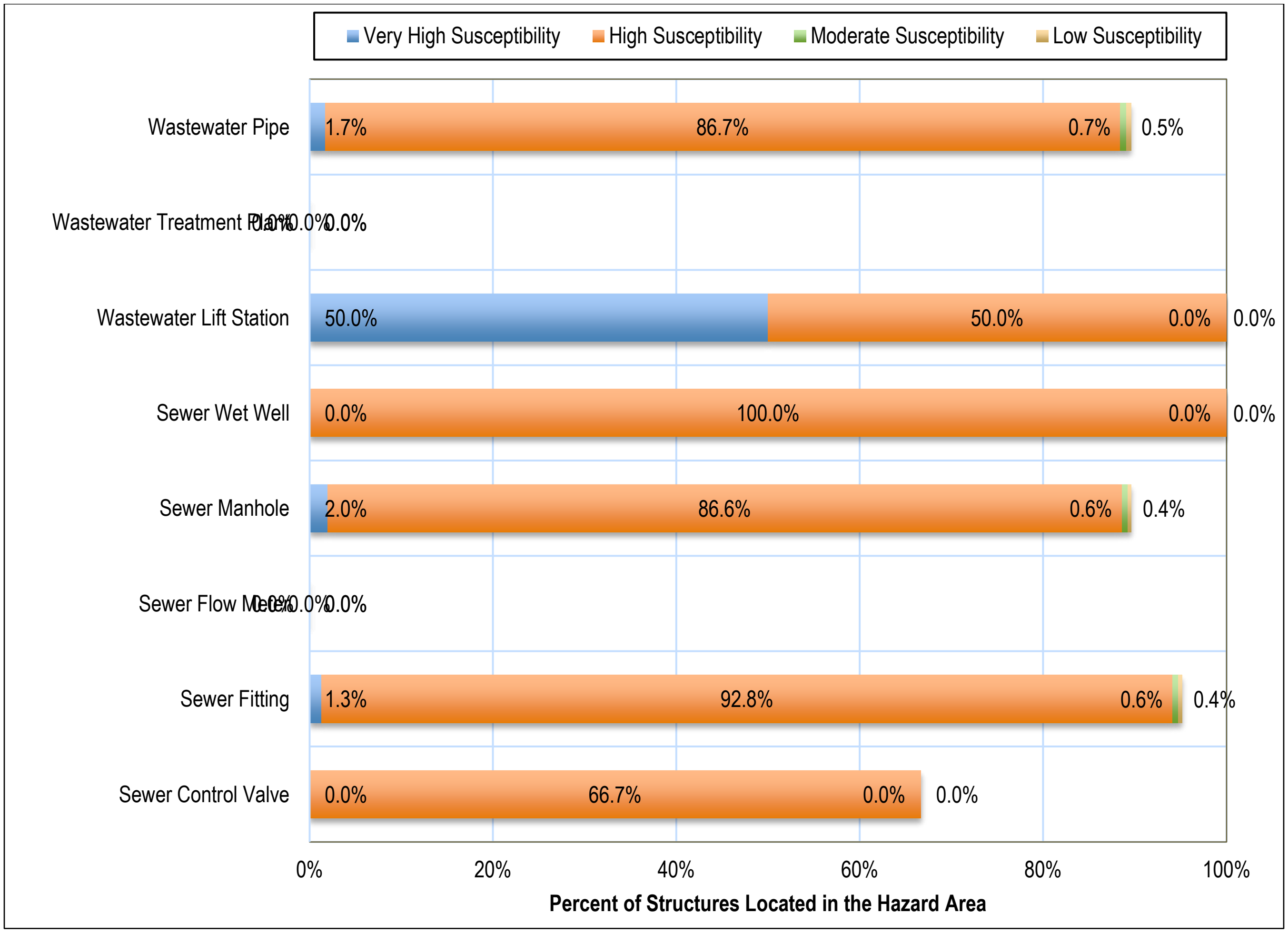


Figure 10-4. Percent of District Wastewater Facilities Exposed to the Landslide Hazard

10.6 SCENARIO

Major landslides in the planning area occur as a result of soil conditions that have been affected by severe storms, groundwater, wildfires or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain isolated over a watershed denatured by wildfire. Landslides are most likely during late winter when the water table is high. After heavy rains from November to December, soils become saturated with water. Soils in watersheds impacted by wildfires tend to become impermeable due to the extreme heat exposure, which can lead to debris flows. This is especially true for soils with high clay content. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the weakening of the slope. Gravity, poor drainage, a rising groundwater table and poor soil exacerbate hazardous conditions.

Landslides are becoming more of a concern as development moves outside of urban centers and into areas less developed in terms of infrastructure. Most landslides would be isolated events affecting specific areas. It is probable that private and public property, including infrastructure, will be affected. Landslides could affect bridges that pass over landslide prone ravines and knock out rail service through the planning area. Road obstructions caused by landslides would create isolation problems for people in sparsely developed areas. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power and communication.

Continued heavy rains and flooding will complicate the problem further. As emergency response resources are applied to problems with flooding, it is possible they will be unavailable to assist with landslides occurring all over the planning area.

10.7 ISSUES

Important issues associated with landslides in the planning area include the following:

- Over 90% of the District's critical assets are located in a very high or high landslide susceptibility zone.
- Over 88% of the District's potable water and wastewater pipelines intersect a very high or high landslide susceptibility zone.
- Landslide activity within the CVWD service area could impact access to the District's critical assets.
- The high occurrence of wildfire activity within the planning area increases the probability for future debris flow potential.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- The impact of climate change on landslides is uncertain. If climate change impacts atmospheric conditions, then exposure to landslide risks is likely to increase.
- Landslides may cause negative environmental consequences, including water quality degradation.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood, and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

11. SEVERE WEATHER

11.1 GENERAL BACKGROUND

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. The most common severe weather events affecting the District are extreme heat and high wind. Both types of severe weather are described in the following sections.

11.1.1 High Winds

High winds are generally short-duration events involving straight-line winds or gusts of over 50 mph, strong enough to cause property damage. High winds or a windstorm are especially dangerous in areas with significant tree stands and areas with exposed property, poorly constructed buildings, manufactured housing units, major infrastructure, and above-ground utility lines. A windstorm can topple trees and power lines, cause damage to residential, commercial, and critical facilities, and leave tons of debris in its wake.

Types of Damaging Winds

Damaging winds are classified as those exceeding 60 mph. Damage from such winds is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-line winds—**Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts—**A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts—**A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts—**A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph.
- **Gust front**—A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- **Derecho—**A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-

cooled air). The word "derecho" is of Spanish origin and means "straight ahead." Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.

- **Bow Echo**—A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

Santa Ana winds are a principal feature of Southern California weather. These are offshore winds, usually warm, blowing from the mountains to the coast, and occurring principally in fall and winter, with a frequency peaking in December. Santa Ana winds are marked by light coastal winds, clean air, and low humidity. They may last from a day to over a week. The Santa Ana condition is usually one of warm temperatures when the rest of the United States is in the grip of winter. High pressure builds over the Great Basin in fall and winter as cold air travels into that region from Canada. When the surface pressure gradient reaches or exceeds 10 millibars, as measured from Tonopah, Nevada, to Los Angeles, wind gusts can reach 70 mph in the mountains and below passes and canyons near the Southern California coast.

Santa Ana winds broadly affect the planning area. Winds tend to channel below specific passes and canyons, coming in gust clusters. High winds may blow in one neighborhood, while a few blocks away there are only gentle warm breezes. Offshore winds from the northeast or east must reach 30 mph or more below passes and canyons to reach minimum criteria for Santa Ana wind advisories. Typical wind speeds are in the 40 to 55 mph range; in extreme cases, winds can gust locally to over 100 mph.

Rating Wind Strength

As shown in Table 11-1 the Beaufort Wind Scale is an empirical measure that relates wind speed to observed conditions at sea or on land.

Table 11-1. Beaufort Wind Scale

Force	Wind (knots)	Classification	Appearance of Wind Effects On Land
0	< 1	Calm	Calm, smoke rises vertically
1	1-3	Light Air	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Dust, leaves, and loose paper lifted; small tree branches move
5	17-21	Fresh Breeze	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Seldom experienced on land, trees broken or uprooted, considerable structural damage
11	56-63	Violent Storm	Seldom experienced on land
12	64+	Hurricane	Seldom experienced on land

Source: NOAA, NWS, Storm Prediction Center

11.1.2 Extreme Temperature

Extreme heat can be defined as temperatures that hover 10 ºF or more above the average high temperature for the region, last for prolonged periods of time, and are often accompanied by high humidity. The National Weather Service (NWS) monitors a heat index that takes both temperature and humidity into account (see Figure 11-1).

Source: National Weather Service

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Figure 11-1. Extreme Heat Index

According to the *California Climate Adaptation Strategy*, heat waves have claimed more lives in California than all other declared disaster events combined. Despite this history, not a single heat emergency was proclaimed at the state or federal level between 1960 and 2016. Heat emergencies are often slow to develop and usually hurt vulnerable populations. It can take a number of days of oppressive heat for a heat wave to have a significant or quantifiable impact. Heat waves do not strike victims immediately, but rather their cumulative effects slowly take the lives of vulnerable populations.

The "urban heat island effect" can produce significantly higher nighttime temperatures where asphalt and concrete (which store heat longer) gradually release heat at night. Urban heat islands develop in urban areas where natural surfaces are paved with asphalt or covered by buildings. Radiation from the sun is absorbed by these surfaces during the day and re-radiated at night, raising ambient temperatures. Urban heat islands have high nighttime minimum temperatures compared to neighboring areas. Waste heat from air conditioners, vehicles, and other equipment contributes to the urban heat island effect.

11.1.3 Secondary Hazards

High winds and extreme heat may cause loss of power if utility service is disrupted. Both also may make communities more vulnerable to wildfire. The California Public Utilities Commission's current guidelines on Public Safety Power Shutoffs (PSPS) permits utilities to cut power to electrical lines in danger of failure to reduce the likelihood of those lines contributing to a wildfire. From 2013-2019, the three largest energy companies in the state conducted 33 PSPS de-energizations. A secondary hazard associated with extreme heat is poor air quality when stagnant atmospheric conditions trap humid air and pollutants near the ground.

11.2 HAZARD PROFILE

11.2.1 Past Events

Los Angeles County has not been included in any federal declarations for heat, high winds, or thunderstorm.

High Winds and Thunderstorm Winds

The planning area has experienced both high wind and thunderstorm wind events. The National Centers for Environmental Information storm events database lists the following wind events from 2000 to 2020:

- 312 high wind events, with 235 considered as damaging wind events.
- 32 thunderstorm events, with four events resulting in death or injury.
- High wind event, CVWD without electrical power for five days

On December 1, 2011, a strong north to northeast wind event crossed sections of Southern California. Widespread wind gusts between 60 and 70 mph were recorded in Ventura County and Los Angeles county. Widespread power outages were reported, especially across the San Gabriel Valley, where over 350,000 residents lost power. In Pasadena, at least 42 buildings were red-tagged due to wind damage. Numerous trees were uprooted or severely damaged from La Canada-Flintridge to Monrovia. Strong cross winds at Los Angeles International Airport resulted in 23 flights being diverted to Ontario International Airport. Power at some sites was out for up to five days (NCDC, 2021).

Extreme Heat

According to the Western Regional Climate Center, the planning area averages 24 days a year with temperatures exceeding 90°F, and those days may be included in a heat wave event. A storm event database maintained by NOAA's National Centers for Environmental Information lists three excessive heat events in the planning area:

- **August 30-31, 2007**— From the 29th through the 31st, strong high pressure built over the southwest United States. With this pattern, above normal temperatures developed across the mountains and valleys of Southern California. An influx of monsoonal moisture from northern Mexico increased the relative humidity across the area. The combination of very hot temperatures and increased relative humidity produce heat index values between 105 and 112 degrees. The excessive heat resulted in numerous heat-related injuries and deaths. The heat wave extended into the first few days of September.
- **September 1-3, 2007**— The heat wave which started at the end of August continued into the first few days of September. The combination of above normal temperatures and relative humidity continued to

produce excessive heat conditions across sections of Southern California. At the end of the heat wave, 18 heat-related deaths were reported across Los Angeles county.

- **June 20 – 21, 2008**—The combination of strong high pressure centered over Arizona and weak offshore flow generated extreme heat conditions across Central and Southern California. Across many sections of the area, afternoon temperatures climbed to between 100 ºF and 114 ºF, setting numerous high temperature records. The extreme heat resulted in several power outages due to excessive electrical use. The remote automatic weather station sensor at Acton reported a heat index of greater than 100 degrees.

11.2.2 Location

Severe weather events have the potential to happen anywhere in the planning area. Extreme heat events may be exacerbated in the District where reduced air flow, reduced vegetation, and increased generation of waste heat can contribute to temperatures that are several degrees higher than in surrounding less urbanized areas. High wind and thunderstorm events affect an entire region.

11.2.3 Frequency

The severe weather events for the planning area are often related to high winds associated with severe storms and Santa Ana winds. Based on a record of 235 damaging wind events (over 60 mph) in 20 years, the planning area will continue to experience these on an annual basis.

The National Climatic Data Center storm events database lists 10 heat events in Los Angeles County since 2000. This correlates to a 0.5 percent annual probability. Climate change is likely to bring hotter temperatures, more hot days, and more frequent heat waves, leading to higher rates of heat-related impairments and deaths.

11.2.4 Severity

The most common problems associated with severe weather are immobility and loss of function for utilities caused by power outage. Fatalities are uncommon but can occur. Power lines may be downed due to high winds, and services such as water or phone may not be able to operate without power. Physical damage to homes and facilities can be caused by wind induced falling objects such as trees.

Extreme heat can cause heat exhaustion, in which the body becomes dehydrated, resulting in an imbalance of electrolytes. Without intervention, heat exhaustion can lead to collapse and heatstroke. Heatstroke occurs when perspiration cannot occur, and the body overheats. Without intervention, heatstroke can lead to confusion, coma, and death. Extreme heat is the primary weather-related cause of death in the U.S. In an 80-year record of weather fatalities across the nation from (1940-2019), excessive heat claimed more lives each year than floods, lightning, tornadoes, and hurricanes. The total averaged to 103 heat-related deaths every 10 years (NWS, 2020). Extreme heat events do not typically impact buildings; however, losses may be associated with the urban heat island effect and overheating of HVAC systems. These extreme heat events can lead to drought, impact water supplies, and lead to an increase in heat-related illnesses and deaths.

Hot weather also can increase levels of ozone, a major component of smog that is created in the presence of sunlight via reactions between chemicals in gasoline vapors and industrial smokestacks. High ozone levels often cause or worsen respiratory problems. The longer a heat wave lasts and the hotter the temperature is, the greater the risk of adverse impacts on human health or infrastructure.

High winds are a frequent problem in the planning area, while thunderstorms occur less frequently. Both have been known to damage utilities. The wind speed given in wind warnings issued by the NWS is for a one-minute average; gusts may be 25 to 30 percent higher.

11.2.5 Warning Time

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. The NWS issues advisories, watches and warnings associated with thunderstorms, wind and temperature as listed in Table 11-2.

Table 11-2. NWS Weather Warnings, Watches and Advisories

	Warning	Watch	Advisory
Wind[a]	Strong sustained winds for one hour or longer, or wind gusts for any duration that are not associated with thunderstorms are occurring or will occur within six to 12 hours	Strong sustained winds for one hour or longer, or wind gusts for any duration that are not associated with thunderstorms are occurring or will occur within 12 to 48 hours	Strong winds are occurring or will occur within 12 to 24 hours but are not so strong as to warrant a high wind warning
Excessive heat[b]	Heat index values are forecast to meet or exceed locally defined warning criteria for more than three hours over at least two consecutive days; issued within 12 hours of the onset of the high heat index	Conditions are favorable in the next 24 to 72 hours for extreme heat index values during the day, combined with nighttime low temperatures of 80 °F or higher that limit perspiration recovery,	Heat index values are forecast to meet or exceed locally defined warning criteria for one or two days; usually issued within 12 hours of the onset of the high heat index

a. NWS offices issue wind-related products based on local criteria for strong sustained winds or gusts
b. Specific criteria varies among local weather forecast offices due to climate variability and the effect of excessive heat on the local population. Typical criteria are maximum daytime temperatures above 105 ºF to 110 °F for up to three hours per day, with minimum nighttime temperatures above 75 °F for two consecutive days. Criteria may be lowered if the heat event occurs early in the season or during a multi-day heat wave or a widespread power outage

Sources: Wikipedia, 2020; NWS, 2020

11.3 EXPOSURE

It can be assumed that all District assets are exposed to some extent to severe weather events profiled in this chapter. Power outages or roaming blackouts may occur as a result of extreme heat events that strain and overheat circuits. During a blackout, all critical facilities that rely on electricity for power will be severely impacted unless they are connected to a backup power source. Facilities on higher ground may also be exposed to wind damage or damage from falling trees.

11.4 VULNERABILITY

Direct impacts from severe weather events are little or no impacts. All District assets are vulnerable to indirect impacts from the severe weather events profiled in this chapter. This vulnerability is tied predominately to the loss of power, as most of the District's critical assets are power dependent. Currently, there are no available models that can estimate loss and loss of function from severe weather events. Therefore, no formal loss estimations are being provided, and this vulnerability assessment is qualitative in its narrative.

Weather induced loss of power for the planning area is prevalent, especially considering the impact of Public Safety Power Shutoff protocols being deployed by electric utility service providers in the state of California. High temperatures, extreme dryness and record-high winds can create conditions in the state where any spark at the wrong time and place can lead to a major wildfire. The Public Safety Power Shutoff is a procedure where if severe weather threatens a portion of the electric system, it may be necessary for the utility service provider, Southern California Edison, to turn off electricity in the interest of public safety. A PSP event can be correlated to severe weather.

The District does have backup power to most, but not all of its critical assets, so there is some degree of vulnerability associated with this core capability. There are portable sources for emergency power supply, but these sources are not as efficient as picked place backup power for each facility.

11.5 FUTURE TRENDS IN DEVELOPMENT

The demand for critical District services may increase with growth in the surrounding area. The State of California's adoption of bills expanding property owners' rights to build accessory dwelling units will increase densities in most the District's service area; areas that, as recently as 2019, were thought to be built out.

Repair or replacement of District assets, if necessary, will be governed by codes and standards applied by the County of Los Angeles, the City of La Cañada -Flintridge, or the City of Glendale, depending upon the location of the asset. These jurisdictions have adopted codes and standards that include adoption of the 2019 California State Building Code, which is based on the 2018 International Building Code. The building code includes provisions for mitigating the impacts from high winds and structure insulation requirements that can mitigate the impacts from extreme heat. These codes and standards would have no direct impact on future District assets, with the exception of any new structures the district may construct.

11.6 SCENARIO

Although extreme heat and high winds occur on an annual basis, a worst-case scenario event would be a severe windstorm or extreme heat event that occurs during a Public Safety Power Shutoff event that disrupts power for a long period of time. This would tax the District's backup power capability beyond its capacity.

11.7 ISSUES

Important issues associated with a severe weather in the planning area include the following:

- Power interruption is the biggest impact from this hazard for the District.
- Prolonged backup power usage during extreme heat events could have regional impacts on air quality.
- The District's backup power capability should be enhanced
- Severe weather events are likely to increase as a result of climate change impacts, including the potential for extreme heat.

12. WILDFIRE

12.1 GENERAL BACKGROUND

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson. Fire hazards present a considerable risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in areas designated as “wildland-urban interface areas,” where development is adjacent to densely vegetated areas.

12.1.1 Secondary Hazards

Wildfires can have a significant impact on air quality, especially with prolonged periods of burning combined with climatic conditions. Wildfires strip slopes of vegetation, exposing them to greater amounts of runoff and debris flow. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

12.2 HAZARD PROFILE

12.2.1 Past Events

Incident information from the California Department of Forestry and Fire Protection (CAL FIRE) identifies 94 wildfires in Los Angeles County since 2005. Los Angeles County has been included in 12 federal wildfire disaster declarations and another five federal fire management declaration events, for a total of 17 federal declaration since 1978. Table 12-1 lists some of the most damaging urban-wildland interface fires that have affected Los Angeles County since 2005 (as reported by CAL FIRE)

The Station Fire was the largest wildfire in the history of Los Angeles County, igniting on August 26, 2009 near the U.S. Forest Service ranger station on the Angeles Crest Highway in the Angeles National Forest. The blaze threatened 12,000 structures in the National Forest and the nearby communities of La Cañada Flintridge, Pasadena, Glendale, Acton, La Crescenta, Juniper Hills, Littlerock, and Altadena, as well as the Sunland and Tujunga neighborhoods of the City of Los Angeles. By the time the fire was extinguished on October 16, over 160,000 acres had burned, 106 structures were destroyed, 10 people were injured, and two firefighters died.

Table 12-1. Damaging Urban-Wildland Interface Fires in Los Angeles County Since 2005

	Dates	Area Burned (acres)
Station Fire	August 26 – October 16, 2009,	160,577
Woolsey Fire	November 8, 2018 – January 4, 2019,	96,949 (Los Angeles and Ventura counties)
Ranch Fire	October 20 – November 01, 2007,	58,401
Buckweed (Agua Dulce) Fire	October 21 – November 01, 2007,	38,000
Lake Fire	August 12 – September 28, 2020,	31,089
Powerhouse Fire	May 30 – June 08, 2007,	30,274
Topanga Fire	September 29 – October 06, 2005,	24,175
Creek Fire	December 5, 2017 – August 06, 2018,	15,619

Given the Station Fire's proximity to the Crescenta Valley, CVWD worked with Los Angeles County, the Cities of Glendale and La Cañada Flintridge, and the U.S. Forest Service to prevent serious damage and disruption to water and sewer service. CVWD closely monitored all progress of the wildfire within the service areas. Response actions included filling all of its reservoirs to overflow levels, increasing flows from Foothill Municipal Water District, moving portable generators to upper reservoir sites, and coordinating with personnel regarding response and availability.

12.2.2 Location

CAL FIRE's Fire and Resource Assessment Program has modeled and mapped wildfire hazard zones using a science-based and field-tested computer model that assigns a fire hazard severity zone (FHSZ) of moderate, high, or very high. The FHSZ model is built from existing CAL FIRE data and hazard information based on factors such as the following:

- **Fuel**—Fuel may include living and dead vegetation on the ground, along the surface as brush and small trees, and above the ground in tree canopies. Lighter fuels such as grasses, leaves and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite. Trees killed or defoliated by forest insects and diseases are more susceptible to wildfire.
- **Weather**—Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere. Of particular importance for wildfire activity are wind and thunderstorms:
  - Strong, dry winds produce extreme fire conditions. Such winds generally reach peak velocities during the night and early morning hours.
  - The thunderstorm season typically begins in June with wet storms and turns dry with little or no precipitation reaching the ground as the season progresses into July and August.
- **Terrain**—Topography includes slope and elevation. The topography of a region influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as highways and lakes; and elevation and slope of landforms (fire spreads more easily uphill than downhill).
- **Probability of Future Occurrence**—The likelihood of an area burning over a 30- to 50-year time period, based on history and other factors.

The model also is based on frequency of fire weather, ignition patterns, and expected rate-of spread. It accounts for flying ember production, which is the principal driver of the wildfire hazard in densely developed areas. A related concern in built-out areas is the relative density of vegetative fuels that can serve as sites for new spot fires within the urban core and spread to adjacent structures. The model refines the zones to characterize fire exposure mechanisms that cause ignitions to structures. Significant land-use changes need to be accounted for through periodic model updates. FHSZ mapping for the District is shown in Figure 12-1 and Figure 12-2.

12.2.3 Frequency

Wildfire frequency can be assessed through review of the number of previous wildfire events and the area burned over a defined period. CAL FIRE records of fires indicate that, from 1878 to 2016, 53.5 percent of the total area within the very-high FHSZ was burned by wildfire (50,782 acres out of 94,904 acres). This averages 0.4 percent of the very-high FHSZ area burned per year over that 139-year period. However, those records are incomplete prior to 1950, so the annual average is likely higher than that. CAL FIRE records indicate that there were 94 fires in the planning area from 2004-2020, which comes to an average of nearly six fires per year.

12.2.4 Severity

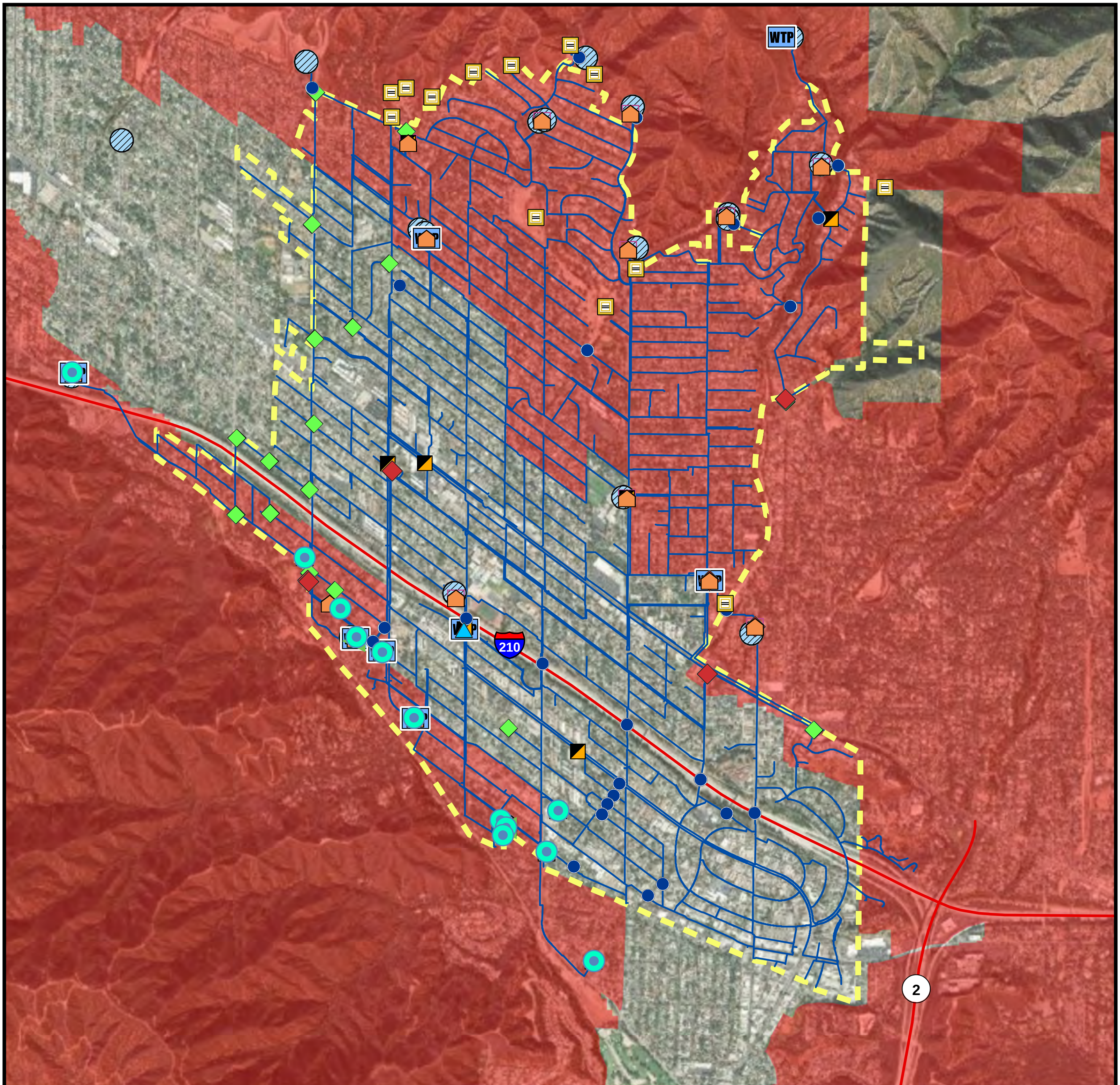
Potential losses from wildfire include human life, structures and other improvements, and natural resources. There are no recorded incidents of loss of life from wildfires in the planning area. Wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds.

Beyond the human impact, wildfires also affect the Earth’s climate. Forests in particular store large amounts of carbon. When they burn, they release carbon dioxide into the atmosphere, which in turn contributes to climate change.

12.2.5 Warning Time

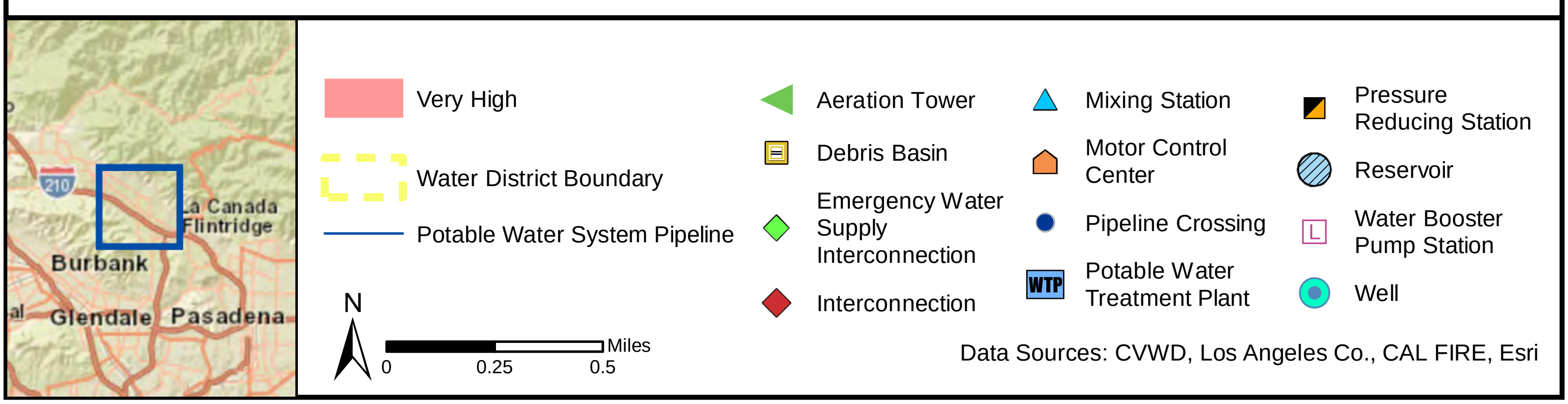
Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Adverse weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

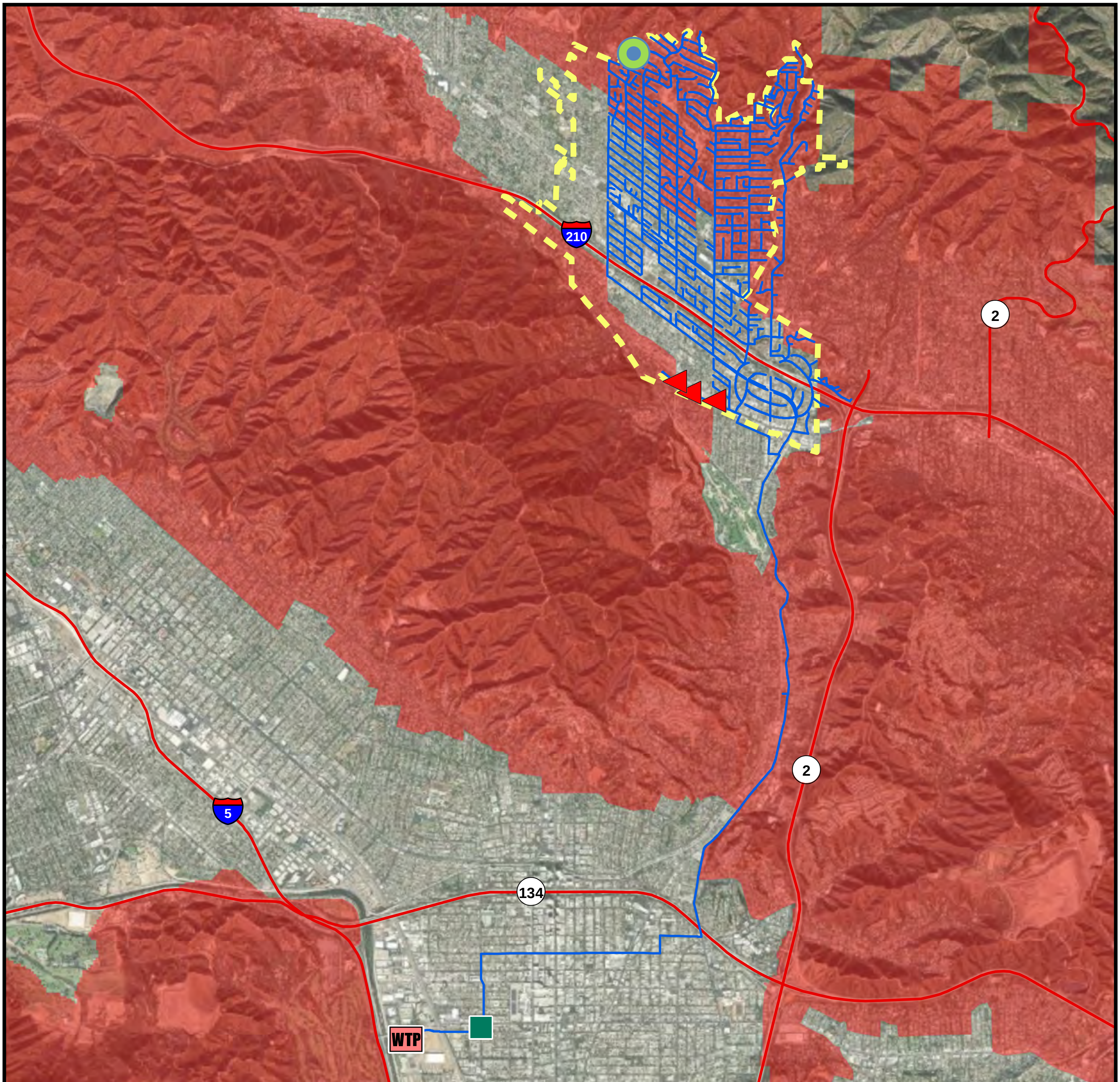
A fire that breaks out and spreads rapidly can require evacuation within days or hours. A fire’s peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications and social media in recent years has further contributed to a significant improvement in warning time.



Crescenta Valley Water District

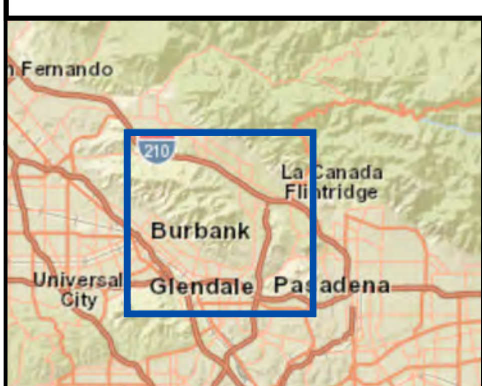
Figure 12-1. Potable Water System - Wildfire Hazard Severity Zones





Crescenta Valley Water District

Figure 12-2. Wastewater System - Wildfire Hazard Severity Zones



Very High

Water District Boundary

Sewer Control Valve

Sewer Flow Meter

Sewer Wet Well

WTP Wastewater Treatment Plant

Wastewater Pipelines

N

0 0.5 1 Miles

Data Sources: CVWD, Los Angeles Co., CAL FIRE, Esri

12.3 EXPOSURE

The risk assessment for wildfire determined District assets that lie within each mapped wildfire severity zone. It was assumed that underground pipelines are not at risk from fire, so only above-ground structures were identified. Table 12-2 summarizes the number of structures in each zone. Figure 12-3 and Figure 12-4 show the results as the percent of total planning area assets.

Table 12-2. Number of District Structures Exposed to the Wildfire Hazard

	Number of Exposed Structures in Wildfire Severity Zone[a]	
	Very High Severity	No Mapped Severity Zone
Potable Water Facilities		
Building	3	1
Aeration Tower	2	0
Debris Basin	13	0
Emergency Interconnection	11	10
Fitting	901	1,023
Hydrant	319	376
Interconnection	7	1
Mixing Station	0	1
Motor Control Center	17	4
Pipeline Crossing	12	14
Potable Water Treatment Plant	9	1
Potable Water Valve	1,025	1,254
Pressure Reducing Station	2	5
Reservoir	16	3
Water Booster Pump Station	12	2
Well	10	2
Total	**2,359**	**2,697**
Wastewater Facilities		
Sewer Control Valve	1	2
Sewer Fitting	3,496	2,986
Sewer Flow Meter	0	1
Sewer Manhole	670	600
Sewer Wet Well	1	0
Wastewater Lift Station	2	0
Wastewater Treatment Plant	0	1
Total	**4,170**	**3,590**

a. All assets not in a Very High wildfire severity zone are not located in any sort of severity zone.

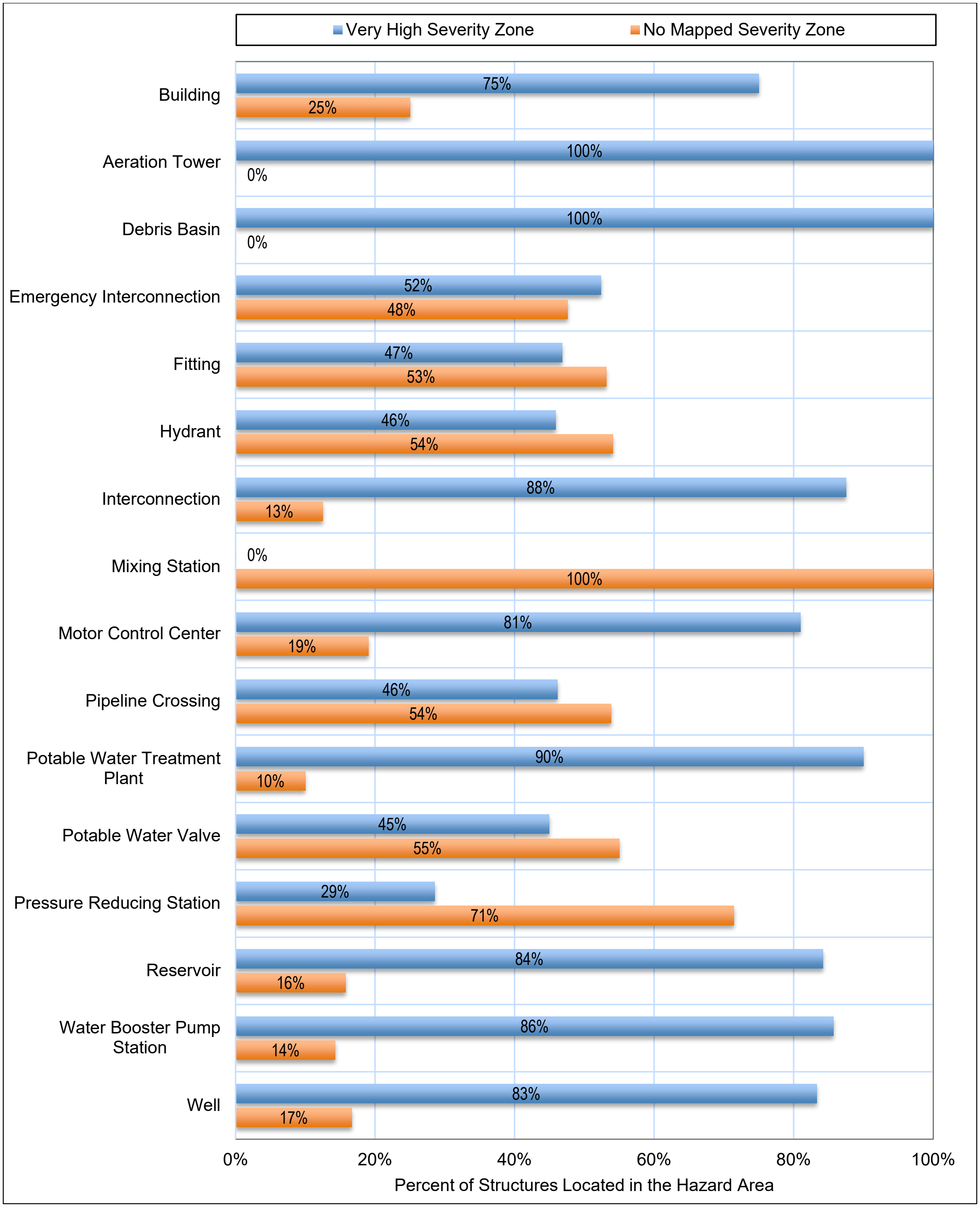


Figure 12-3. Percent of District Potable Water Structures Exposed to the Wildfire Hazard

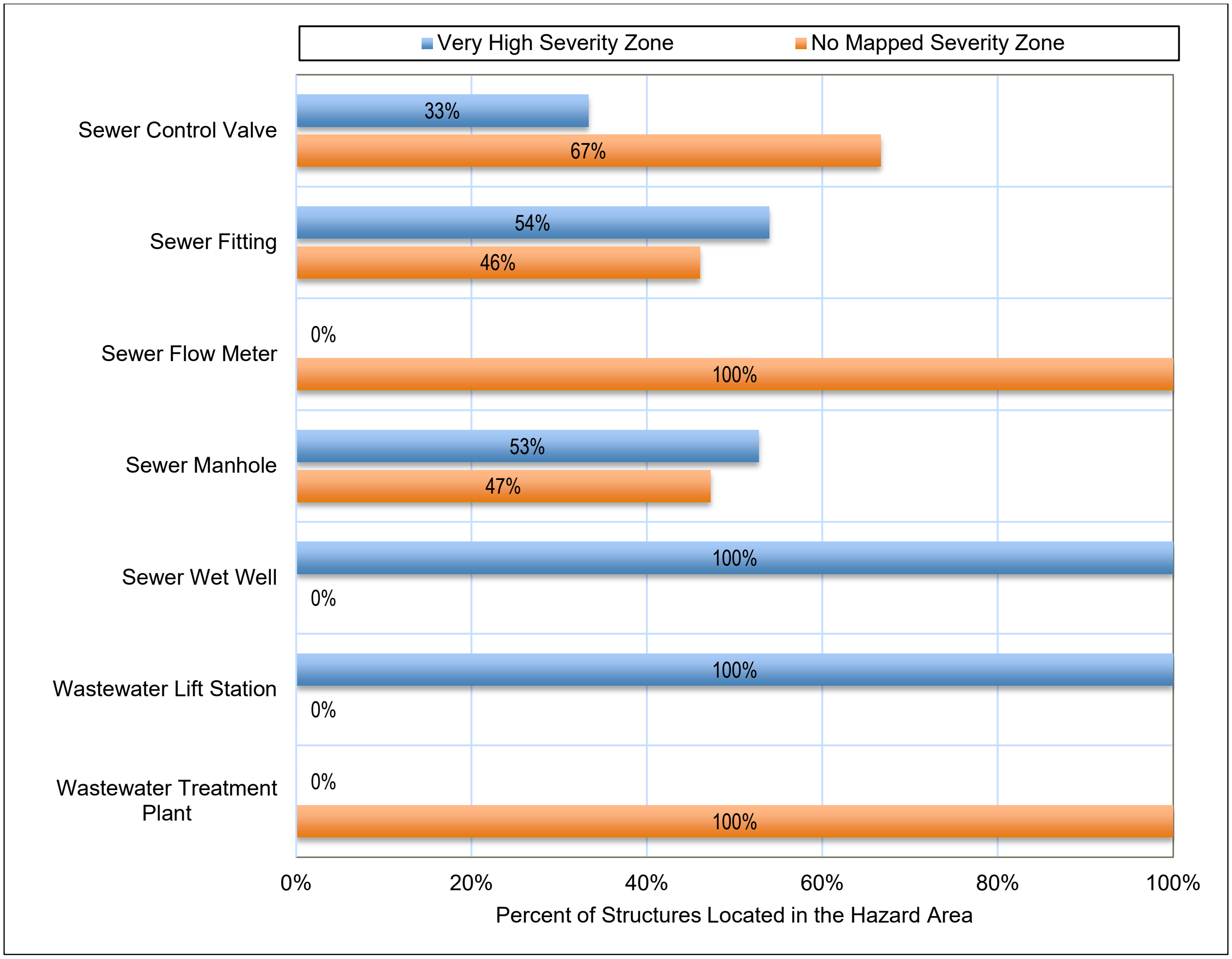


Figure 12-4. Percent of District Wastewater Structures Exposed to the Wildfire Hazard

12.4 VULNERABILITY

Structures, above-ground infrastructure, and critical facilities are all vulnerable to the wildfire hazard. There is currently no validated damage function available to support wildfire mitigation planning. Vulnerable assets are assumed to include all those identified as exposed to the wildfire hazard. Critical facilities of wood frame construction or with wood roofs are especially vulnerable during wildfire events.

12.5 FUTURE TRENDS IN DEVELOPMENT

Urbanization alters the natural fire regime and can create the potential for expansion of urbanized areas into wildland areas. The demand for critical District services may increase with growth in the surrounding area. The State of California’s adoption of bills expanding property owners’ rights to build accessory dwelling units will increase densities in most the District’s service area; areas that, as recently as 2019, were thought to be built out.

Repair or replacement of District assets, if necessary, will be governed by codes and standards applied by the County of Los Angeles, the City of La Cañada -Flintridge, or the City of Glendale, depending upon the location of the asset. These jurisdictions have adopted codes and standards that include adoption of the 2019 California State Building Code, which is based on the 2018 International Building Code.

12.6 SCENARIO

A major wildfire in the planning area might begin with a high rainfall spring season, adding to fuels already present on the forest floor. Flashy fuels would build throughout the spring. The summer could see the onset of insect infestation. A dry summer could follow the wet spring, exacerbated by dry hot winds. Carelessness with combustible materials or a tossed lit cigarette, or a sudden lighting storm could trigger a multitude of small isolated fires.

The embers from these smaller fires could be carried miles by hot, dry winds. The deposition zone for these embers would be deep in the forests and interface zones. Fires that start in flat areas move slower, but wind still pushes them. It is not unusual for a wildfire pushed by wind to burn the ground fuel and later climb into the crown and reverse its track. This is one of many ways that fires can escape containment, typically during periods when response capabilities are overwhelmed. These new small fires would most likely merge. Suppression resources would be redirected from protecting the natural resources to saving more remote subdivisions.

The worst-case scenario would include an active fire season throughout the American west, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

12.7 ISSUES

The major issues for wildfire are the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Wildfires could cause landslides as a secondary natural hazard.
- Public Safety Power Shutoff (PSPS) events for “fire weather” could impact District operations.
- Climate change could increase the wildfire hazard.
- Future growth into the foothills interface areas should continue to be managed by local agencies like Los Angeles County and the Cities of Glendale and La Canada Flintridge.
- Vegetation management activities should include enhancement through expansion of the target areas as well as additional resources as directed by the local fire authority.
- Backup power is needed for critical assets exposed to the wildfire hazard.
- Increased water storage can enhance firefighting capability.
- There is a need for coordination with local fire departments and increased training of CVWD personnel.

13. CLIMATE CHANGE CONSIDERATIONS

13.1 WHAT IS CLIMATE CHANGE?

Climate, consisting of patterns of temperature, precipitation, humidity, wind and seasons, plays a fundamental role in shaping natural ecosystems and the human economies and cultures that depend on them. “Climate change” refers to changes over a long period of time.

The well-established worldwide warming trend of recent decades and its related impacts are caused by increasing concentrations of carbon dioxide and other greenhouse gases in the earth’s atmosphere. Greenhouse gases are gases that trap heat in the atmosphere, resulting in a warming effect. Carbon dioxide is the most commonly known greenhouse gas; however, methane, nitrous oxide and fluorinated gases also contribute to warming. Emissions of these gases come from a variety of sources, such as the combustion of fossil fuels, agricultural production, and changes in land use. According to the National Aeronautics and Space Administration (NASA), carbon dioxide concentrations measured about 280 parts per million (ppm) before the industrial era began in the late 1700s and have risen dramatically since then, surpassing 400 ppm in 2013 for the first time in recorded history (see Figure 13-1).

Source: NASA, 2020

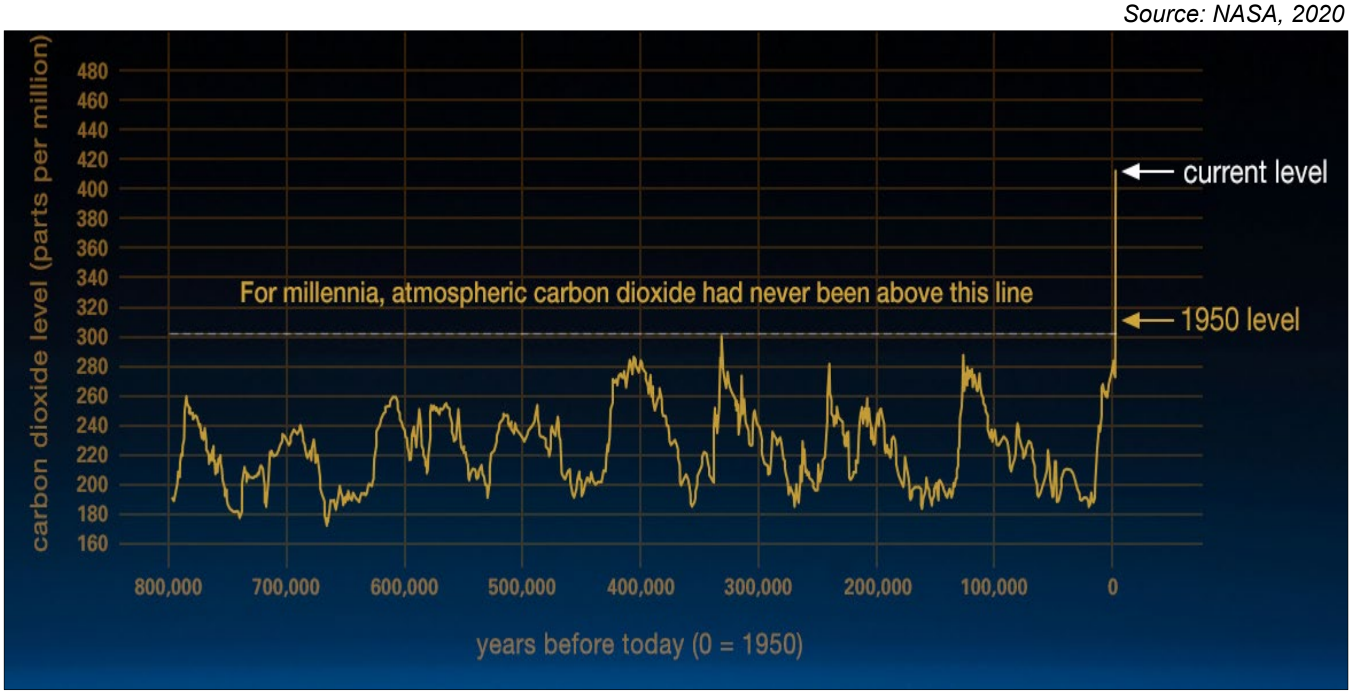


Figure 13-1. Global Carbon Dioxide Concentrations Over Time

13.2 HOW CLIMATE CHANGE AFFECTS HAZARD MITIGATION

Climate change will affect people, property, economy, and ecosystems in a variety of ways. Consequences of climate change include increased flood vulnerability, and increased heat-related illnesses. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards.

An essential aspect of hazard mitigation is predicting the likelihood of hazard events in a planning area. Typically, predictions are based on statistical projections from records of past events. This approach assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies of, for example, floods are used to estimate future frequencies: if a river has flooded an average of once every 5 years for the past 100 years, then it can be expected to continue to flood an average of once every 5 years.

For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. As flooding is generally associated with precipitation frequency and quantity, for example, the frequency of flooding will not remain constant if broad precipitation patterns change over time. Specifically, as hydrology changes, storms currently considered to be the 100-year flood might strike more often, leaving many communities at greater risk. The risks of landslide, severe storms, and wildfire are all affected by climate patterns as well. For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards. Information about how climate patterns are changing provides insight on the reliability of future hazard projections used in mitigation analysis.

13.3 CURRENT GLOBAL INDICATIONS OF CLIMATE CHANGE

The major scientific agencies of the United States—including NASA and the National Oceanic and Atmospheric Administration (NOAA)—have presented evidence that climate change is occurring. NASA summarizes key evidence as follows (NASA, 2020a):

- Global Temperature Rise—The planet’s average surface temperature has risen about 1.62 ºF since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere. Most of the warming occurred in the past 35 years, with the five warmest years on record taking place since 2010.
- Warming Oceans—The oceans have absorbed much of this increased heat, with the top 2,300 feet of ocean showing warming of more than 0.4 ºF since 1969.
- Shrinking Ice Sheets—The Greenland and Antarctic ice sheets have decreased in mass. Greenland lost an average of 286 billion tons of ice per year between 1993 and 2016, and Antarctica lost about 127 billion tons of ice per year during the same time period. The rate of Antarctica ice mass loss has tripled in the last decade.
- Glacial Retreat—Glaciers are retreating almost everywhere around the world—including in the Alps, Himalayas, Andes, Rockies, Alaska, and Africa.
- Decreased Snow Cover—Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and that the snow is melting earlier
- Sea Level Rise—Global sea level rose about 8 inches in the last century. The rate in the last two decades is nearly double that of the last century and is accelerating slightly every year.

- Declining Arctic Sea Ice—Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades
- Extreme Events—The number of record high temperature events in the United States has been increasing since 1950, while the number of record low temperature events has been decreasing. The U.S. has also witnessed increasing numbers of intense rainfall events.
- Ocean Acidification—Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 billion tons per year.

13.4 PROJECTED FUTURE IMPACTS

The Third National Climate Assessment Report for the United States indicates that impacts resulting from climate change will continue through the 21st century and beyond. Although not all changes are understood at this time, the following impacts are expected in the United States (NASA, 2017):

- Temperatures will continue to rise.
- Growing seasons will lengthen.
- Precipitation patterns will change.
- Droughts and heat waves will increase.
- Hurricanes will become stronger and more intense.
- Sea level will rise 1 to 8.2 feet by 2100 (NOAA, 2020a and 2020b).
- The Arctic may become ice free.

The *California Climate Adaptation Planning Guide* outlines the following climate change impact concerns for the South Coast climate impact region (Cal EMA et al., 2012):

- Increased temperatures
- Reduced overall precipitation
- Sea level rise
- Public health (heat and air quality)
- Reduced water supply
- Reduced tourism
- Coastal erosion
- Wildfire risk.

Some of these changes are direct or primary climatic changes, such as increased temperature, while others are indirect or secondary impacts resulting from the direct changes, such as heat and air pollution. Some direct changes may interact with one another to create unique secondary impacts. These primary and secondary impacts may then result in impacts on human and natural systems. The climate change impacts likely to affect the planning area are summarized in Table 13-1.

Table 13-1. Summary of Climate Change Impacts Likely to Affect the Planning Area

Primary Impact	Secondary Impact	Example Human and Natural System Impacts
Increased Temperature	Heat wave and high carbon emissions	• Increased frequency of illness and death • Increased high alert ozone days, urban heat islands • Increased stress on mechanical systems, such as HVAC systems • Increased stress on electricity supply and demand
Reduced Precipitation	Changed seasonal patterns	• Reduced water supply • Reduced tourism
	Increased wildfires	• More people, wildlife, land, and structures impacted by fires. • Summer dryness will begin earlier, last longer, and become more intense.
Sea Level Rise	Permanent inundation of previously dry land	• Loss of assets and tax base • Loss of coastal habitat • Loss of tourism
	Larger area impacted by extreme high tide	• More people and structures impacted by storms
	Increased coastal erosion	• Loss of assets and tax base
Reduced Mountain Snowpack	Reduced water supply	• Primary sources of water are State Water Project and the Colorado River, both originating in mountain snowpack; change may reduce water supply. • Increased costs for water

Adapted and expanded from California Adaptation Planning Guide: Planning for Adaptive Communities

Climate change projections contain inherent uncertainty, largely because they depend on future greenhouse gas emission scenarios. Generally, the uncertainty in greenhouse gas emissions is addressed by the assessment of differing scenarios: low-emissions scenarios and high-emissions scenarios. In low-emissions scenarios, greenhouse gas emissions are reduced substantially from current levels. In high-emissions scenarios, greenhouse gas emissions generally increase or continue at current levels. Uncertainty in outcomes is generally addressed by averaging a variety of model outcomes.

Despite this uncertainty, climate change projections present valuable information to help guide decision-making for possible future conditions. The following sections summarize information developed by Cal-Adapt, a resource for public information on how climate change might impact local communities, for the Los Angeles Region.

13.4.1 Temperature

The historical (1981-2010) average temperature for the region was 66.6ºF. By 2090, the average temperature is expected to increase above this baseline by 3.5ºF and 6.0ºF in the low- and high-emissions scenarios, respectively (see Figure 13-2). By 2100, if temperatures rise to the higher warning range, there could be up to 100 more days per year with temperatures above 90 ºF.

13.4.2 Extreme Heat

The extreme heat day temperature threshold for the planning area is 96.7°F. The historical average number of extreme heat days is four. The number of extreme heat days, the number of warm nights (68.5°F threshold), the number of heat waves and the duration of heat waves are all expected to increase over the next century (see Figure 13-3).

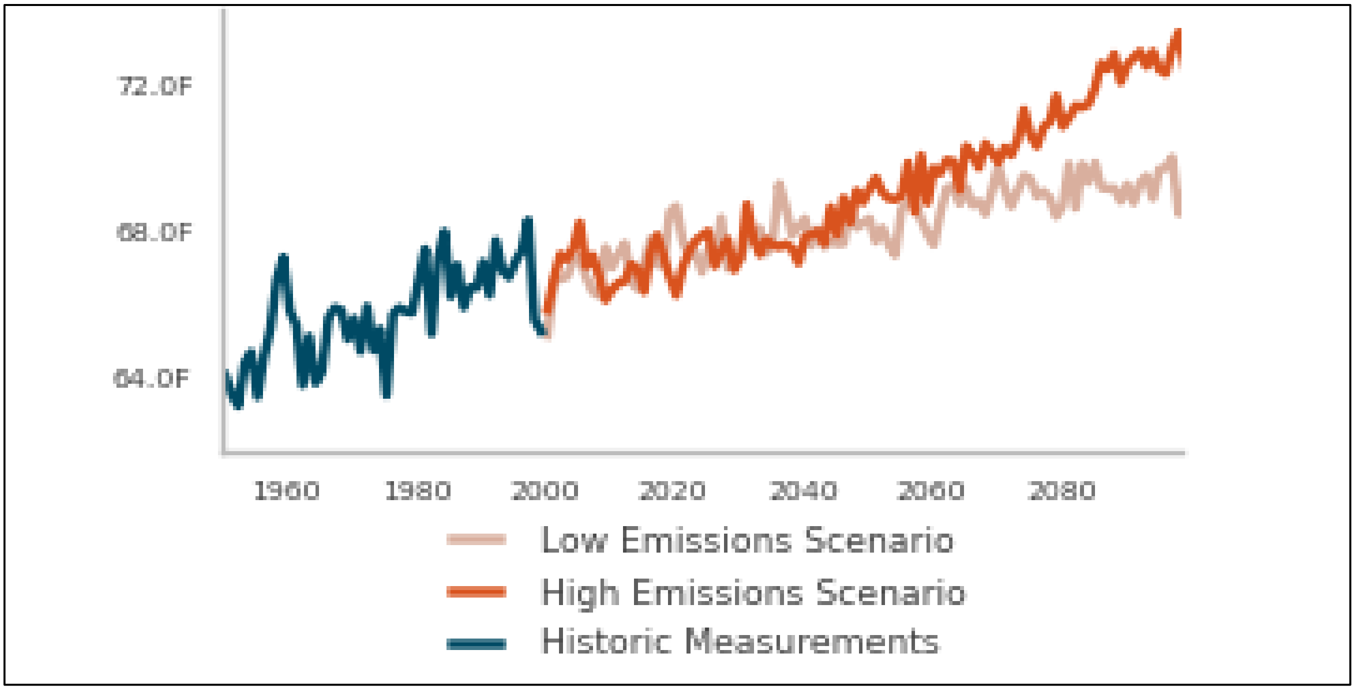


Figure 13-2. Observed and Projected Average Temperatures for the Los Angeles Region

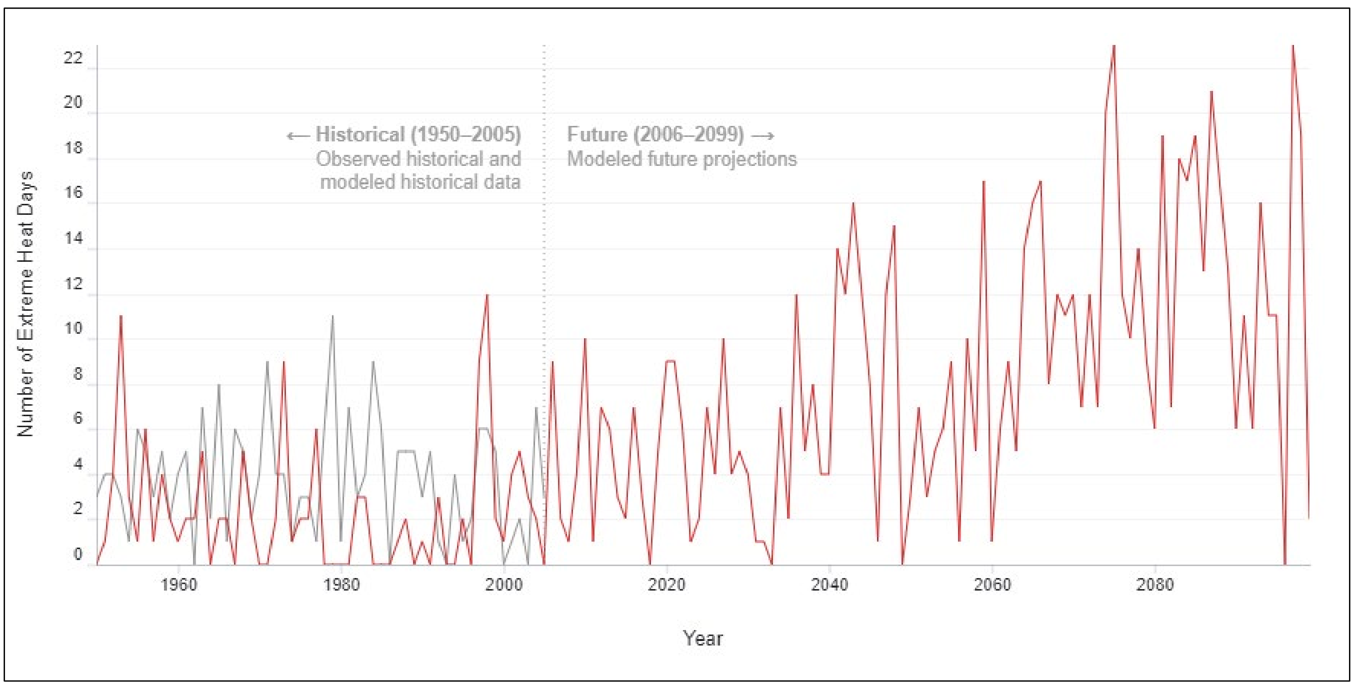


Figure 13-3. Projected Number of Extreme Heat Days by Year for the Los Angeles Region

13.4.3 Precipitation

Precipitation projections for California remain uncertain. Models show differing impacts from slightly wetter winters to slightly drier winters, with the potential for a 10- to 20-percent decrease in total annual precipitation. Changes in precipitation patterns, coupled with warmer temperatures, may lead to significant changes in hydrology. In high-emissions scenarios, more precipitation may fall as rain rather than snow and this snow may melt earlier in the season, thus impacting the timing of changes in stream flow and flooding (Cal-Adapt, 2016).

13.4.4 Snowpack

While there are no snow water equivalency measurements for the planning area, Cal-Adapt indicates that parts of California should expect snowpack levels to be reduced by up to 25 inches from the baseline (1961-1990) by 2090.

13.4.5 Wildfire

Wildfire risk is expected to change in the coming decades (see Figure 13-4). Under both high- and low-emissions scenarios, the change in area burned may slightly increase until 2020 and then decrease by 10 to 20 percent by 2085.

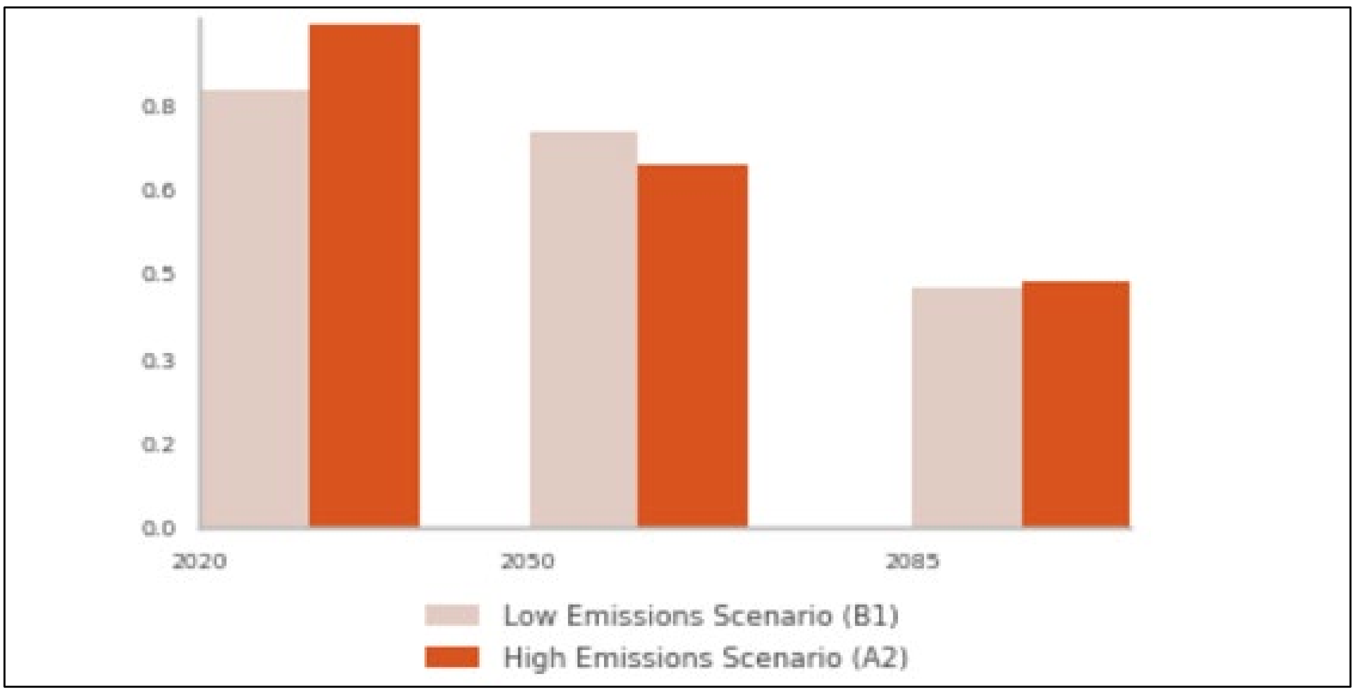


Figure 13-4. Projected Changes in Fire Risk for Los Angeles Region, Relative to 2010 Levels

13.5 RESPONSES TO CLIMATE CHANGE

Communities and governments worldwide are working to address, evaluate and prepare for climate changes that are likely to impact communities in coming decades. Adaptation is defined by the IPCC as the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC, 2014).

Societies across the world are facing the need to adapt to changing conditions associated with natural disasters and climate change such as those indicated above. Farmers are altering crops and agricultural methods to deal with changing rainfall and rising temperature; architects and engineers are redesigning buildings; planners are looking at managing water supplies to deal with droughts or flooding.

Most ecosystems show a remarkable ability to adapt to change and to buffer surrounding areas from the impacts of change. Forests can bind soils and hold large volumes of water during times of plenty, releasing it through the year; floodplains can absorb vast volumes of water during peak flows; coastal ecosystems can hold out against storms, attenuating waves and reducing erosion. Other ecosystem services—such as food provision, timber, materials, medicines, and recreation—can provide a buffer to societies in the face of changing conditions.

Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change. This includes the sustainable management, conservation and restoration of specific ecosystems that provide key services.

13.6 CLIMATE CHANGE IMPACTS ON HAZARDS

The following sections provide information on how each identified hazard of concern for this planning process may be impacted by climate change and how these impacts may alter current exposure and vulnerability for the people, property, critical facilities, and the environment in the planning area to these hazards.

13.6.1 Drought

Impacts on the Hazard

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure.

With a warmer climate, droughts could become more frequent, more severe, and longer lasting. According to the National Climate Assessment, “higher surface temperatures brought about by global warming increase the potential for drought. Evaporation and the higher rate at which plants lose moisture through their leaves both increase with temperature. Unless higher evapotranspiration rates are matched by increases in precipitation, environments will tend to dry, promoting drought conditions” (Globalchange.gov, 2014). Because expected changes in precipitation patterns are still uncertain, the potential impacts and likelihood of drought are uncertain.

Critical Facilities

Critical facility exposure and vulnerability are unlikely to increase as a result of increased drought resulting from climate change; however, critical facility operators may need to alter standard management practices and actively manage resources, particularly in water-related service sectors.

13.6.2 Earthquake

Impacts on the Hazard

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity, according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms or heavy precipitation could experience liquefaction or an increased propensity for slides during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events.

Critical Facilities

Because impacts on the earthquake hazard are not well understood, increases in exposure and vulnerability of local resources are not able to be determined.

13.6.3 Flood

Impacts on the Hazard

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain areas to contribute to peak storm runoff. High frequency flood events (e.g. 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 1-percent-annual-chance flood may become more likely, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, bypass channels and levees, as well as the design of local sewers and storm drains.

Critical Facilities

Critical facility exposure and vulnerability may increase as a result of climate change impacts on the flood hazard. Runoff patterns may change resulting in risk to facilities that have not historically been at risk from flooding. Additionally, changes in the management and design of flood protection critical facilities may be needed as additional stress is placed on these systems.

13.6.4 Landslide

Climate Change Impacts on the Hazard

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature is likely to affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

Critical Facilities

Critical facility exposure and vulnerability would be unlikely to increase as a result of climate change impacts on the landslide hazard; however, critical facility owners and operators may experience more frequent disruption to service provision as a result of landslide hazards. For example, transportation systems may experience more frequent delays if slides blocking these systems occur more frequently. In addition, increased sedimentation resulting from landslides may negatively impact flood control facilities, such as dams.

13.6.5 Severe Weather

Impacts on the Hazard

Climate change presents a challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily in recent decades (see Figure 13-5). Historical data shows that the probability for severe weather events increases in a warmer climate.

Source: Munich RE, 2020

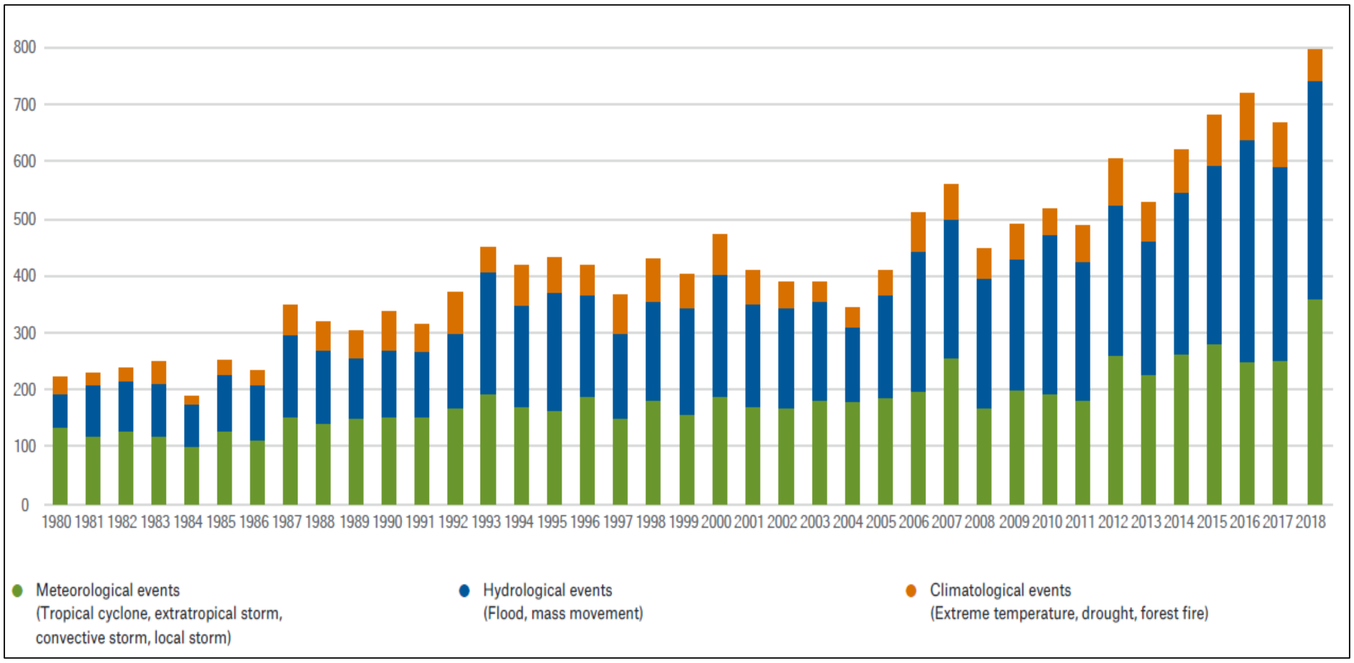


Figure 13-5. Worldwide Natural Catastrophe Events, 1980 – 2018

This increase in average surface temperatures can also lead to more intense heat waves that can be exacerbated in urbanized areas by what is known as urban heat island effect. The evidence suggests that heat waves are already increasing, especially in western states.

Critical Facilities

Critical facility exposure and vulnerability would be unlikely to increase as a result of climate change impacts on the severe weather hazard; however, critical facility operators may experience more frequent disruptions. For example, more frequent and intense storms may cause more frequent disruptions in power service.

13.6.6 Wildfire

Impacts on the Hazard

Wildfire is determined by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. Additionally, changes in climate patterns may impact the distribution and perseverance of insect outbreaks that create dead trees (increase fuel). When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Critical Facilities

Larger, more severe, more frequent fires may impact the people, property, and critical facilities by increasing the risk of ignition from nearby fire sources. Additionally, secondary impacts such as air quality issues may increase.

14. RISK RANKING

FEMA requires all hazard mitigation planning to have jurisdiction-specific mitigation actions based on local risk, vulnerability, and community priorities (FEMA, 2011). This plan includes a risk ranking protocol for the District, in which "risk" was calculated by multiplying probability by impact on people, property and the District's continuity of operations following the hazard events assessed. The risk estimates were generated using methodologies promoted by FEMA. The Steering Committee reviewed, discussed and approved the methodology and results.

Numerical ratings of probability and impact were based on the hazard profiles and exposure and vulnerability evaluations presented in Chapters 7 through 12. Using that data, the Core Planning Team ranked the risk of all the natural hazards of concern described in this plan. When available, estimates of risk were generated with data from Hazus or GIS. For hazards of concern with less specific data available, qualitative assessments were used. As appropriate, results were adjusted based on local knowledge and other information not captured in the quantitative assessments. The hazards of interest described in Chapter 15 were not ranked for the following reasons:

- A key component of risk as defined for the planning effort is probability of occurrence. While it is possible to assign a recurrence interval for natural hazards because of historical occurrence, it is not feasible to assign recurrence intervals for the other hazards of interest, which lack such historical precedent.
- Federal hazard mitigation planning regulations do not require the assessment of non-natural hazards (44 CFR, 201.6). It is FEMA's position that this is a local decision.

Risk ranking results are used to help establish mitigation priorities. The District used these rankings to inform the identification and prioritization of actions for the plan. The District chose to identify mitigation actions, at a minimum, to address each hazard with a "high" or "medium" risk ranking. Actions that address hazards with a low or no hazard ranking are optional.

14.1 PROBABILITY OF OCCURRENCE

A probability factor is assigned based on how often a hazard is likely to occur. The probability of occurrence of a hazard event is generally based on past hazard events in an area, although weight can be given to expected future probability of occurrence based on established return intervals, changing climate conditions, and knowledge of local conditions. For example, if a jurisdiction has experienced two damaging floods in the last 25 years, the probability of occurrence is high for flooding and scores a 3 under this category. If a jurisdiction has experienced no damage from landslides in the last 100 years, the probability of occurrence for landslide is low and scores a 1 under this category. Each hazard was assigned a probability factor as follows:

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)

- Medium—Hazard event is likely to occur within 100 years (Probability Factor = 2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor = 1)
- None—If there is no exposure to a hazard, there is no probability of occurrence (Probability Factor = 0)

The assessment of hazard frequency is generally based on past hazard events in the area. Table 14-1 summarizes the probability assessment for each hazard of concern for this plan.

Table 14-1. Probability of Hazards

Hazard Event	Probability (high, medium, low)	Probability Factor
Drought	High	3
Earthquake	High	3
Flood	High	3
Landslide/debris flow	High	3
Severe Weather	High	3
Wildfire	High	3

14.2 IMPACT

The impact of each hazard is divided into three categories: impacts on people, impacts on District property and assets, and impacts on the continuity of District operations. These categories are also assigned weighted values. Impact on people was assigned a weighting factor of 3, impact on property was assigned a weighting factor of 2 and impact on the economy was assigned a weighting factor of 1.

- **People**—Values are assigned based on the percentage of the total population exposed in your service area to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. Impact factors were assigned as follows:
  - High—25 percent or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium—10 percent to 24 percent of the population is exposed to a hazard (Impact Factor = 2)
  - Low—9 percent or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the population is exposed to a hazard (Impact Factor = 0)
- **Property**—Values are assigned based on the percentage of the total District assets exposed to the hazard event:
  - High—25 percent or more of the total replacement value of assets is exposed to a hazard (Impact Factor = 3)
  - Medium—10 percent to 24 percent of the total replacement value of assets is exposed to a hazard (Impact Factor = 2)
  - Low—9 percent or less of the total replacement value of assets is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the total replacement value is exposed to a hazard (Impact Factor = 0)
- **Continuity of Operations**—Impact on water and sewer operations are assessed based on estimates of how long it will take CVWD to become 100-percent operable after a hazard event. The estimated functional downtime for critical facilities has been subjectively assigned an impact as follows:
  - High—Functional downtime of 365 days or more (Impact Factor = 3)

- Medium—Functional downtime of 180 to 364 days (Impact Factor = 2)
- Low—Functional downtime of 180 days or less (Impact Factor = 1)
- No impact—No functional downtime is estimated from the hazard (Impact Factor = 0).

Table 14-2 summarizes the impacts for each hazard.

Table 14-2. Hazard Impact on People, Property and Operations

Hazard Event	People (Weighting Factor = 3)		Property (Weighting Factor = 2)		Operations (Weighting Factor = 1)	
	Impact / Score	Weighted Score	Impact / Score	Weighted Score	Impact / Score	Weighted Score
Drought	Low / 1	3	High / 3	6	High / 3	3
Earthquake	High / 3	9	High / 3	6	Low / 1	1
Flood	Low / 1	3	Low / 1	2	Low / 1	1
Landslide	Medium / 2	6	High / 3	6	Low / 1	1
Severe Weather	Medium / 2	6	Low / 1	2	Low / 1	1
Wildfire	Medium / 2	6	Medium / 2	4	Medium / 2	2

14.3 RISK RATING AND RANKING

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors for people, property, and continuity of operations, as summarized in Table 14-3.

Table 14-3. Hazard Risk Rating

Hazard Event	Probability Factor	Sum of Weighted Impact Factors	Total (Probability x Impact)
Drought	3	(3+6+3) = 12	3x12=36
Earthquake	3	(9+6+1) = 16	3x16=48
Flood	3	(3+2+1) = 6	3x6=18
Landslide	3	(6+6+1) = 13	3x13=39
Severe Weather	3	(6+2+1) = 9	3x9=27
Wildfire	3	(6+4+2) = 12	3x12 =36

Based on these ratings, a priority of high, medium, or low was assigned to each hazard. Generally, score of 30 or greater receive a "high" rating, score between 15 and 29 receive a "medium" rating, and score of less than 15 receives a "low" rating. The hazards ranked as being of highest concern are earthquake and severe weather. Hazards ranked as being of medium concern are landslide, flood, and wildfire. The hazards ranked as being of lowest concern are drought and dam failure. Figure 14-1 shows the hazard risk ranking.

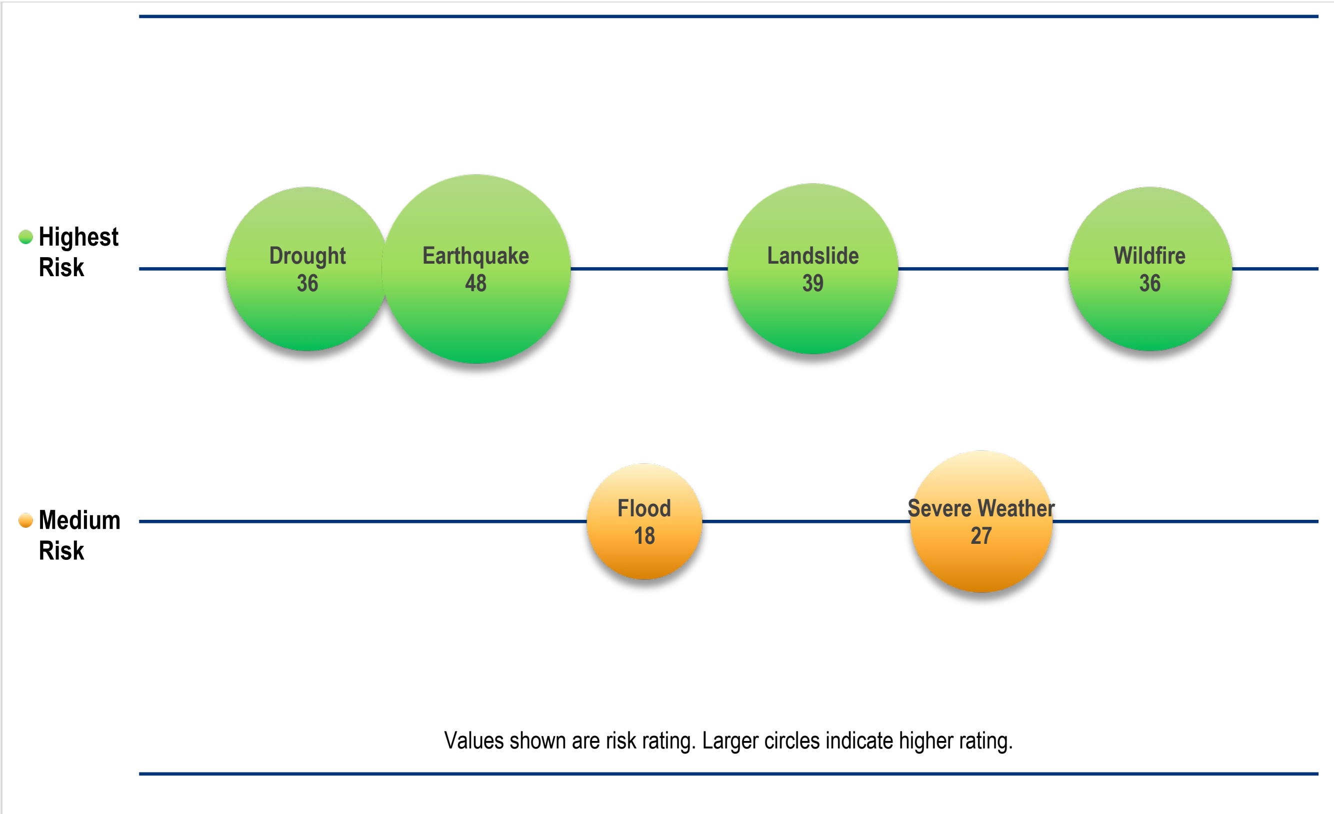


Figure 14-1. Hazard Risk Rating

15. OTHER HAZARDS OF INTEREST

The hazards of concern assessed in this plan are those that present significant risks in the CVWD service area. Additional hazards, both natural and human-caused, were identified by the Steering Committee as having some potential to impact the planning area, but at a much lower risk level than the hazards of concern. These other hazards are identified as hazards of interest.

The sections below provide short profiles of each hazard of interest, including qualitative discussion of their potential to impact the District. No formal risk assessment of these hazards was performed, and no mitigation initiatives have been developed to address them. However, the District should be aware of these hazards and should take steps to reduce the risks they present whenever it is practical to do so.

15.1 CYBER-THREATS

This risk assessment includes cyber-attacks and cyber-terrorism under the single hazard of cyber-threats. While all cyber-terrorism is a form of cyber-attack, not all cyber-attacks are cyber-terrorism.

15.1.1 Background

Cyber-Attacks

A cyber-attack is an intentional and malicious crime that compromises the digital infrastructure of a person or organization, often for financial or terror-related reasons. Such attacks vary in nature and are perpetrated using digital mediums or sometimes social engineering to target human operators. Generally, attacks last minutes to days, but large-scale events and their impacts can last much longer. As information technology continues to grow in capability and interconnectivity, cyber-attacks become increasingly frequent and destructive. According to the Ponemon Institute's *2015 Cost of Cyber Crime*, the cost of cyber-crime in the U.S. is at an annual average of $15.4 million per company.

Cyber-threats differ by motive, attack type and perpetrator profile. Motives range from the pursuit of financial gain to political or social aims. Attack types include using viruses to erase entire systems, breaking into systems and altering files, using someone's personal computer to attack others, or stealing confidential information. Such threats having a wide range of effects on individuals, communities, and organizations (FEMA 2013).

Computer systems can experience a variety of cyber-attacks, from blanket malware infection to targeted attacks on system capabilities. Cyber-attacks seek to breach IT security measures designed to protect an individual or organization. The initial attack is followed by more severe attacks for the purpose of causing harm, stealing data, or financial gain. Organizations are prone to different types of attacks that can be either automated or targeted in nature. Table 15-1 describes the most common cyber-attack mechanisms faced by organizations today.

Table 15-1. Common Mechanisms for Cyber-Attacks

Type	Description
Advanced Persistent Threat (APT)	An attack in which the attacker gains access to a network and remains undetected. APT attacks are designed to steal data instead of cause damage.
Denial of Service Attacks	Attacks that focus on disrupting service to a network in which attackers send high volumes of data until the network becomes overloaded and can no longer function.
Drive-by Downloads	Malware is downloaded unknowingly by the victims when they visit an infected site.
Malvertising	Malware downloaded to a system when the victim clicks on an affected ad.
Man in the Middle	Man-in-the-Middle attacks mirror victims and endpoints for online information exchange. In this type of attack, the attacker communicates with the victims, who believe they are interacting with a legitimate endpoint website. The attacker is also communicating with the actual endpoint website by impersonating the victim. As the process goes through, the attacker obtains entered and received information from both the victim and endpoint.
Password Attacks	Third party attempts to crack a user's password and subsequently gain access to a system. Password attacks do not typically require malware, but rather stem from software applications on the attacker's system. These applications may use a variety of methods to gain access, including generating large numbers of generated guesses, or dictionary attacks, in which passwords are systematically tested against all of the words in a dictionary.
Phishing	Malicious email messages that ask users to click a link or download a program. Phishing attacks may appear as legitimate emails from trusted third parties.
Ransomware	Occurs when an individual downloads ransom malware, or ransomware, often through phishing or drive-by download, and the subsequent execution of code results in encryption of all data and personal files stored on the system. The victim then receives a message that demands a fee in the form of electronic currency or cryptocurrency, such as Bitcoin, for the decryption code
Socially Engineered Trojans	Programs designed to mimic legitimate processes (e.g. updating software, running fake antivirus software) with the end goal of human-interaction caused infection. When the victim runs the fake process, the Trojan is installed on the system.
Unpatched Software	Nearly all software has weak points that may be exploited by malware. Most common software exploitations occur with Java, Adobe Reader, and Adobe Flash. These vulnerabilities are often exploited as small amounts of malicious code are often downloaded via drive-by download.

Cyber-Terrorism

Cyber-terrorism is the use of computers and information, particularly over the Internet, to recruit others to an organization's cause, cause physical or financial harm, or cause a severe disruption of infrastructure service. Such disruptions can be driven by religious, political, or other motives. Like traditional terrorism tactics, cyber-terrorism seeks to evoke very strong emotional reactions, but it does so through information technology rather than a physically violent or disruptive action. Cyber-terrorism has three main types of objectives (Kostadinov 2012):

- **Organizational**—Cyber-terrorism with an organizational objective includes specific functions outside of or in addition to a typical cyber-attack. Terrorist groups today use the internet on a daily basis. This daily use may include recruitment, training, fundraising, communication, or planning. Organizational cyber-terrorism can use platforms such as social media as a tool to spread a message beyond country borders and instigate physical forms of terrorism. Additionally, organizational goals may use systematic attacks as a tool for training new members of a faction in cyber-warfare.
- **Undermining**—Cyber-terrorism with undermining as an objective seeks to hinder the normal functioning of computer systems, services, or websites. Such methods include defacing, denying, and exposing information. While undermining tactics are typically used due to high dependence on online structures to support vital operational functions, they typically do not result in grave consequences unless undertaken as part of a larger attack. Undermining attacks on computers include the following (Waldron 2011):

  - Directing conventional kinetic weapons against computer equipment, a computer facility, or transmission lines to create a physical attack that disrupts the reliability of equipment.
  - Using electromagnetic energy, most commonly in the form of an electromagnetic pulse, to create an electronic attack against computer equipment or data transmissions. By overheating circuitry or jamming communications, an electronic attack disrupts the reliability of equipment and the integrity of data.
  - Using malicious code directed against computer processing code, instruction logic, or data. The code can generate a stream of malicious network packets that disrupt data or logic by exploiting vulnerability in computer software, or a weakness in computer security practices. This type of cyber-attack can disrupt the reliability of equipment, the integrity of data, and the confidentiality of communications (Wilson 2008)

- **Destructive**—The destructive objective for cyber-terrorism is what organizations fear most. Through the use of computer technology and the Internet, the terrorists seek to inflict destruction or damage on tangible property or assets, and even death or injury to individuals. There are no cases of pure cyber-terrorism as of the date of this plan.

15.1.2 Profile

Location

This hazard is not geography-based. Attacks can originate from any computer to affect any other computer in the world. If a system is connected to the Internet or operating on a wireless frequency, it is susceptible to exploitation. Targets of cyber-attacks can be individual computers, networks, organizations, business sectors, or governments. Financial institutions and retailers are often targeted to extract personal and financial data that can be used to steal money from individuals and banks. The most affected sectors are finance, energy and utilities, and defense and aerospace, as well as communication, retail, and health care. Both public and private operations in Southern California are threatened on a near-daily basis by the millions of currently engineered cyberattacks developed to automatically seek technological vulnerabilities.

Frequency

Cyber-attacks are experienced on a daily basis, often without being noticed. Up-to-date virus protection software used in public and private sectors prevents most cyberattacks from becoming successful. Programs that promote public education on virus protection are an effective way to mitigate cyber-threats.

Severity

There is no index for measuring the severity of a cyber-attack. An international study released by Malwarebytes in 2016 found that cyber-ransom threats caused 34 percent of business victims to lose revenue and 20 percent had to stop business immediately. The study also reported that nearly 60 percent of all cyber-ransom attacks demanded over $1,000, over 20 percent asked for more than $10,000, and 1 percent asked for over $150,000.

Warning Time

There is no warning time for cyber-attacks. The top vector for spreading cyber-ransom threats is email.

15.1.3 Impacts

All critical assets operated by a computer system are exposed to cyber-attacks. A catastrophic cyber-attack can have far-ranging effects on District assets. All critical facilities operated by electricity and/or a computer system are vulnerable to cyber-attacks. Cyber-attacks may affect structures if any critical electronic systems suffer service disruption. For instance, a cyber-attack may cripple the electronic system that controls a cooling system or pressure system within critical infrastructure. This may result in physical damage to the structure from components overheating, or an explosion if pressure relief systems are rendered inoperable. Such failures may not be immediately recognizable as cyber-attacks, appearing at first to be attributable to mechanical malfunctions.

Economic impacts can be far-reaching if a cyber-attack is prolonged for a week or longer. Cyber-attacks can have extensive fiscal impacts. Companies and government services can lose large sums of unrecoverable revenue from site downtime and possible compromise of sensitive confidential data. Cyber-incidents could result in the theft or modification of important data—including personal, agency, or corporate information— and the sabotage of critical processes, including the provision of basic services by government or private-sector entities.

The District will continue to be impacted by cyber-attacks in the future. The nature of these attacks is projected to evolve in sophistication over time. The District has a vested interest is securing its cyber based systems. The reality remains that many computers and networks in organizations of all sizes and industries around the U.S. will continue to suffer intrusion attempts on a daily basis from viruses and malware that are passed through websites and emails.

The America's Water Infrastructure Act assessment that the District is currently performing includes a significant cyber security assessment and recommendations element. The District will integrate elements of this Hazard Mitigation Plan with the America's Water Infrastructure Act assessment as appropriate.

15.2 HAZARDOUS MATERIALS

15.2.1 Definition

A hazardous material is a substance or combination of substances that, because of quantity, concentration, or physical, chemical, or infectious characteristics, may cause or contribute to an increase in mortality or an increase in serious illness, or otherwise pose a hazard to human life, property, or the environment. According to the California State Hazard Mitigation Plan, hazardous materials are substances that are flammable, combustible, explosive, toxic, noxious, corrosive, an oxidizer, an irritant or radioactive. Title 49 of the CFR lists thousands of hazardous materials, including gasoline, insecticides, household cleaning products, and radioactive materials. Even the natural gas used in homes and businesses is a dangerous substance when a leak occurs. State-regulated substances that have the greatest probability of adversely impacting communities are listed in California Code Title 19.

Hazardous materials are present in nearly every city and county in the United States in facilities that produce, store, or use them:

- Fuel storage vessels (both in and above ground)
- Water treatment plants use chlorine to eliminate bacterial contaminants.
- Hazardous materials are transported along interstate highways and railways daily.

- The natural gas used in homes and businesses is a dangerous substance when a leak occurs.
- Many businesses, through intentional action, lack of awareness or accidental occurrences, have contamination in and around their property.

Hazardous material releases can pose a risk to life, public health, air quality, water quality and the environment. They may result in the evacuation of a facility or an entire neighborhood. In addition to the immediate risk, long-term public health and environmental impacts may result from sustained exposure to certain substances.

15.2.2 Types of Incidents

The following are the most common types of hazardous material incidents:

- **Fixed-Facility Hazardous Materials Incident**—This is the uncontrolled release from a fixed site of materials that pose a risk to health, safety, and property. It is possible to identify and prepare for fixed-site incidents because federal and state laws require those facilities to notify state and local authorities about materials being used or produced at the site.
- **Hazardous Materials Transportation Incident**—A hazardous materials transportation incident is any event during transport resulting in uncontrolled release of materials that can pose a risk to health, safety, and property. Transportation incidents are difficult to prepare for because there is little if any notice about what materials could be involved should an accident happen. Transported hazardous wastes include thousands of shipments of radiological materials moved across the United States by ground transportation, mostly medical materials, and low-level radioactive waste. Hazardous materials transportation incidents can occur on any transportation corridor, although most occur on interstate highways, other major federal or state highways, or major rail lines. Many incidents occur in sparsely populated areas and affect very few people. Others are in areas with much higher population densities, such as the January 6, 2005 train accident in Graniteville, South Carolina that released chlorine gas killing nine, injuring 500, and causing the evacuation of 5,400 residents.
- **Interstate Pipeline Hazardous Materials Incident**—There are a significant number of interstate natural gas, heating oil, and petroleum pipelines running through the State of California. These are used to provide natural gas to utilities and to transport these materials from production facilities to end-users.

Hazardous materials are likely accidently released or spilled numerous times each day. Eliminating these widespread substances would be nearly impossible, but the threat of accidental releases or spills may be reduced by mitigation. The following required mitigation efforts pertaining to hazardous substances are implemented through state and federal regulation:

- Fixed Facilities:
  - Process hazard analysis through the California Division of Occupational Safety and Health
  - Policies and procedures, hazard communication, and training
  - Placarding and labeling of containers
  - Hazard assessment
  - Security
  - Process and equipment maintenance
  - Mitigating techniques (flares, showers, mists, containment vessels, failsafe devices)
  - Use of inherently safer alternative products
  - Emergency plans and coordination
  - Response procedures

- Transported:
  - Placards and labeling of containers
  - Proper container for material type
  - Random inspections of transporters
  - Safe handling policies and procedures
  - Hazard communications
  - Training for handlers
  - Permitting
  - Transportation flow studies, e.g., restricting HAZMAT transportation over certain routes.

15.2.3 Oversight

Los Angeles County Public Works is a Unified Program Agency and a Participating Agency to the Los Angeles Los Angeles County Certified Unified Program Agency, which is managed by the Los Angeles County Fire Department Health Hazardous Materials Division.

The City of Glendale Fire Department oversees the Hazardous Material Business Plan Program in compliance with the state's Health and Safety Code (Chapter 6.95). It requires any business that uses, stores, or manufactures hazardous materials to file a Hazardous Material Business Plan with the Fire Department. CVWD complies with these requirements.

15.3 EPIDEMIC/PANDEMIC

An outbreak is defined by the U.S. Centers for Disease Control and Prevention (CDC) as the occurrence of more cases of disease than normally expected within a specific place or group of people over a given period of time. State and local regulations require immediate reporting of any known or suspected outbreaks by health care providers, health care facilities, laboratories, veterinarians, schools, child day care facilities, and food service establishments. An epidemic is a localized outbreak that spreads rapidly and affects a large number of people or animals in a community. A pandemic is an epidemic that occurs worldwide or over a very large area and affects a large number of people or animals.

Heath hazards may affect the District service area in various ways – bioterrorism, natural disaster, disease outbreak. Each of these situations could have impact on not only residents but also District staff. The District will work with local, state, and federal officials to ensure effective delivery of services during such situations.

NOTE REGARDING COVID-19

As this planning process was being completed, the State of California, including Crescenta Valley Water District, and the world have been affected by the COVID-19 pandemic for more than one year. COVID-19 is the disease caused by SARS-CoV-2 virus (severe acute respiratory syndrome coronavirus 2)

The impacts of this crisis have affected the way society prepares for and responds to pandemics. At the time of this plan, the District had minimal operational impact from COVID-19, with the exception of planning for the addition of office space to accommodate social distancing guidelines to enable remote distancing workers to return to the work site.

Data on the impacts from this pandemic and the development policies to respond are being reviewed at the time of this writing and have not been vetted enough to inform this plan update.

Part 3. Mitigation Plan

16. GOALS AND OBJECTIVES

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The Steering Committee established a set of goals and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The goals, objectives and actions in this plan all support each other. Objectives were selected that meet multiple goals. Actions were prioritized based on ability to accomplish multiple objectives.

16.1 GOALS

The following goals were set for this hazard mitigation plan:

1. Protect life and property
2. Maintain continuity of essential water and sewer services
3. Increase public awareness of the risks of loss of water/sewer service
4. Facilitate partnerships with recognized stakeholders within the Crescenta Valley and implement a coordination plan between the stakeholders
5. Protect local water supply sources
6. Protect against environmental consequences caused by water and sewer system failure initiated by natural hazards

16.2 OBJECTIVES

The Steering Committee members identified the following plan objectives:

1. Implement activities that assist in protecting lives by making CVWD's infrastructure, critical facilities, and other properties more resistant to natural hazards
2. Protect water quality and supply
3. Properly address aging infrastructure issues to reduce/minimize future hazards and disasters
4. Raise awareness and communicate to the Crescenta Valley Community about the risks to District assets
5. Leverage grant funding and low interest loan programs to implement hazard mitigation capital projects
6. Establish policies to ensure mitigation projects are prioritized for critical facilities, services, and infrastructure
7. Create, rehabilitate, enhance, and preserve local ecosystems to serve as natural hazard mitigation functions

17. MITIGATION BEST PRACTICES

Catalogs of hazard mitigation alternatives were developed that present a broad range of alternatives to be considered for use in the planning area, in compliance with 44 CFR (Section 201.6(c)(3)(ii)). One catalog was developed for each natural hazard of concern evaluated in this plan. The catalogs present alternatives that are categorized in two ways:

- Who would have responsibility for implementation:
  - Individuals (personal scale)
  - Businesses (corporate scale)
  - Government (government scale).
- What the alternative would do:
  - Manipulate the flooding hazard
  - Reduce exposure to the flooding hazard
  - Reduce vulnerability to the flooding hazard
  - Increase the ability to respond to or be prepared for the flooding hazard.

The catalogs list mitigation actions that might be able to reduce the risk of hazards in the planning area. They show a baseline set of alternatives that are backed by a planning process and are consistent with plan goals and objectives. Mitigation actions recommended in this plan were selected from among the alternatives. The following actions in the catalog would generally not be selected as recommended mitigations for this plan:

- Any action that is not feasible
- Any action that is already being implemented
- Any action for which there is an apparently more cost-effective alternative
- Any government action that is beyond the capabilities of the District to implement (government actions in the catalogs are generic to all forms of government, and may not fall within the responsibilities of a water or sewer district)
- Any government action that does not have public or political support

The catalogs for each hazard of concern are presented in Table 17-1 through Table 17-6.

Table 17-1. Alternatives to Mitigate the Drought Hazard

Personal-Scale	Corporate-Scale	Government-Scale[a]
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Drought-resistant landscapes ❖ Reduce water system losses ❖ Modify plumbing systems (through water saving kits) • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice active water conservation	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Drought-resistant landscapes ❖ Reduce private water system losses • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice active water conservation	• **Manipulate the hazard:** ❖ Groundwater recharge through stormwater management • **Reduce exposure to the hazard:** ❖ Identify and create groundwater backup sources • **Reduce vulnerability to the hazard:** ❖ Water use conflict regulations ❖ Reduce water system losses ❖ Distribute water saving kits • **Increase the ability to respond to or be prepared for the hazard:** ❖ Public education on drought resistance ❖ Encourage recycling ❖ Identify alternative water supplies for times of drought, mutual aid agreements with alternative suppliers ❖ Develop drought contingency plan ❖ Develop criteria "triggers" for drought-related actions ❖ Improve accuracy of water supply forecasts ❖ Modify rate structure to influence active water conservation techniques ❖ Increase emergency storage capacity

a. These catalogs are generic and are not specific to the District. Many of the government-scale alternatives listed are beyond the range of responsibilities of a water or sewer district.

Table 17-2. Alternatives to Mitigate the Earthquake Hazard

Personal-Scale	Corporate-Scale	Government-Scale[a]
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area (off soft soils) • **Reduce vulnerability to the hazard:** ❖ Retrofit structure (anchor house structure to foundation) ❖ Secure household items that can cause injury or damage (such as water heaters, bookcases, and other appliances) ❖ Build to higher design • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice "drop, cover, and hold" ❖ Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72-hour self-sufficiency during an event ❖ Keep cash reserves for reconstruction ❖ Become informed on the hazard and risk reduction alternatives available. ❖ Develop a post-disaster action plan for your household	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate or relocate mission-critical functions outside hazard area where possible • **Reduce vulnerability to the hazard:** ❖ Build redundancy for critical functions and facilities ❖ Retrofit critical buildings and areas housing mission-critical functions • **Increase the ability to respond to or be prepared for the hazard:** ❖ Adopt higher standard for new construction; consider "performance-based design" when building new structures ❖ Keep cash reserves for reconstruction ❖ Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. ❖ Develop a continuity of operations plan	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate critical facilities or functions outside hazard area where possible • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure ❖ Provide redundancy for critical functions ❖ Adopt higher regulatory standards ❖ Perform seismic retrofits for vulnerable critical buildings and areas • **Increase the ability to respond to or be prepared for the hazard:** ❖ Provide better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (e.g., tax incentives, information) ❖ Include retrofitting and replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components such as pipe, spare well pumps, power line, and road repair materials ❖ Develop and adopt a continuity of operations plan ❖ Initiate triggers guiding improvements (such as <50% substantial damage or improvements) ❖ Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. ❖ Develop a post-disaster action plan that includes grant funding and debris removal components.

a. These catalogs are generic and are not specific to the District. Many of the government-scale alternatives listed are beyond the range of responsibilities of a water or sewer district.

Table 17-3. Alternatives to Mitigate the Flood Hazard

Personal-Scale	Corporate-Scale	Government-Scale[a]
• **Manipulate the hazard:** ❖ Clear storm drains and culverts ❖ Use low-impact development • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area ❖ Elevate utilities above base flood elevation ❖ Use low-impact development techniques • **Reduce vulnerability to the hazard:** ❖ Raise structures above base flood elevation ❖ Elevate items within house above base flood elevation ❖ Build new homes above base flood elevation ❖ Flood-proof structures • **Increase the ability to respond to or be prepared for the hazard:** ❖ Buy flood insurance ❖ Develop household plan, such as retrofit savings, communication, 72-hour self-sufficiency during and after an event	• **Manipulate the hazard:** ❖ Clear storm drains and culverts ❖ Use low-impact development • **Reduce exposure to the hazard:** ❖ Locate critical facilities outside hazard area ❖ Use low-impact development techniques • **Reduce vulnerability to the hazard:** ❖ Build critical function redundancy or retrofit critical buildings ❖ Provide flood-proofing when new critical infrastructure must be located in floodplains • **Increase the ability to respond to or be prepared for the hazard:** ❖ Keep cash reserves for reconstruction ❖ Support and implement hazard disclosure for sale of property in risk zones. ❖ Solicit cost-sharing through partnerships on projects with multiple benefits.	• **Manipulate the hazard:** ❖ Maintain drainage system ❖ Institute low-impact development techniques on property ❖ Dredging, levee construction, and providing regional retention areas ❖ Structural flood control, levees, channelization, or revetments. ❖ Stormwater management regulations and master planning ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff • **Reduce exposure to the hazard:** ❖ Locate or relocate critical facilities outside of hazard area ❖ Acquire or relocate identified repetitive loss properties ❖ Promote open space uses in high hazard areas via techniques such as planned unit developments, easements, setbacks, greenways, sensitive area tracks. ❖ Adopt development criteria such as planned unit developments, density transfers, clustering ❖ Institute low impact development techniques on property ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure, bridge replacement program ❖ Provide redundancy for critical functions and infrastructure ❖ Adopt regulations for freeboard, cumulative substantial improvement, substantial damage, compensatory storage, non-conversion deed restrictions. ❖ Stormwater management regulations and master planning. ❖ Adopt "no-adverse impact" floodplain management policies that strive to not increase the flood risk on downstream communities. • **Increase the ability to respond to or be prepared for the hazard:** ❖ Produce better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) ❖ Incorporate retrofitting or replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components ❖ Develop and adopt a continuity of operations plan ❖ Maintain and collect data to define risks and vulnerability ❖ Train emergency responders ❖ Create an elevation inventory of structures in the floodplain ❖ Develop and implement a public information strategy ❖ Charge a hazard mitigation fee ❖ Integrate floodplain management policies into other planning mechanisms within the planning area. ❖ Consider climate change impacts on the risk associated with the flood hazard ❖ Consider the residual risk associated with structural flood control in future land use decisions ❖ Enforce National Flood Insurance Program ❖ Adopt a Stormwater Management Master Plan

a. These catalogs are generic and are not specific to the District. Many of the government-scale alternatives listed are beyond the range of responsibilities of a water or sewer district.

Table 17-4. Alternatives to Mitigate the Landslide Hazard

Personal-Scale	Corporate-Scale	Government-Scale[a]
• **Manipulate the hazard:** ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope ❖ Minimize vegetation removal and the addition of impervious surfaces. • **Reduce exposure to the hazard:** ❖ Locate structures outside of hazard area (off unstable land and away from slide-run out area) • **Reduce vulnerability to the hazard:** ❖ Retrofit home • **Increase the ability to respond to or be prepared for the hazard:** ❖ Institute warning system, and develop evacuation plan ❖ Keep cash reserves for reconstruction ❖ Educate yourself on risk reduction techniques for landslide hazards	• **Manipulate the hazard:** ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope • **Reduce exposure to the hazard:** ❖ Locate structures outside of hazard area (off unstable land and away from slide-run out area) • **Reduce vulnerability to the hazard:** ❖ Retrofit at-risk facilities • **Increase the ability to respond to or be prepared for the hazard:** ❖ Institute warning system, and develop evacuation plan ❖ Keep cash reserves for reconstruction ❖ Develop a continuity of operations plan ❖ Educate employees on the potential exposure to landslide hazards and emergency response protocol.	• **Manipulate the hazard:** ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope • **Reduce exposure to the hazard:** ❖ Acquire properties in high-risk landslide areas. ❖ Adopt land use policies that prohibit the placement of habitable structures in high-risk landslide areas. • **Reduce vulnerability to the hazard:** ❖ Adopt higher regulatory standards for new development within unstable slope areas. ❖ Armor/retrofit critical infrastructure against the impact of landslides. • **Increase the ability to respond to or be prepared for the hazard:** ❖ Produce better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas: better land controls, tax incentives, information ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components ❖ Develop and adopt a continuity of operations plan ❖ Educate the public on the landslide hazard and appropriate risk reduction alternatives.

a. These catalogs are generic and are not specific to the District. Many of the government-scale alternatives listed are beyond the range of responsibilities of a water or sewer district.

Table 17-5. Alternatives to Mitigate the Severe Weather Hazard

Personal-Scale	Corporate-Scale	Government-Scale[a]
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Insulate house ❖ Provide redundant heat and power ❖ Insulate structure ❖ Plant appropriate trees near home and power lines ("Right tree, right place" National Arbor Day Foundation Program) • **Increase the ability to respond to or be prepared for the hazard:** ❖ Trim or remove trees that could affect power lines ❖ Promote 72-hour self-sufficiency ❖ Obtain a NOAA weather radio. ❖ Obtain an emergency generator.	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Relocate critical infrastructure (such as power lines) underground ❖ Reinforce or relocate critical infrastructure such as power lines to meet performance expectations ❖ Install tree wire • **Increase the ability to respond to or be prepared for the hazard:** ❖ Trim or remove trees that could affect power lines ❖ Create redundancy ❖ Equip facilities with a NOAA weather radio ❖ Equip vital facilities with emergency power sources.	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure such as locating utilities underground ❖ Trim trees back from power lines ❖ Consider "cool roofs" and "green roofs" • **Increase the ability to respond to or be prepared for the hazard:** ❖ Support programs such as "Tree Watch" that proactively manage problem areas through use of selective removal of hazardous trees, tree replacement, etc. ❖ Establish and enforce building codes that require all roofs to withstand snow loads ❖ Increase communication alternatives ❖ Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors. ❖ Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines ❖ Provide NOAA weather radios to the public

a. These catalogs are generic and are not specific to the District. Many of the government-scale alternatives listed are beyond the range of responsibilities of a water or sewer district.

Table 17-6. Alternatives to Mitigate the Wildfire Hazard

Personal-Scale	Corporate-Scale	Government-Scale[a]
• **Manipulate the hazard:** ❖ Clear potential fuels on property such as dry overgrown underbrush and diseased trees • **Reduce exposure to the hazard:** ❖ Create and maintain defensible space around structures ❖ Locate outside of hazard area ❖ Mow regularly • **Reduce vulnerability to the hazard:** ❖ Create and maintain defensible space around structures and provide water on site ❖ Use fire-retardant building materials ❖ Create defensible spaces around home • **Increase the ability to respond to or be prepared for the hazard:** ❖ Employ techniques from the National Fire Protection Association's Firewise Communities program to safeguard home ❖ Identify alternative water supplies for fire fighting ❖ Install/replace roofing material with non-combustible roofing materials.	• **Manipulate the hazard:** ❖ Clear potential fuels on property such as dry underbrush and diseased trees • **Reduce exposure to the hazard:** ❖ Create and maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area • **Reduce vulnerability to the hazard:** ❖ Create and maintain defensible space around structures and infrastructure and provide water on site ❖ Use fire-retardant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. • **Increase the ability to respond to or be prepared for the hazard:** ❖ Support Firewise community initiatives. ❖ Create /establish stored water supplies to be utilized for firefighting.	• **Manipulate the hazard:** ❖ Clear potential fuels on property such as dry underbrush and diseased trees ❖ Implement best management practices on public lands. • **Reduce exposure to the hazard:** ❖ Create and maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area ❖ Enhance building code to include use of fire resistant materials in high hazard area. • **Reduce vulnerability to the hazard:** ❖ Create and maintain defensible space around structures and infrastructure ❖ Use fire-retardant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. ❖ Consider higher regulatory standards (such as Class A roofing) ❖ Establish biomass reclamation activities • **Increase the ability to respond to or be prepared for the hazard:** ❖ More public outreach and education efforts, including an active Firewise program ❖ Possible weapons of mass destruction funds available to enhance fire capability in high-risk areas ❖ Identify fire response and alternative evacuation routes ❖ Seek alternative water supplies ❖ Become a Firewise community ❖ Use academia to study impacts/solutions to wildfire risk ❖ Establish/maintain mutual aid agreements between fire service agencies. ❖ Create/implement fire plans ❖ Consider the probable impacts of climate change on the risk associated with the wildfire hazard in future land use decisions

a. These catalogs are generic and are not specific to the District. Many of the government-scale alternatives listed are beyond the range of responsibilities of a water or sewer district.

18. MITIGATION ACTIONS

18.1 RECOMMENDED MITIGATION ACTIONS

The Steering Committee selected actions to be included in a hazard mitigation action plan based on the risk assessment of identified hazards of concern and the defined hazard mitigation goals and objectives. Table 18-1 lists the recommended hazard mitigation actions that make up the action plan (actions are not listed by priority in this table; prioritization is described below). The timeframe indicated in the table is defined as follows:

- Short-term = Completion within 5 years
- Long-term = Completion within 10 years

Table 18-1. Hazard Mitigation Action Plan Matrix

Applies to New or Existing Assets	Objectives Met	Lead Agency	Support Agency	Estimated Cost	Sources of Funding	Timeline
Action #1 -- Acquire stationary emergency electric generators for Main Booster Stations (2 total)						
Hazards Mitigated: Earthquake, Flood, Wildfire, Severe Weather, Landslide						
New	1,2,5	CVWD	N/A	High ($1.1 Million)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #2 – Acquire stationary emergency electric generators for well sites (5 total sites)						
Hazards Mitigated: Earthquake, Flood, Wildfire, Sever Weather, Landslide						
New	1,2,5	CVWD	N/A	Med ($885,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #3 – Acquire portable emergency electric generators for booster stations (4 total)						
Hazards Mitigated: Earthquake, Flood, Wildfire, Severe Weather, Landslide						
New	1,2,5	CVWD		Low ($475,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #4 – Acquire portable emergency electric generators for well sites (4 total)						
Hazards Mitigated: Earthquake, Flood, Wildfire, Severe Weather, Landslide						
New	1,2,5	CVWD		Low ($140,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #5 – Install seismic sensors and value actuators on reservoir inlet/outlet valves (4 sites)						
Hazards Mitigated: Earthquake						
New	1,2,3,4,5	CVWD	N/A	Med ($320,000)	FEMA HMA Grant funding, District Funds	Short term
Action #6 – Installation of security cameras at reservoir and well sites (88 cameras total)						
Hazards Mitigated: Earthquake, wildfire, severe weather, landslide, flood						
New	1,2,4,5	CVWD	N/A	Low ($175,000)	Homeland Security Grant Program, EMPG, District Funds	Long Term
Action #7 – Installation of an emergency chlorine / ammonia portable station						
Hazards Mitigated Earthquake, wildfire, severe weather, landslide						
New	1,2	CVWD	N/A	Low ($125,000)	District funds, EPA grant funding	Long term

Applies to New or Existing Assets	Objectives Met	Lead Agency	Support Agency	Estimated Cost	Sources of Funding	Timeline
Action #8 – Conduct seismic evaluation study of existing CVWD building (4 buildings)						
Hazards Mitigated:	Earthquake					
New	1,3,4,6	CVWD	N/A	Low ($110,000)	District funds, FEMA HMA grant funding	Short term
Action #9 – Seismically upgrade CVWD buildings						
Hazards Mitigated:	Earthquake					
New	1,3,4,7	CVWD	N/A	High ($2.1 Million)	FEMA HMA Grant funding, District Funds for Local Match	Long term
Action #10 – Repair slope and inlet/outlet pipeline at Edmund #2 Reservoir						
Hazards Mitigated:	Earthquake, wildfire, landslide					
New	1,2,3,4	CVWD	N/A	High ($170,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #11 – Replace above ground outlet pipe at Gross Canyon Reservoir such that it will mitigate the future impacts from Earthquake, Landslide and Wildfire events.						
Hazards Mitigated:	Earthquake, wildfire, landslide					
New	1,2,3,4	CVWD		High ($225,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #12 – Conduct feasibility study for relocation / upgrades to access roads at reservoirs						
Hazards Mitigated:	Earthquake, wildfire, sever weather, landslide, flood					
Existing	1,3,4,5,6	CVWD		Low ($95,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #13 – Relocate access roadway at Pickens Canyon Reservoir						
Hazards Mitigated:	Earthquake, wildfire, landslide, flood					
Existing	1,3,4	CVWD		High ($2.1 Million)	FEMA HMA Grant funding, District Funds for Local Match	Long Term
Action #14 – Retrofit access road to Edmund #2 Reservoir						
Hazards Mitigated:	Earthquake, wildfire, landslide, flood					
Existing	1,3,4	CVWD		High ($1.15 million)	FEMA HMA Grant funding, District Funds for Local Match	Long Term
Action #15 – Retrofit access roadway at Shields Reservoir						
Hazards Mitigated:	Earthquake, wildfire, landslide, flood					
New and Existing	1,3,4	CVWD		High ($850,000)	FEMA HMA Grant funding, District Funds for Local Match	Long term
Action #16 – Retrofit CVWD / La Cañada Irrigation District interconnection at Canalda Dr.						
Hazards Mitigated:	Drought, Earthquake, wildfire, severe weather, landslide					
New	1,2,3,4	CVWD	N/A	Med ($75,000)	FEMA HMA Grant funding, District Funds for Local Match	Long term
Action #17 – Install emergency interconnection pipeline among Glendale/FMWD/CVWD						
Hazards Mitigated:	Drought, Earthquake, wildfire, Flood					
New and Existing	1,2,3,4,5	CVWD	FMWD, Glendale	High ($1.35 Million)	District funds, grant funding	Long term
Action #18 – Conduct feasibility study for sewer bypass system for large diameter pipeline with Glendale						
Hazards Mitigated:	Earthquake, wildfire, landslide, flood					
New	1,3,4,6	CVWD	Glendale	Low ($55,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #19 – Install sewer bypass system for large diameter pipeline with Glendale						
Hazards Mitigated:	Earthquake, wildfire, landslide, flood					
New	1,2,3,4,	CVWD	Glendale	High ($2.25 million)	FEMA HMA Grant funding, District Funds for Local Match	Long term

Applies to New or Existing Assets	Objectives Met	Lead Agency	Support Agency	Estimated Cost	Sources of Funding	Timeline
Action #20 – Conduct feasibility study of protection of water & sewer pipeline within Caltrans Bridge Freeway crossing						
Hazards Mitigated:	Earthquake					
New	1,3,4,6	CVWD	N/A	Low ($75,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #21 – Conduct feasibility study for new water storage facility and pipeline crossings of Pickens Canyon						
Hazards Mitigated:	Drought, Earthquake, wildfire, landslide, flood					
New and Existing	1,3,4,6	CVWD		Low ($95,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #22 – Conduct feasibility study for pipeline crossing of LA County Flood Control Channels						
Hazards Mitigated:	Earthquake, wildfire, landslide, flood					
New	1,3,4,6	CVWD	N/A	Low ($75,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term
Action #23 – Develop Emergency Community Water Fulfillment Center						
Hazards Mitigated:	Drought, Earthquake, wildfire, landslide, flood					
New	1,3,4	CVWD		Low ($50,000)	FEMA HMA Grant funding, District Funds for Local Match	Short term

18.2 ACTION PLAN PRIORITIZATION

The actions recommended in the action plan were prioritized based on the following factors:

- Cost and availability of funding
- Benefit, based on likely risk reduction to be achieved
- Number of plan objectives achieved
- Timeframe for project implementation
- Eligibility for grand funding programs

Two priorities were assigned for each action:

- A high, medium, or low priority for implementing the action
- A high, medium, or low priority for pursuing grant funding for the action.

The sections below describe the analysis of benefits and costs and the assignment of the two priority ratings.

18.2.1 Benefit/Cost Review

The action plan must be prioritized according to a benefit/cost analysis of the proposed actions (44 CFR, Section 201.6(c)(3)(iii)). For this hazard mitigation plan, a qualitative benefit-cost review was performed for each action by assigning ratings for benefit and cost as follows:

- Cost:
  - **High**—Existing funding will not cover the cost of the action; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee or rate increases).
  - **Medium**—The action could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the action would have to be spread over multiple years.

  - **Low**—The action could be funded under the existing budget. The action is part of or can be part of an ongoing existing program.
- Benefit:
  - **High—**Action will provide an immediate reduction of risk exposure for life and property.
  - **Medium—**Action will have a long-term impact on the reduction of risk exposure for life and property, or action will provide an immediate reduction in the risk exposure for property.
  - **Low—**Long-term benefits of the action are difficult to quantify in the short term.

To assign priorities, each action with a benefit rating equal to or higher than its cost rating (such as high benefit/medium cost, medium benefit/medium cost, medium benefit/low cost, etc.) was considered to be cost-beneficial. This is not the detailed level of benefit/cost analysis required for some FEMA hazard-related grant programs. Such analysis would be performed at the time a given action is being submitted for grant funding.

18.2.2 Implementation Priority

Implementation priority ratings were assigned as follows:

- **High Priority**—An action that meets multiple objectives, has benefits that exceed costs, and has a secured source of funding. Action can be completed in the short term (1 to 5 years).
- **Medium Priority**—An action that meets multiple objectives, has benefits that exceed costs, and is eligible for funding though no funding has yet been secured for it. Action can be completed in the short term (1 to 5 years), once funding is secured. Medium-priority actions become high-priority actions once funding is secured.
- **Low Priority**—An action that will mitigate the risk of a hazard, has benefits that do not exceed the costs or are difficult to quantify, has no secured source of funding, and is not eligible for any known grant funding. Action can be completed in the long term (1 to 10 years). Low-priority actions may be eligible for grant funding from programs that have not yet been identified.

18.2.3 Grant Pursuit Priority

Grant pursuit priority ratings were assigned as follows:

  - **High Priority**—An action that meets identified grant eligibility requirements, has high benefits, and is listed as high or medium implementation priority; local funding options are unavailable or available local funds could be used instead for actions that are not eligible for grant funding.
  - **Medium Priority**—An action that meets identified grant eligibility requirements, has medium or low benefits, and is listed as medium or low implementation priority; local funding options are unavailable.
  - **Low Priority**—An action that has not been identified as meeting any grant eligibility requirements.

18.2.4 Prioritization Summary for Mitigation Actions

Table 18-2 lists the priority of each recommended action.

Table 18-2. Mitigation Action Priority

Action #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant-Eligible?	Can Project Be Funded Under Existing Programs/ Budgets?	Implementation Priority	Grant Pursuit Priority
1	3	High	High	Yes	Yes	No	Medium	High
2	3	High	Med	Yes	Yes	No	Medium	High
3	3	High	Low	Yes	Yes	No	Medium	High
4	3	High	Low	Yes	Yes	No	Medium	High
5	5	High	Med	Yes	Yes	No	Medium	Low
6	4	High	Low	Yes	Yes	No	Medium	Low
7	2	High	Low	Yes	Yes	Yes	High	Low
8	4	High	Low	Yes	Yes	Yes	High	Low
9	4	High	High	Yes	Yes	No	Medium	Low
10	4	High	High	Yes	Yes	No	Medium	Medium
11	4	High	High	Yes	Yes	No	Medium	Medium
12	5	High	Low	Yes	Yes	Yes	High	Low
13	3	High	High	Yes	Yes	No	Medium	Medium
14	3	High	High	Yes	Yes	No	Low	Low
15	3	High	High	Yes	Yes	No	Low	Low
16	4	High	Med	Yes	Yes	Yes	High	Low
17	5	High	High	Yes	Yes	No	Medium	Medium
18	4	High	Low	Yes	Yes	Yes	High	Low
19	4	High	High	Yes	Yes	No	Medium	Medium
20	4	Med	Low	Yes	Yes	Yes	High	Low
21	4	Med	Low	Yes	Yes	Yes	High	Low
22	4	Med	Low	Yes	Yes	Yes	High	Low
23	3	Med	Low	Yes	Yes	No	Low	Low

18.3 CLASSIFICATION OF MITIGATION ACTIONS

Each recommended action was classified based on the hazard it addresses and the type of mitigation it involves. Table 18-3 shows these classifications. Mitigation types used for this categorization are as follows:

- **Prevention**—Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. Includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection**—Modification of buildings or structures to protect them from a hazard or removal of structures from a hazard area. Includes acquisition, elevation, relocation, structural retrofit, storm shutters, and shatter-resistant glass.
- **Public Education and Awareness**—Actions to inform customers and local officials about hazards and ways to mitigate them. Includes outreach projects, hazard information centers, and school-age and adult education.

Table 18-3. Analysis of Mitigation Actions

Hazard Type	Action Addressing Hazard, by Mitigation Type							
	Prevention	Property Protection	Public Education & Awareness	Natural Resource Protection	Emergency Services	Structural Projects	Climate Resilient	Community Capacity Building
High-Risk Hazards								
Earthquake	5, 6, 8, 12, 18, 20, 21, 22	7, 9, 12, 13, 14, 15, 16, 19, 20, 22	23		1, 2, 3, 4, 23	10, 11, 17		8, 12, 18, 20, 21, 22, 23
Landslide	6, 12, 18, 21, 22	7, 12, 13, 14, 15, 16, 19, 22	23		1, 2, 3, 4, 23	10, 11, 17		12, 18, 21, 22, 23
Drought	21	16	23		23	17		21, 23
Wildfire	6, 12, 18, 21, 22	7, 12, 13, 14, 15, 16, 19, 22	23		1, 2, 3, 4, 23	10, 11, 17		12, 18, 21, 22, 23
Medium-Risk Hazards								
Severe Weather	6, 12	7, 12	23		1, 2, 3, 4, 23			12, 23
Flood	6, 12, 18, 21, 22	7, 12, 13, 14, 15, 16, 19, 22	23		1, 2, 3, 4, 23	17		12, 18, 21, 22, 23
Low-Risk Hazards								
None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

- **Natural Resource Protection**—Actions that minimize hazard loss and preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, wetland restoration and preservation, and green infrastructure.
- **Emergency Services**—Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities.
- **Structural Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Includes dams, setback levees, floodwalls, retaining walls, and safe rooms.
- **Climate Resiliency**—Actions that incorporate methods to mitigate and/or adapt to the impacts of climate change. Includes aquifer storage and recovery activities, incorporating future conditions projections in project design or planning, or actions that specifically address jurisdiction-specific climate change risks, such as sea level rise or urban heat island effect.
- **Community Capacity Building**—Actions that increase or enhance local capabilities to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. Includes staff training, memorandums of understanding, development of plans and studies, and monitoring programs.

18.4 ACTION PLAN IMPLEMENTATION

The mitigation action plan presents a range of action items for reducing loss from hazard events. The District has prioritized actions and can begin to implement the highest-priority actions over the next five years. The effectiveness of the hazard mitigation plan depends on its effective implementation and incorporation of the outlined action items into all relevant District plans, policies, and programs. Some action items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. The District will have lead responsibility for overseeing the plan implementation.

19. PLAN ADOPTION AND MAINTENANCE

19.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). This plan will be submitted for a pre-adoption review to Cal OES and FEMA Region IX prior to adoption. Once pre-adoption approval has been provided, the District will formally adopt the plan. DMA compliance and its benefits cannot be achieved until the plan is adopted. The District Board of Directors resolution adopting this plan is provided in Appendix D

19.2 PLAN MAINTENANCE STRATEGY

Plan maintenance is the formal process for achieving the following:

- Ensuring that the hazard mitigation plan remains an active and relevant document and that the adopting jurisdiction maintains its eligibility for applicable funding sources
- Monitoring and evaluating the plan annually and producing an updated plan every five years
- Integrating public participation throughout the plan maintenance and implementation process
- Incorporating the mitigation actions outlined in the plan into existing planning mechanisms and programs.

To achieve these ends, a hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A method and schedule for monitoring, evaluating, and updating the mitigation plan within a 5-year cycle
- An approach for how the community will continue public participation in the plan maintenance process.
- A process by which local governments will incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate

Table 19-1 summarizes the plan maintenance strategy. The sections below further describe each element.

19.2.1 Plan Implementation and Monitoring

The effectiveness of the hazard mitigation plan depends on monitoring, implementation, and incorporation of its action items into existing District plans, policies, and programs. Together, the action items in the plan provide a framework for activities that the District can implement over the next five years. The Planning Team and the Steering Committee have established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs. The Director of Engineering will have individual responsibility for overseeing the plan monitoring and implementation strategy as summarized in Table 19-1.

Table 19-1. Plan Maintenance Matrix

Task	Approach	Timeline	Lead Responsibility	Support Responsibility
Monitoring	Preparation of status updates and action implementation tracking as part of submission for Annual Progress Report.	Biennial after the adoption and final approval of the plan by FEMA. Reporting period TBD	Director of Engineering	Steering Committee
Evaluation	Review the status of previous actions as submitted by the monitoring task lead and support the assessment of the effectiveness of the plan; compile the Annual Progress Report; assess appropriate action for preparing next hazard mitigation plan update.	Biennial after final plan approval by FEMA, or following a major disaster that significantly impacts the district	Director of Engineering	Steering Committee
Update	The District will complete a comprehensive update to this plan every 5 years. Plan update to be facilitated through oversight of a stakeholder Steering Committee	Every 5 years or after a major disaster that significantly impacts the district	Director of Engineering	Steering Committee
Continuing Public Involvement	The principle means for providing the public access to the implementation of this plan will be the District Hazard Mitigation Plan website.	Annually	Director of Engineering	Public Affairs Manager
Plan Integration	Integrate relevant information from hazard mitigation plan into other plans and programs where viable and opportunities arise	Ongoing	Director of Engineering	N/A

19.2.2 Plan Evaluation

The plan will be evaluated by how successfully the implementation of identified actions has helped to achieve the goals and objectives identified in this plan. This will be assessed by a review of the changes in risk that occur over the performance period and by the degree to which mitigation goals and objectives are incorporated into existing plans, policies, and programs. The minimum task of the District will be the evaluation of the progress of its action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation.

The evaluation will be summarized in an annual progress report. This report should be used as follows:

- Posted on the District website page dedicated to the hazard mitigation plan
- Presented to the District board to inform them of the progress of actions implemented

Uses of the progress report will be at the discretion of the Director of Engineering. Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance the District's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize the District's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with the other stakeholders in the planning area.

An oversight committee with representation similar to the Steering Committee that oversaw the development of this plan should have an active role in the plan evaluation. The new steering committee will review the annual progress report and provide input to the District on possible enhancements to be considered at the next update.

19.2.3 Plan Update

Federal regulations require that local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under the Disaster Mitigation Act (44 CFR Section 201.6.d(3)). This plan's format allows the District to review and update sections when new data become available. New data can be easily incorporated, resulting in a plan that will remain current and relevant. The District intends to update the plan on a five-year cycle from the date of plan approval. This cycle may be accelerated to less than 5 years based on the following triggers:

- A presidential disaster declaration that impacts the planning area
- A hazard event that causes loss of life

It will not be the intent of the update process to develop a completely new hazard mitigation plan. Based on needs identified by the Planning Team, the update will, at a minimum, include the following elements:

- The update process will be convened through a new steering committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plan will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or District policies identified under other planning mechanisms.
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The Board of Directors will adopt the updated plan.

Future plan updates will be overseen by a steering committee similar to the one that participated in this update process, so keeping an interim steering committee intact will provide a head start on future updates. The steering committee's role will be to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

19.2.4 Continuing Public Participation

The public will continue to be apprised of the plan's progress through the District website, including providing copies of annual progress reports on the website. This site will not only house the final plan, it will become the one-stop shop for information regarding the plan and plan implementation. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new steering committee.

This strategy will be based on the needs and capabilities of the District at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

19.2.5 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this update was prepared. This planning process provided the District with the opportunity to identify, review and expand on core capabilities of the District that could support or enhance the outcomes of this plan. Opportunities for integration identified by this planning process include:

- District Strategic Plan
- District Master Plans
- District emergency response plans
- America’s Water Infrastructure Act plan – in process
- Capital improvement programs

Some action items do not need to be implemented through regulation. Instead, they can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

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Crescenta Valley Water District Hazard Mitigation Plan

Appendix A. Public Involvement Materials

A. Public Involvement Materials

To Be Completed for Next Draft

Appendix B. Summary of Federal and State Agencies, Programs and Regulations

B. SUMMARY OF FEDERAL AND STATE AGENCIES, PROGRAMS AND REGULATIONS

Existing laws, ordinances, plans and programs at the federal and state level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). The following federal and state programs have been identified as programs that may interface with the actions identified in this plan. Each program enhances capabilities to implement mitigation actions or has a nexus with a mitigation action in this plan. Information presented in this section can be used to review local capabilities to implement mitigation actions. A review of local plans, studies, reports, and technical information is provided in Chapter 4 of this hazard mitigation plan.

FEDERAL

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) seeks to prevent discrimination against people with disabilities in employment, transportation, public accommodation, communications, and government activities. Title II of the ADA deals with compliance with the Act in emergency management and disaster-related programs, services, and activities. It applies to state and local governments as well as third parties, including religious entities and private nonprofit organizations.

The ADA has implications for sheltering requirements and public notifications. During an emergency alert, officials must use a combination of warning methods to ensure that all residents have all necessary information. Those with hearing impairments may not hear radio, television, sirens, or other audible alerts, while those with visual impairments may not see flashing lights or other visual alerts. Two technical documents for shelter operators address physical accessibility needs of people with disabilities, as well as medical needs and service animals.

The ADA intersects with disaster preparedness programs in regard to transportation, social services, temporary housing, and rebuilding. Persons with disabilities may require additional assistance in evacuation and transit (e.g., vehicles with wheelchair lifts or paratransit buses). Evacuation and other response plans should address the unique needs of residents. Local governments may be interested in implementing a special-needs registry to identify the home addresses, contact information, and needs for residents who may require more assistance.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Bureau of Land Management

The U.S. Bureau of Land Management (BLM) funds and coordinates wildfire management programs and structural fire management and prevention on BLM lands. BLM works closely with the Forest Service and state and local governments to coordinate fire safety activities. The Interagency Fire Coordination Center in Boise, Idaho serves as the center for this effort.

Civil Rights Act of 1964

The Civil Rights Act of 1964 prohibits discrimination based on race, color, religion, sex, or nation origin and requires equal access to public places and employment. The Act is relevant to emergency management and hazard mitigation in that it prohibits local governments from favoring the needs of one population group over another. Local government and emergency response must ensure the continued safety and well-being of all residents equally, to the extent possible. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. Numerous issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

The CWA is important to hazard mitigation in several ways. There are often permitting requirements for any construction within 200 feet of water of the United States, which may have implications for mitigation projects identified by a local jurisdiction. Additionally, CWA requirements apply to wetlands, which serve important functions related to preserving and protecting the natural and beneficial functions of floodplains and are linked with a community's floodplain management program. Finally, the National Pollutant Discharge Elimination System is part of the CWA and addresses local stormwater management programs. Stormwater management plays a critical role in hazard mitigation by addressing urban drainage or localized flooding issues within jurisdictions.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Community Development Block Grant Disaster Resilience Program

In response to disasters, Congress may appropriate additional funding for the U.S. Department of Housing and Urban Development Community Development Block Grant programs to be distributed as Disaster Recovery grants (CDBG-DR). These grants can be used to rebuild affected areas and provide seed money to start the recovery process. CDBG-DR assistance may fund a broad range of recovery activities, helping communities and neighborhoods that otherwise might not recover due to limited resources. CDBG-DR grants often supplement disaster programs of FEMA, the Small Business Administration, and the U.S. Army Corps of Engineers. Housing and Urban Development generally awards noncompetitive, nonrecurring CDBG-DR grants by a formula that considers disaster recovery needs unmet by other federal disaster assistance programs. To be eligible for CDBG-DR funds, projects must meet the following criteria:

- Address a disaster-related impact (direct or indirect) in a presidentially declared county for the covered disaster
- Be a CDBG-eligible activity (according to regulations and waivers)
- Meet a national objective.

Incorporating preparedness and mitigation into these actions is encouraged, as the goal is to rebuild in ways that are safer and stronger. CDBG-DR funding is a potential alternative source of funding for actions identified in this plan.

Community Rating System

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.
- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The discount partially depends on location of the property. Properties outside the special flood hazard area receive smaller discounts: a 10-percent discount if the community is at Class 1 to 6 and a 5-percent discount if the community is at Class 7 to 9. The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 66 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Assistance grant funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

Emergency Relief for Federally Owned Roads Program

The U.S. Forest Service's Emergency Relief for Federally Owned Roads Program was established to assist federal agencies with repair or reconstruction of tribal transportation facilities, federal lands transportation facilities, and other federally owned roads that are open to public travel and have suffered serious damage by a natural disaster over a wide area or by a catastrophic failure. The program funds both emergency and permanent repairs (Office of Federal Lands Highway, 2016). Eligible activities under this program meet some of the goals and objectives for this plan and the program is a possible funding source for actions identified in this plan.

Emergency Watershed Program

The USDA Natural Resources Conservation Service (NRCS) administers the Emergency Watershed Protection (EWP) Program, which responds to emergencies created by natural disasters. Eligibility for assistance is not dependent on a national emergency declaration. The program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. EWP is an emergency recovery program. Financial and technical assistance are available for the following activities (Natural Resources Conservation Service, 2016):

- Remove debris from stream channels, road culverts, and bridges
- Reshape and protect eroded banks
- Correct damaged drainage facilities
- Establish cover on critically eroding lands
- Repair levees and structures
- Repair conservation practices.

This federal program could be a possible funding source for actions identified in this plan.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- Endangered means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- Threatened means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- Critical habitat means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- Section 4: Listing of a Species—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- Section 7: Consultation—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- Section 9: Prohibition of Take—It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding, or sheltering.
- Section 10: Permitted Take—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- Section 11: Citizen Lawsuits—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license.

Every five years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters), or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors seismic research and applies it in performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication Engineering Guidelines for the Evaluation of Hydropower Projects guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

Federal Wildfire Management Policy and Healthy Forests Restoration Act

Federal Wildfire Management Policy and Healthy Forests Restoration Act (2003). These documents call for a single comprehensive federal fire policy for the Interior and Agriculture Departments (the agencies using federal fire management resources). They mandate community-based collaboration to reduce risks from wildfire.

National Dam Safety Act

Potential for catastrophic flooding due to dam failures led to passage of the National Dam Inspection Act in 1972, creation of the National Dam Safety Program in 1996, and reauthorization of the program through the Dam Safety Act in 2006. National Dam Safety Program, administered by FEMA requires a periodic engineering analysis of the majority of dams in the country; exceptions include the following:

- Dams under jurisdiction of the Bureau of Reclamation, Tennessee Valley Authority, or International Boundary and Water Commission
- Dams constructed pursuant to licenses issued under the Federal Power Act
- Dams that the Secretary of the Army determines do not pose any threat to human life or property.

The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect lives and property of the public. The National Dam Safety Program is a partnership among the states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Under FEMA's leadership, state assistance funds have allowed all participating states to improve their programs through increased inspections, emergency action planning, and purchases of needed equipment. FEMA has also expanded existing and initiated new training programs. Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most of the dams in the United States.

National Environmental Policy Act

The National Environmental Policy Act requires federal agencies to consider the environmental impacts of proposed actions and reasonable alternatives to those actions, alongside technical and economic considerations. The National Environmental Policy Act established the Council on Environmental Quality, whose regulations (40 CFR Parts 1500-1508) set standards for compliance. Consideration and decision-making regarding environmental impacts must be documented in an environmental impact statement or environmental assessment. Environmental impact assessment requires the evaluation of reasonable alternatives to a proposed action, solicitation of input from organizations and individuals that could be affected, and an unbiased presentation of direct, indirect, and cumulative environmental impacts. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

National Fire Plan (2001)

The 2001 National Fire Plan was developed based on the National Fire Policy. A major aspect of the National Fire Plan is joint risk reduction planning and implementation carried out by federal, state, and local agencies and communities. The National Fire Plan presented a comprehensive strategy in five key initiatives:

- Firefighting—Be adequately prepared to fight fires each fire season.
- Rehabilitation and Restoration—Restore landscapes and rebuild communities damaged by wildfires.
- Hazardous Fuel Reduction—Invest in projects to reduce fire risk.
- Community Assistance—Work directly with communities to ensure adequate protection.
- Accountability—Be accountable and establish adequate oversight, coordination, program development, and monitoring for performance.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities that enact floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act.

For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent-annual-chance flood and the 0.2-percent-annual-chance flood. Base flood elevations and the boundaries of the flood hazard areas are shown on Flood Insurance Rate Maps, which are the principle tool for identifying the extent and location of the flood hazard. Flood Insurance Rate Maps are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under the local floodplain management program. In recent years, Flood Insurance Rate Maps have been digitized as Digital Flood Insurance Rate Maps, which are more accessible to residents, local governments, and stakeholders.

NFIP participants must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 1-percent-annual-chance flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

NFIP participation is limited to local governments that possess permit authority and have the ability to adopt and enforce regulations that govern land use. This does not typically apply to special purpose districts.

National Incident Management System

The National Incident Management System (NIMS) is a systematic approach for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards. The NIMS provides a flexible but standardized set of incident management practices. Incidents typically begin and end locally, and they are managed at the lowest possible geographical, organizational, and jurisdictional level. In some cases, success depends on the involvement of multiple jurisdictions, levels of government, functional agencies, and emergency responder disciplines. These cases necessitate coordination across a spectrum of organizations. Communities using NIMS follow a comprehensive national approach that improves the effectiveness of emergency management and response personnel across the full spectrum of potential hazards (including natural hazards, technological hazards, and human-caused hazards) regardless of size or complexity.

Although participation is voluntary, federal departments and agencies are required to make adoption of NIMS by local and state jurisdictions a condition to receive federal preparedness grants and awards. The content of this plan is considered to be a viable support tool for any phase of emergency management. The NIMS program is considered as a response function, and information in this hazard mitigation plan can support the implementation and update of all NIMS-compliant plans within the planning area.

Presidential Executive Order 11988, Floodplain Management

Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. It requires federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values of floodplains. The requirements apply to the following activities (FEMA, 2015a):

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

Presidential Executive Order 11990, Protection of Wetlands

Executive Order 11990 requires federal agencies to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. The requirements apply to the following activities (National Archives, 2016):

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

All actions identified in this plan will seek full compliance with all applicable presidential executive orders.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers operates and maintains approximately 700 dams nationwide. It is also responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding design, construction, operation, and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety. The Corps maintains the National Inventory of Dams, which contains information about a dam's location, size, purpose, type, last inspection, and regulatory status (U.S. Army Corps of Engineers, 2017).

U.S. Army Corps of Engineers Flood Hazard Management

The following U.S. Army Corps of Engineers authorities and programs related to flood hazard management:

- The Floodplain Management Services program offers 100-percent federally funded technical services such as development and interpretation of site-specific data related to the extent, duration, and frequency of flooding. Special studies may be conducted to help a community understand and respond to flood risk. These may include flood hazard evaluation, flood warning and preparedness, or flood modeling.
- For more extensive studies, the Corps of Engineers offers a cost-shared program called Planning Assistance to States and Tribes. Studies under this program generally range from $25,000 to $100,000 with the local jurisdiction providing 50 percent of the cost.
- The Corps of Engineers has several cost-shared programs (typically 65 percent federal and 35 percent non-federal) aimed at developing, evaluating, and implementing structural and non-structural capital projects to address flood risks at specific locations or within a specific watershed:
  - The Continuing Authorities Program for smaller-scale projects includes Section 205 for Flood Control, with a $7 million federal limit and Section 14 for Emergency Streambank Protection with a $1.5 million federal limit. These can be implemented without specific authorization from Congress.
  - Larger scale studies, referred to as General Investigations, and projects for flood risk management, for ecosystem restoration or to address other water resource issues, can be pursued through a specific authorization from Congress and are cost-shared, typically at 65 percent federal and 35 percent non-federal.
  - Watershed management planning studies can be specifically authorized and are cost-shared at 50 percent federal and 50 percent non-federal.

- The Corps of Engineers provides emergency response assistance during and following natural disasters. Public Law 84-99 enables the Corps to assist state and local authorities in flood fight activities and cost share in the repair of flood protective structures. Assistance is provided in the flowing categories:
  - Preparedness—The Flood Control and Coastal Emergency Act establishes an emergency fund for preparedness for emergency response to natural disasters; for flood fighting and rescue operations; for rehabilitation of flood control and hurricane protection structures. Funding for Corps of Engineers emergency response under this authority is provided by Congress through the annual Energy and Water Development Appropriation Act. Disaster preparedness activities include coordination, planning, training and conduct of response exercises with local, state, and federal agencies.
  - Response Activities—Public Law 84-99 allows the Corps of Engineers to supplement state and local entities in flood fighting urban and other non-agricultural areas under certain conditions (Engineering Regulation 500-1-1 provides specific details). All flood fight efforts require a project cooperation agreement signed by the public sponsor and the sponsor must remove all flood fight material after the flood has receded. Public Law 84-99 also authorizes emergency water support and drought assistance in certain situations and allows for "advance measures" assistance to prevent or reduce flood damage conditions of imminent threat of unusual flooding.
  - Rehabilitation—Under Public Law 84-99, an eligible flood protection system can be rehabilitated if damaged by a flood event. The flood system would be restored to its pre-disaster status at no cost to the federal system owner, and at 20-percent cost to the eligible non-federal system owner. All systems considered eligible for Public Law 84-99 rehabilitation assistance have to be in the Rehabilitation and Inspection Program prior to the flood event. Acceptable operation and maintenance by the public levee sponsor are verified by levee inspections conducted by the Corps on a regular basis. The Corps has the responsibility to coordinate levee repair issues with interested federal, state, and local agencies following natural disaster events where flood control works are damaged.

These authorities and programs are all available to support any related hazard mitigation actions.

U.S. Fire Administration

There are federal agencies that provide technical support to fire agencies/organizations. For example, the U.S. Fire Administration, which is a part of FEMA, provides leadership, advocacy, coordination, and support for fire agencies and organizations.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service fire management strategy uses prescribed fire to maintain early successional fire-adapted grasslands and other ecological communities throughout the National Wildlife Refuge system.

STATE

AB 32: The California Global Warming Solutions Act

This bill identifies the following potential adverse impacts of global warming:

> "… the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems."

AB 32 establishes a state goal of reducing greenhouse gas emissions to 1990 levels by 2020 (a reduction of approximately 25 percent from forecast emission levels), with further reductions to follow. The law requires the state Air Resources Board to do the following:

- Establish a program to track and report greenhouse gas emissions.
- Approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions from sources of greenhouse gas emissions.
- Adopt early reduction measures to begin moving forward.
- Adopt, implement and enforce regulations—including market mechanisms such as “cap and-trade” programs—to ensure that the required reductions occur.

The Air Resources Board has adopted a statewide greenhouse gas emissions limit and an emissions inventory, along with requirements to measure, track, and report greenhouse gas emissions by the industries it determined to be significant sources of greenhouse gas emissions.

Assembly Bill 756: Public Water System PFAs

Existing law, the California Safe Drinking Water Act, requires the State Water Resources Control Board to administer provisions relating to the regulation of drinking water to protect public health, including, but not limited to, conducting research, studies, and demonstration programs relating to the provision of a dependable, safe supply of drinking water, enforcing the federal Safe Drinking Water Act, adopting implementing regulations, and conducting studies and investigations to assess the quality of water in private domestic water supplies. Under the California Safe Drinking Water Act, the implementing regulations are required to include, but are not limited to, monitoring of contaminants and requirements for notifying the public of the quality of the water delivered to customers.

This bill authorizes the state Water Resources Control Board to order a public water system to monitor for perfluoroalkyl substances and polyfluoroalkyl substances (PFAs). It requires a community water system or a non-transient noncommunity water system, upon a detection of these substances, to report that detection, as specified. The bill requires a community water system or a non-transient noncommunity water system where a detected level of these substances exceeds the response level to take a water source where the detected levels exceed the response level out of use or provide a prescribed public notification.

AB 2800: Climate Change—Infrastructure Planning

This California State Assembly bill passed in 2016 and until July 1, 2020, requires state agencies to take into account the current and future impacts of climate change when planning, designing, building, operating, maintaining, and investing in state infrastructure. The bill, by July 1, 2017, and until July 1, 2020, requires an agency to establish a Climate-Safe Infrastructure Working Group to examine how to integrate scientific data concerning projected climate change impacts into state infrastructure engineering.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was enacted in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The Alquist-Priolo Earthquake Fault Zoning Act’s main purpose is to prevent construction of buildings used for human occupancy on the surface trace of active faults. Before a new project is permitted, cities and counties require a geologic investigation to demonstrate that proposed buildings will not be constructed on active faults. The act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards, such as liquefaction or seismically induced landslides. The law requires the State of California Geologist to establish regulatory zones around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Local agencies must regulate most development projects within the zones. Projects include all land divisions and most structures for human occupancy. All seismic hazard mitigation actions identified in this plan will seek full compliance with the Alquist-Priolo Earthquake Fault Zoning Act.

California Department of Forestry and Fire Protection

CAL FIRE has responsibility for wildfires in areas that are not under the jurisdiction of the Forest Service or a local fire organization, including lands designated as State Responsibility Areas. CAL FIRE also has fire protection responsibilities by contract and mutual aid agreements. For example, CAL FIRE provides year-round fire protection under Amador Plan agreements with certain local government agencies (Public Resources Code §4144). Through these agreements, CAL FIRE provides local structural and wildfire protection or dispatch services to a community and maintains a staffing level that otherwise would be available only during the fire season. The local entity pays the additional cost of the service.

California Department of Parks and Recreation (State Parks)

State Parks manages portions of the California coastline including coastal wetlands, estuaries, beaches, and dune systems. The State Parks Resources Management Division has limited wildfire protection resources available to suppress fires on State Park lands. State Parks does not operate a fire station in Humboldt County and relies on CAL FIRE as the primary wildfire protection resource for the lands under its management. State Parks cooperates with CAL FIRE and Redwood National Park on prescribed burns and can provide limited mutual aid.

California Department Water Resources

In California, the DWR is the coordinating agency for floodplain management. The DWR works with FEMA and local governments by providing grants and technical assistance, evaluating community floodplain management programs, reviewing local floodplain ordinances, participating in statewide flood hazard mitigation planning, and facilitating annual statewide workshops. Compliance is monitored by FEMA regional staff and by the DWR.

California Division of Safety of Dams

California's Division of Safety of Dams (a division of the DWR) monitors the dam safety program at the state level and maintains a working list of dams in the state. When a new dam is proposed, Division engineers and geologists inspect the site and the subsurface. Upon submittal of an application, the Division reviews the plans and specifications prepared by the owner to ensure that the dam is designed to meet minimum requirements and that the design is appropriate for the known geologic conditions. After approval of the application, the Division inspects all aspects of the construction to ensure that the work is done in accordance with the approved plans and specifications. After construction, the Division inspects each dam to ensure that it is performing as intended and is not developing problems. The Division periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California. Over 1,200 dams are inspected by Division engineers on a yearly schedule to ensure performance and maintenance of dams (California Division of Safety of Dams, 2017).

California Environmental Quality Act

The California Environmental Quality Act (CEQA) was passed in 1970, shortly after the federal government enacted the National Environmental Policy Act, to institute a statewide policy of environmental protection. CEQA requires state and local agencies in California to follow a protocol of analysis and public disclosure of the potential environmental impacts of development projects. CEQA makes environmental protection a mandatory part of every California state and local agency's decision-making process.

CEQA establishes a statewide environmental policy and mandates actions all state and local agencies must take to advance the policy. Jurisdictions conduct analysis of the project to determine if there are potentially significant environmental impacts, identify mitigation measures, and possible project alternatives by preparing environmental reports for projects that requires CEQA review. This environmental review is required before an agency takes action on any policy, program, or project. Any project action identified in this plan will seek full CEQA compliance upon implementation.

California Fire Alliance

The California Fire Alliance (CFA) was established in response to directives from the 2001 National Fire Plan. The CFA pursues four strategies to deal with the National Fire Plan's community assistance initiative:

- Work with communities at risk from wildfires to develop community-based planning leadership and facilitate the development of community fire loss mitigation plans, which transcend jurisdiction and ownership boundaries.
- Assist communities in development of fire loss mitigation planning, education, and projects to reduce the threat of wildfire losses on public and private lands.
- Develop an information and education outreach plan to increase awareness of wildfire protection program opportunities available to communities at risk.
- Work collaboratively to develop, modify, and maintain a comprehensive list of communities at risk.

California Fire Plan

The State Board of Forestry and CAL FIRE have prepared a comprehensive update of the California Fire Plan for wildfire protection. The planning process included defining a level of service measurement; considering assets at risk; incorporating the cooperative interdependent relationships of wildfire protection providers; providing for public stakeholder involvement; and creating a fiscal framework for policy analysis. The California Fire Plan's overall goal is to reduce costs and losses from wildfire in the state by protecting assets at risk through pre-fire management and by reducing the spread of fire through more successful initial response.

California Fire Safe Council

In 1993, the statewide Fire Safe Council, consisting of private and public membership, was formed to educate and encourage Californians to plan and prepare for wildfires by reducing the risk of fire to property, communities, and natural/structural resources. In 2002, this group created a nonprofit organization and board of directors, called the

California Fire Safe Council. The Council works with the California Fire Alliance to facilitate the distribution of National Fire Plan grants for wildfire risk reduction and education (www.grants.firesafecouncil.org). The Council also provides assistance to local Fire Safe Councils through its website (www.firesafecouncil.org), the distribution of educational materials, and technical assistance, primarily through regional representatives. More than 130 local Fire Safe Councils have formed in California to plan, coordinate, and implement fire prevention activities.

California Fire Service and Rescue Emergency Mutual Aid Plan

The Governor's Office of Emergency Services Fire and Rescue Branch administers the California Fire Service and Rescue Emergency Mutual Aid Plan. The agency provides guidance and procedures for agencies developing emergency operations plans, as well as training and technical support, primarily to overall emergency service organizations and urban search and rescue teams.

California Multi-Hazard Mitigation Plan

Under the DMA, California must adopt a federally approved state multi-hazard mitigation plan to be eligible for certain disaster assistance and mitigation funding. The intent of the State of California Multi-Hazard Mitigation Plan is to reduce or prevent injury and damage from hazards in the state through the following:

- Documenting statewide hazard mitigation planning in California
- Describing strategies and priorities for future mitigation activities
- Facilitating the integration of local and tribal hazard mitigation planning activities into statewide efforts
- Meeting state and federal statutory and regulatory requirements.

The plan is an annex to the State Emergency Plan, and it identifies past and present mitigation activities, current policies and programs, and mitigation strategies for the future. It also establishes hazard mitigation goals and objectives. The plan will be reviewed and updated annually to reflect changing conditions and new information, especially information on local planning activities.

Under 44 CFR Section 201.6, local hazard mitigation plans must be consistent with their state's hazard mitigation plan. In updating this plan, the Steering Committee reviewed the California State Hazard Mitigation Plan to identify key relevant state plan elements.

California Residential Mitigation Program

The California Residential Mitigation Program was established in 2011 to help Californians strengthen their homes against damage from earthquakes. The program is a joint powers authority created by Cal OES and the California Earthquake Authority, which is a not-for-profit, publicly managed, privately funded provider of home earthquake insurance to California homeowners and renters.

Earthquake Brace + Bolt was developed to help homeowners lessen the potential for damage to their houses during an earthquake. A residential seismic retrofit strengthens an existing older house, making it more resistant to earthquake activity such as ground shaking and soil failure. The seismic retrofitting involves bolting the house to its foundation and adding bracing around the perimeter of the crawl space. Most homeowners hire a contractor to do the retrofit work, and owners of houses in ZIP Codes with house characteristics suitable for this type of retrofit are eligible for up to $3,000 toward the cost. A typical retrofit by a contractor may cost between $3,000 and $7,000, depending on the location and size of the house, contractor fees, and the amount of materials and work involved. If the homeowner is an experienced do-it-yourselfer, a retrofit can cost less than $3,000.

California Water Use Efficiency Legislation

Two long-term water-use efficiency/conservation bills signed into law in 2018 (SB 606 and AB 1668) are intended to help the state better prepare for droughts and climate change. One of the biggest components of the bills is the creation of water-use objectives for water agencies (not individual households or businesses). Local water agencies are responsible for calculating their water-use objective and determining whether their systemwide, aggregate water use meets that objective. If necessary, they will also have flexibility in how best to help customers use water more efficiently, such as conservation rebates and educational programs.

Starting in 2027, the State Water Board could issue fines to local water agencies that have not met their water-use objectives. These fines would be levied on agencies, not individuals. The bills also establish new planning and submittal requirements for Agricultural Water Management and Urban Water Management plans. Water agencies must calculate their system-wide, water-use objectives by November 2023 based on the following components:

- Water efficiency standards for indoor water use—This will be based on a provisional standard of 55 gallons of water a day per person served by the water agency.
- Outdoor water use—This standard is still being determined but will account for local climate and irrigable acres.
- Commercial, industrial, and institutional landscape irrigation
- Water loss (system leaks)
- Unique local circumstances (e.g., livestock water use)
- Credit for recycled water use

Disadvantaged and Low-Income Communities Investments

Senate Bill (SB) 535 directs state and local agencies to make investments that benefit California's disadvantaged communities. It also directs the California Environmental Protection Agency to identify disadvantaged communities for the purposes of these investments based on geographic, socio-economic, public health, and environmental hazard criteria. Assembly Bill (AB) 1550 increased the percent of funds for projects located in disadvantaged communities from 10 to 25 percent and added a focus on investments in low-income communities and households. This program is a potential alternative source of funding for actions identified in this plan.

Governor's Executive Order S-13-08

Governor's Executive Order S-13-08 enhances the state's management of climate impacts from sea level rise, increased temperatures, shifting precipitation and extreme weather events. There are four key actions in the executive order:

- Initiate California's first statewide climate change adaptation strategy to assess expected climate change impacts, identify where California is most vulnerable, and recommend adaptation policies. This effort will improve coordination within state government so that better planning can more effectively address climate impacts on human health, the environment, the state's water supply and the economy.

- Request that the National Academy of Science establish an expert panel to report on sea level rise impacts in California, to inform state planning and development efforts.
- Issue interim guidance to state agencies for how to plan for sea level rise in designated coastal and floodplain areas for new projects.
- Initiate a report on critical infrastructure projects vulnerable to sea level rise.

Office of the State Fire Marshal

The Office of the State Fire Marshal is a division of CAL FIRE that has a wide variety of fire safety and training responsibilities and provides technical support to fire agencies/organizations.

Senate Bill 97: Guidelines for Greenhouse Gas Emissions

Senate Bill 97, enacted in 2007, amends CEQA to clearly establish that greenhouse gas emissions and the effects of greenhouse gas emissions are appropriate subjects for CEQA analysis. It directs the Governor's Office of Planning and Research to develop draft CEQA guidelines for the mitigation of greenhouse gas emissions or their effects by July 1, 2009 and directs the California Natural Resources Agency to certify and adopt the CEQA Guidelines by January 1, 2010.

Standardized Emergency Management System

California Code Title 19 establishes the Standardized Emergency Management System to standardize the response to emergencies involving multiple jurisdictions. The system is intended to be flexible and adaptable to the needs of all emergency responders in California. It requires emergency response agencies to use basic principles and components of emergency management. Local governments must use the system by December 1, 1996, to be eligible for state funding of response-related personnel costs under California Code Title 19 (Sections 2920, 2925 and 2930). The roles and responsibilities of Individual agencies contained in existing laws or the state emergency plan are not superseded by these regulations. This hazard mitigation plan is considered to be a support document for all phases of emergency management, including those associated with the system.

Western Governors Association Ten-Year Comprehensive Strategy

The Western Governors Association Ten-Year Comprehensive Strategy: A Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment (August 2001), Crescenta Valley Water District Hazard Mitigation Plan

Appendix C. Detailed Risk Assessment Results

C. DETAILED RISK ASSESSMENT RESULTS

To Be Completed for Next Draft

Appendix D. Hazard Mitigation Plan Adoption Resolution

D. HAZARD MITIGATION PLAN ADOPTION RESOLUTION

To Be Provided with Final Draft