EXHIBIT 1 to NOTICE OF SPECIAL MEETING

AGENDA
EAST ORANGE COUNTY WATER DISTRICT
(EOCWD)

Thursday, October 22, 2020
185 N. McPherson Road, Orange, California

5:00 pm

NOTE: Pursuant to California Governor's Executive Order No. N-29-20, executed March 17, 2020, members of the Board of Directors may elect to attend this Regular Meeting by telephone or video conference due to concerns relative to COVID-19 Coronavirus and avoidance of public gatherings. **THERE WILL BE NO PUBLIC LOCATION FOR ATTENDING THIS BOARD MEETING IN PERSON.** The public may attend telephonically by calling into the meeting at:

(848) 227-7998 - Conference ID# 6340973161#

Alternatively, the District does have capacity to allow members of the public to utilize its Highfive.com platform to attend its meeting by videoconference, though such attendees shall be responsible for downloading and installing the necessary software at their own risk. Any interested parties may contact Sylvia Prado at (714) 538-5815 or sprado@eocwd.com. Members of the public may also e-mail comments to Ms. Prado up to 30 minutes before the Board meeting, and such comments will be presented to the Board. Members of the public wishing to attend the meeting that require other reasonable modification or accommodation to facilitate such attendance should contact Ms. Prado at the number or e-mail provided at least five (5) hours before the meeting to make such request.

1. **Call Meeting to Order and Pledge of Allegiance – Director Sears**

2. **Public Communications to the Board**

3. **Action Calendar**

   A. **ID1 Capacity, Reliability, and Augmentation Project No. 1 – Change Order for Design-Build Contract with Quanta Electric Power Construction Management, Inc. and Corresponding Budget Amendment from Reserves to Account #73015E3** (Exhibit **"A"**)

   Recommended Motion: "THAT THE BOARD (1) AUTHORIZE THE GENERAL MANAGER TO NEGOTIATE AND EXECUTE A CHANGE ORDER TO THE DESIGN-BUILD AGREEMENT WITH QUANTA ELECTRIC POWER CONSTRUCTION FOR THE ID1 CAPACITY, RELIABILITY, AND AUGMENTATION PROJECT NO. 1, WITH AN INCREASED DESIGN ALLOWANCE IN AN AMOUNT NOT-TO-EXCEED $790,400 FOR PHASE 1 SERVICES; AND (2) INCREASE ACCOUNT #73015E3 IN THE ID1 CAPITAL IMPROVEMENT BUDGET BY $790,400."

B. **Hazard Mitigation Plan ("HMP") Approval** (Exhibit **"B"**)

Recommended Motion: "THAT THE BOARD APPROVE THE HAZARD MITIGATION PLAN AS PRESENTED, AND AUTHORIZE THE GENERAL MANAGE TO DEVELOP AND COMMENCE ACTIONS NECESSARY TO IMPLEMENT SUCH PLAN."

C. **Delegation of Authority – Municipal Water District of Orange County ("MWDOC") Common Interest Agreement** (Exhibit **"C"**)

Recommended Motion: "THAT THE BOARD DELEGATE AUTHORITY TO GENERAL MANAGER LISA OHLUND TO APPROVE AND EXECUTE A COMMON INTEREST AGREEMENT WITH MWDOC AS NECESSARY TO EFFICIENTLY COLLABORATE WITH SIMILARLY-SITUATED PARTIES ENGAGED IN LEGAL MATTERS."

4. Closed Session

A. **Public Employment**
Govt. Code § 54957(b)
Title: General Manager

B. **Conference with Legal Counsel — Anticipated Litigation**
(Govt. Code § 54956.9(d)(2)&(3))
Significant exposure to litigation: one matter

5. Adjournment

The scheduled date of the next Regular Meeting of the Board of Directors is November 19, 2020, at 5:00 p.m., in the offices of the East Orange County Water District, 185 N. McPherson Road, Orange, California.

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Availability of agenda materials: Agenda exhibits and other writings that are disclosable public records distributed to all or a majority of the members of the East Orange County Water District Board of Directors in connection with a matter subject to discussion or consideration at an open meeting of the Board are available for public inspection in the District's office, 185 N. McPherson Road, Orange, California ("District Office"). If such writings are distributed to members of the Board less than 24 hours prior to the meeting, they will be available at the reception desk of the District Office during business hours at the same time as they are distributed to the Board members, except that if such writings are distributed less than one hour prior to, or during, the meeting, they will be available in the meeting room of the District Office.

Disability-related accommodations: If you have a disability and require any special disability-related modification or accommodation, including auxiliary aids or services, in order to participate in the meeting, please contact Sylvia Prado at the District Office at (714) 538-5815 during business hours at least five (5) hours before the scheduled meeting. With reasonable notice, this agenda may be made available in appropriate alternative formats to persons with a disability, on written request to Sylvia Prado in the District Office, at least twenty-four (24) hours prior to the scheduled meeting.

NOTICE OF SPECIAL MEETING
OF THE
BOARD OF DIRECTORS OF
EAST ORANGE COUNTY WATER DISTRICT

NOTICE IS HEREBY GIVEN that a Special Meeting of the Board of Directors of the East Orange County Water District has been called by the President of the Board of Directors thereof to be held on Thursday, October 22, 2020 at 5:00 p.m., at 185 N. McPherson Road, Orange, CA 92869.

The following business will be transacted:

1. see Exhibit "1" attached to this Notice
2. ______
3. ______
4. ______

DATED THIS 21st day of October, 2020.

JEFFREY A. HOSKINSON, Secretary
East Orange County Water District
and of the Board of Directors thereof

MEMO

TO: BOARD OF DIRECTORS

FROM: GENERAL MANAGER

SUBJECT: ID1 CAPACITY, RELIABILITY AND AUGMENTATION PROJECT #1 – CONTRACT CHANGE ORDER #1 WITH QUANTA ELECTRIC POWER CONSTRUCTION (QUANTA SERVICES)

DATE: OCTOBER 22, 2020

BACKGROUND

At the June 18, 2020 Meeting, the Board awarded the Capacity, Reliability and Augmentation Project #1's (CRA Project #1's) Phase I services to Quanta Services in the amount of $1,349,032.00.

Since that time, staff have identified three additional segments for replacement and are recommending that Contract Change Order #1be issued to add these segments to the Phase 1 contract. One segment is of urgent necessity, a siphon replacement, and two segments are for capacity improvements that have recently been identified as a high priority due to the potential capacity impacts posed by the State's ADU legislation

Segment #1 (Holt Siphon)

On January 2, 2020, staff was cleaning a siphon at 14612 Holt Avenue in Tustin. The cleaning nozzle stopped as it approached the downstream manhole indicating a blockage. Staff discovered a partial collapse of the 6" VCP sewer pipe where the upstream pipe entered the manhole. Following the repair of the collapsed segment, the remaining portion of this siphon and all of the other siphons were CCTV'd throughout the District. Multiple cracks and fractures were discovered in the remaining portion of the Holt Siphon. Due to the small pipe diameter causing challenges with CIPP rehabilitation, and the significant risk of having no available bypass, staff is recommending replacement and upsizing of the siphon.

The cost for Segment #1(Holt Siphon) Phase 1 Services is $266,592.00

Segment #2 (Browning Add-on)

In May, staff retained AKM Consulting Engineers to prepare an Addendum to the Sewer Master Plan due to legislation approving densification and making it easier to construct Accessory Dwelling Units (ADUs). The Scope of Work for this addendum includes evaluating the impacts on sewer capacity due to this densification. AKM completed the model update and, at the August E&O Meeting, staff presented a location map showing the remaining capacity in the sewers throughout the District. It showed limited capacity in the Browning Avenue sewer north of Bryan and the Newport Avenue sewer north of Foothill. Staff requested a quote from Quanta to upsize 7,000 feet in Browning and found it to be cost prohibitive. AKM reanalyzed the data and recommended replacement of 1,485 feet from Browning to Bent Twig as it currently has limited to no capacity, and in the future model it has none. Staff is still evaluating the capacity in Newport Avenue and will address it at a future time.

The cost for Segment #2 (Browning Add-On) Phase 1 Services is $278,360.00

Segment #3 (Crawford Canyon)

Another area identified with limited capacity in the 2018 Master Plan is a 695-foot segment in Crawford Canyon Road north of Brae Glen. This was not considered a high priority project in the 2018 Master Plan, however, with the new legislation it has become a high priority project as this existing segment has very little additional capacity left for ADUs.

The Segment #3 (Crawford Canyon) Phase 1 Services cost is $245,448.00.

Staff recommends awarding Contract Change Order #1 for Phase 1 services for the additional scope of work above to Quanta Services in the amount of $790,400.00. it is estimated that this work may add an additional $4-5 million to the overall project construction costs.

FISCAL IMPACT

Funds have been budgeted in Account #73015E3 for this project, however there is a need to move funds in the amount of $790,400 from Reserves into Acct #73015E3 to cover these additional Phase I services. These costs, as well as the Phase I Services and the construction costs are anticipated to be funded through a debt issuance that staff is currently developing.

RECOMMENDATION

That the Committee recommend the Board: 1) approve Contract Change Order #1 with Quanta Electric Power Construction for additional Phase 1 Design-Build services in the amount of $790,400.00, increasing their contract from $1,349,032.00 to $2,139,432.00, for the ID1 Capacity, Reliability, and Augmentation Project #1 and 2) increase Account #73015E3 in the ID1 Capital Improvement Budget by $790,400.00.

EAST ORANGE COUNTY WATER DISTRICT

MEMO

TO: BOARD OF DIRETORS

FROM: GENERAL MANAGER

SUBJECT: **ADOPTION OF THE EOCWD HAZARD MITIGATION PLAN**

DATE: OCTOBER, 22, 2020

Background

The Disaster Mitigation Act of 2000 (Stafford Act) addresses mitigation planning and requires state and local governments to prepare hazard mitigation plans as a precondition for receiving Federal Emergency Management Agency (FEMA) mitigation project grants. As a result of the Canyon I and II fires of 2017 being declared a major federal disaster, the State of California (CalOES) was eligible for Hazard Mitigation Grant Program (HMGP) funding for agencies impacted by the disaster. Cal OES then established a program to accept subapplications from other agencies, including special districts. The district submitted an application in early 2019 and on June 25, 2019 we were notified that we were awarded a grant in the amount of $115,986.

On September 19, 2019, the Board awarded a contract to Tetra Tech to prepare a Hazard Mitigation Plan in the amount of $116,580. Commencing with the creation of the Hazard Mitigation Plan Steering Committee, Tetra Tech, the Committee and staff worked to develop the attached Hazard Mitigation Plan (the Plan) from January through July. We held a virtual Public Meeting on August 4, 2020 to obtain public comment, and then submitted the draft Plan to CalOES and FEMA on September 1, 2020, expecting that the two agencies would use their full 90-day review time and that we would receive comments and recommended changes before obtaining their approvals. In actuality, we received approval of the draft Plan on September 10th from CalOES and then from FEMA on September 17th; both approvals came without comments or changes (see attached).

The 289-page Plan is a thorough, detailed and forthright risk assessment of the potential natural hazards facing the District's assets. The nine hazards identified as important to review were:

- Earthquake
- Wildfire
- Dam Failure
- Drought
- Flood
- Landslide
- Severe Weather
- Space Weather
- Climate Change

Ultimately, an Action Plan was developed that identified sixteen (16) actions that could be taken to mitigate the various hazards. As presented in Table 20-1, these actions are ranked as follows:

Table 20-1. 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—.Construct New EOC/Administrative Building outside of Dam Inundation area, flood zone to appropriate seismic codes and standards. *Hazards Mitigated:* Dam Failure, Earthquake, Flood						
Existing	1,6,7	District	N/A	High ($6 Million)	District reserves, FEMA HMA Funding, DHS EOC Funding	Short Term, DOF
Action #2—Reconstruct Peters Canyon Reservoir to avoid future seismic landslide and wildfire risks *Hazards Mitigated:* Earthquake, Landslide, Wildfire						
Existing	1,2,3,6,7	District	N/A	High ($8 Million)	District reserves, FEMA HMA Funding,	Short Term, DOF
Action #3— Foothill Regional Environmentally Sustainable H2O (FRESH) project that involves the capture of stormwater runoff to attenuate stormwater impacts and pumping the captured stormwater to an impounded storage facility. *Hazards Mitigated:* Dam Failure, Drought, Flood						
New and Existing	3,5,7	District	Orange County	High ($80 Million)	District reserves, FEMA HMA Funding,	Long Term
Action #4—Acquire fixed place generators of sufficient size and capacity for the 3 district wells that currently do not have them, and convert Bartlet Reservoir, OC 70 Pump and the Administrative building for portable generator support to fixed place generator support. *Hazards Mitigated:* Dam Failure, Earthquake, Flood, Landslide, Severe Weather, Wildfire and Space Weather						
New and Existing	1,7	District		High ($2 Million)	District reserves, FEMA HMA Funding,	Short Term, DOF
Action #5—Upgrade the hardware and software of the District's SCADA system to provide increased security for District facilities *Hazards Mitigated:* Terrorism						
Existing	1,2,6,7	District	N/A	High ($1.5 Million)	District Reserves, DHS-EMPG Funding	Short Term, DOF
Action #6—Replace vulnerable Water Transmission Pipelines that interface liquefiable soils to mitigate future impacts from earthquake *Hazards Mitigated:* Earthquake						
Existing	1,2,6,7	District	N/A	High ($5 Million)	District reserves, FEMA HMA Funding,	Long Term
Action #7— District to maintain on its website a page dedicated to keeping the public apprised of hazard mitigation milestones achieved by this plan over its performance period, and provide the public a medium for which to stay engaged with the plan and its implementation. *Hazards Mitigated* Dam Failure, Drought, Earthquake, Flood, Landslide, Severe Weather, Space Weather, Wildfire						
New and Existing	1,4	District	N/A	Low	District funds	Ongoing
Action #8—Establish Security upgrades to facilities that would allow for the District remotely conduct a windshield survey and then make the appropriate adjustments such as closing valves to protect an existing water source in times of emergency. *Hazards Mitigated:* Terrorism, Dam Failure, Earthquake, Flood, Landslide, Severe Weather, wildfire						
Existing	2,7	District	N/A	High ($1 Million)	District Reserves, DHS-EMPG Funding	Short Term, DOF
Action #9—Replace existing well that are considered to be sub-standard as for code compliance due to their age to mitigate future impacts from earthquakes. *Hazards Mitigated:* Earthquake, Drought						
Existing	1,2,3,6,7	District	N/A	High ($2 Million)	District Reserves, FEMA HMA Funding, (State Proposition 1 Grant)	Short Term, DOF
Action #10—Vulnerable Sewer Line Replacement *Hazards Mitigated:* Earthquake						
Existing	1,2,3,6,7	District	N/A	High ($10 Million)	District reserves and debt financing, FEMA HMA Funding	Short Term. DOF
Action #11—Replace the seismically vulnerable Vista Panorama Reservoir. Hazards Mitigated: Drought, Earthquake						
Existing	1,2,3,6,7	District		High (1.5 Million)	District reserves and debt financing, FEMA HMA Funding	Short term, DOF

Applies to New or Existing Assets	Objectives Met	Lead Agency	Support Agency	Estimated Cost	Sources of Funding	Timeline
Action #12—Replace exposed wastewater pipes that cross waterways and flood channels with ductile pipe to better withstand dam failure, flood and earthquake impacts.						
Hazards Mitigated	Dam failure, Earthquake, flood					
Existing	1,2,3,6,7	District		High ($400 Million)	District reserves and debt financing, FEMA HMA Funding	Long Term
Action #13—Wholesale Water System Transmission Main Rehabilitation needed to mitigate seismic vulnerability due to location within susceptible soils.						
Hazards Mitigated:	Earthquake					
Existing	1,2,3,6,7	District		High ($55 Million)	District reserves and debt financing, FEMA HMA Funding	Long Term
Action #14—Treatment Plant Rehabilitation needed to mitigate seismic vulnerability due to location within susceptible soils.						
Hazards Mitigated:	Earthquake, Dam Failure					
Existing	1,2,3,6,7	District		High ($25 Million)	District reserves and debt financing, FEMA HMA Funding	Long Term
Action #15— Coordinate and Collaborate with other Orange County Stakeholders with a stake in hazard mitigation and planning in increasing the regional resilience of the Orange County operation area that interfaces with district assets and interests.						
Hazards Mitigated:	Dam Failure, Drought, Earthquake, Flood, Landslide, Severe Weather, Space Weather, Wildfire					
New and Existing	1,3,4,7	District	Other OC Stakeholders	Low	District funds	Ongoing
Action #16— As the opportunities arise, the District will seek to integrate viable components of this hazard mitigation plan into other plans and programs that can support or enhance the District's ability to increase its resilience to the hazards assessed by this plan.						
Hazards Mitigated:	Dam Failure, Drought, Earthquake, Flood, Landslide, Severe Weather, Space Weather, Wildfire					
New and Existing	1,2,3,4,5,6,7	District	N/A	Low	District Funds	Ongoing

The identification of these actions, and subsequent approval by the Board will form an important part of the District's CIP planning going forward, and meets Strategic Plan Goal #1, providing a safe, reliable and environmentally-sustainable water and sewer services and infrastructure, and in particular, Strategy 6 (Conduct planning to ensure reliable and high quality water supplies), Strategy 8 (Position EOCWD to respond to emergencies) and Strategy 9 (Ensure infrastructure is appropriately developed, designed, constructed, maintained & replaced).

The approval of the Plan will also enable the District to apply for FEMA's "Building Resilient Infrastructure in Communities" (BRIC) grant program. From the Draft Plan:

"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."

This program funds up to 75% of eligible project costs if awarded.

There are ongoing responsibilities for the District required by the grant and the HMP; these requirements are summarized in Table 21-1:

Table 21-1. 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.	Annually after the adoption and final approval of the plan by FEMA. Actual reporting period TBD	General Manager	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.	Annually after final plan approval by FEMA, or upon comprehensive update to General Plan or major disaster	General Manager	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 following a major disaster event that significantly impacts the district	General Manager	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. https://www.eocwd.com/hazardmitigationplan	Annually	General Manager	Contractor support for Public Outreach
Plan Integration	Integrate relevant information from hazard mitigation plan into other plans and programs where viable and opportunities arise	Ongoing	General Manager	N/A

At their October 15, 2020 meeting, the Engineering and Operations Committee recommended approval of the Plan by the Board. Once the Board approves the Plan, it will be submitted one more time to FEMA for final overall approval.

Fiscal Impact

There is no direct expense associated with the approval of the Plan, however staff is retaining consultant Tetra Tech to prepare an application for BRIC funding for replacement of the Peters Canyon (6 MG) Reservoir (~$16,000).

Recommendation

The Board approved the EOCWD Hazard Mitigation Plan and authorize the General Manager to develop and commence actions necessary to implement such plan.

September 10, 2020

Ms. Juliette Hayes, Mitigation Division Director
Federal Emergency Management Agency, Region IX
1111 Broadway Street, Suite 1200
Oakland, California 94607

Subject: East Orange County Water District Local Hazard Mitigation Plan

Dear Ms. Hayes:

The California Governor's Office of Emergency Services (Cal OES) is forwarding the Local Hazard Mitigation Plan for the East Orange County Water District for formal review. The documents were transmitted to FEMA electronically.

If you have any questions, please contact me at (916) 845-8531 or Karen McCready-Hoover, Emergency Services Coordinator, Local Mitigation Planning Division, at (916) 845-8177.

Sincerely,

Victoria LaMar-Haas

VICTORIA LAMAR-HAAS, Chief
Local Mitigation Planning Division

Enclosures

c: Lisa Ohlund, General Manager, East Orange County Water District

U.S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA 94607

FEMA

September 17, 2020

Ms. Lisa Ohlund
General Manager
East Orange County Water District
185 N. McPherson Road
Orange, CA 92869

Dear Ms. Ohlund:

We have completed our review of the *East Orange County Water District Hazard Mitigation Plan* and have determined that this plan is eligible for final approval pending its adoption by the East Orange County Water District.

Formal adoption documentation must be submitted to the FEMA Region IX office by the jurisdiction within one calendar year of the date of this letter, or the entire plan must be updated and resubmitted for review. We will approve the plan upon receipt of the documentation of formal adoption.

If you have any questions regarding the planning or review processes, please contact the FEMA Region IX Hazard Mitigation Planning Team at fema-r9-mitigation-planning@fema.dhs.gov.

Sincerely,

for Alison Kearns
Risk Analysis Branch Chief
Mitigation Division
FEMA, Region IX

cc: Victoria LaMar-Haas, Hazard Mitigation Planning Chief, California Governor's Office of Emergency Services
Jennifer Hogan, State Hazard Mitigation Officer, California Governor's Office of Emergency Services

EOCWD
EAST ORANGE COUNTY
WATER DISTRICT

HMP
HAZARD MITIGATION PLAN

Creating a resilient East Orange County Water District

Public Review Draft

TETRA TECH

August 2020

East Orange County Water District Hazard Mitigation Plan

August 2020

PREPARED FOR

East Orange County Water District

185 N. McPherson Road
Orange, CA 92869
714-538-5815 | eocwd.com

PREPARED BY

Tetra Tech, Inc.

1999 Harrison St., Suite 500
Oakland, CA 94612
510-302-6300 | tetratech.com

Tetra Tech Project #103s6701
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Part 2. Risk Assessment

Appendices

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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
AWIA	America's Water Infrastructure Act (2018)
Cal OES	California Governor's Office of Emergency Services
CDBG	Community Development Block Grant
EMPG	Emergency Management Performance Grant
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Administration
GIS	Geographic Information System
Hazus	Hazards U.S.
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HUD	U.S. Department of Housing and Urban Development
IBC	International Building Code
IT	Information Technology
MRP	Mean Return Period
NCDC	National Climatic Data Center
NEHRP	National Earthquake Hazards Reduction Program
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OC	Orange County
OCFA	Orange County Fire Authority
PDM	Pre-Disaster Mitigation Grant Program
PGA	Peak Ground Acceleration
ppm	Parts per million
SFHA	Special Flood Hazard Area
USACE	US Army Corps of Engineers
UBC	Uniform Building Code
USDA	U.S. Department of Agriculture
USDM	U.S. Drought Monitor
USGS	United States Geological Survey

ACKNOWLEDGMENTS

East Orange County Water District

- Lisa Ohlund, General Manager
- Marilyn Thoms, EOCWD Consultant Project Manager, Solutions Project Management
- Sylvia Prado, Administrative Assistant II
- Cheryl Krantz, Administrative Assistant I
- Jerry Mendzer, Operations Manager
- Jeff Smyth, Engineering Manager
- Justin Glover, Outreach Manager, Communications LAB
- Maria Gonzalez, Outreach Manager, Communications LAB

Consultants

- Rob Flaner, Tetra Tech, Project Manager
- Bart Spencer, Tetra Tech, Project Lead
- Carol Bauman, Tetra Tech, Risk Assessment Lead
- Dan Portman, Tetra Tech, Senior Technical Specialist
- Steve Parker, Tetra Tech, GIS Analyst
- Desmian Alexander, Tetra Tech, Junior Planner

Stakeholders/Steering Committee

- Kevin Rice, Steering Committee Chair and Citizen
- Kevin Greene, Steering Committee Vice-Chair and Citizen
- Thomas Broz, Citizen
- Randy Harper, Orange County Office of Emergency Management
- Jane Rice, Citizen
- David Stuart, Citizen
- Michael Grisso, Water Manager, City of Tustin
- Mark Ouellette, Emergency Services Manager, City of Orange

Special Acknowledgments

Development of this plan would not have been possible without the commitment of the East Orange County 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 District’s service area in Orange County 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.

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 EAST ORANGE COUNTY WATER DISTRICT

The East Orange County Water District (the District) has completed a planning process to prepare for the impacts of hazards that could impact the District. 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 District residents, 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 *East Orange County 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 the District and its community.

All residents and businesses of the District 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 and sewerage) in eastern Orange County, 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 *East Orange County 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 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 #4344-323-124P) 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 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. The Planning Team was formed to lead the planning effort, made up of the following members:

- Lisa Ohlund (East Orange County Water District)—General Manager
- Marilyn Thoms (Solutions Project Management)—Consultant EOCWD Project Manager
- Rob Flaner (Tetra Tech)—Project Manager
- Bart Spencer (Tetra Tech)—Lead Project Planner
- Justin Glover (CommunicationsLAB), Outreach Manager
- Maria Gonzalez (CommunicationsLAB), Outreach Coordinator

At the outset of planning, the 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 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.

The Steering Committee, made up of local residents and 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 approximately once per month over the seven-month period commencing in January 2020.

Table 2-1. Steering Committee Members

Name	Title	Department or Agency
Kevin Rice (Chair)	Attorney	Citizen
Kevin Greene (Vice Chair)	Accounting Manager	Citizen
Thomas Broz	Civil Engineer	Citizen
Michael Grisso	Water Manager	City of Tustin
Randy Harper	Manager	County of Orange Emergency Management
Mark Ouellette	Emergency Services Manager	City of Orange
Jane Rice	IT Executive	Citizen
David Stuart	Energy Executive	Citizen
Lisa Ohlund	General Manager	East Orange County Water District
Marilyn Thoms	Consultant Project Manager	Solutions Project Management
Justin Glover	Consultant Outreach Manager	CommunicationsLAB
Maria Gonzalez	Consultant Outreach Coordinator	CommunicationsLAB

2.2 COORDINATION WITH OTHER AGENCIES

During a seven-month process to prepare the plan, residents 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:

- Orange County Fire Authority
- City of Tustin
- Orange County
- Orange County Sheriff's Department
- California Governor's Office of Emergency Services (Cal OES)
- California Department of Water Resources, Division of Safety of Dams
- City of Orange

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:

- California State Hazard Mitigation Forum
- County of Orange/Orange County Fire Authority Hazard Mitigation Plan
- City of Tustin Hazard Mitigation Plan
- MWDOC Hazard Mitigation 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 District sought public input by hosting meetings and sharing ways to participate via web, social media, survey, and other communications with customers and stakeholders. An informational website on the plan also was made available.

2.4.1 Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies, and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan. The effort to include stakeholders in this process included stakeholder 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

2.4.2 Survey

The 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 13 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

2.4.3 Public Meetings

With the outbreak of the COVID-19 pandemic in March 2020, public gatherings and public meeting gatherings were suspended to reduce and prevent the spread of the virus. Steering Committee meeting notices were posted on the District's website; opportunity was provided for any public comment during these meetings. On August 4, 2020, 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 after the fact on Facebook and YouTube.

2.4.4 Media Outreach

Press Releases

The following press releases were distributed over the course of the plan's development as key milestones were achieved:

- December 6, 2019—Announcement of hazard mitigation development process
- January 13, 2020—Announcement of initial Steering Committee meeting

The August 4, 2020, virtual public meeting was advertised on Facebook and Instagram.

HMP
HAZARD MITIGATION PLAN
Creating a resilient EOCWD

EOCWD
EAST ORANGE COUNTY
WATER DISTRICT

Hazard Mitigation Plan

Community Survey

Dear Valued Resident:

We sincerely hope you are healthy and safe. Just prior to the outbreak of COVID-19, the East Orange County Water District (EOCWD) received a grant under the federal government's Disaster Mitigation Act of 2000 (Public Law 106-109).

This grant provides funding for EOCWD to plan and implement a hazard mitigation plan (HMP) to address natural disasters. The plan will be developed with significant public input and its development will be overseen by a public steering committee made up of your neighbors in East Orange and North Tustin.

We're hopeful that through this hazard mitigation planning process, our residents will not only suggest ways that EOCWD can protect the community's water and sewer infrastructure against disasters but also think about ways our residents and their families can be better prepared for the next natural disaster.

Your participation in this survey will help EOCWD continue to evolve and improve. We appreciate you taking the time to answer this survey candidly with your insights and opinions.

Thank you in advance for your feedback and 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.)
- ☐ Wildfire
- ☐ Dam Failure
- ☐ Other (please specify)

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

Internet

At the beginning of the plan update process, a District hazard mitigation website was created to include information about the update process (http://www.eocwd.com/hazardmitigationplan; see Figure 2-2). 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.

2.4.5 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.

Eighteen participants signed in to view the live stream on line of the August 4, 2020 virtual public meeting. An additional 321 people viewed the video of the meeting after the fact. Appendix A includes a summary of public interaction for this meeting.

A draft version of the hazard mitigation plan was made available for public review August 14 – 28, 2020; no public comments were received.

Survey Outreach

Completed surveys were received from 117 respondents. Of these respondents, 77 percent indicated that they have experienced a pandemic, and 47 percent indicated that they have been affected by drought. Most respondents (74 percent) said they have not experienced impacts from any non-natural hazards; 17 percent reported experience with critical infrastructure failure (electrical system) and 13 indicated having experienced a cyber attack. Survey results were shared with the Steering Committee. Detailed survey results are provided in Appendix A. Key results are summarized as follows:

- The hazards that the most respondents identified as being of extreme concern were, in order, wildfire, climate change and pandemic. However, on a weighted average of all levels of concern, the top hazards in order were pandemic, earthquake, wildfire and drought.
- The majority of respondents believe that the best method to receive emergency preparedness information is from the internet, followed by social media and TV news.
- Asked what level of preparedness they believe the District has to continue providing water after a disaster, 38 percent rated the District's preparedness as average, above average or "very prepared"; 49 percent said they believe the District is only somewhat prepared; and 13 percent said they believe the District is not prepared at all.
- More than a third of respondents stated they had an average level of preparedness for hazard events (37 percent), followed by 32 percent with "just a little" preparedness, 17 percent not prepared at all, 11 percent with above-average preparedness, and 3 percent very prepared.
- If water service were temporarily disrupted, 41 percent of respondents said they could continue for 1 to 3 days without drinking water; 32 percent could continue for 3 to 5 days; 15 percent could continue for 5 to 7 days; and 12 percent could continue for more than 7 days.

2.5 PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

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

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

Table 2-2. Plan Development Chronology/Milestones

Date	Event	Description
1/23/2020	1st Steering Committee Meeting	The project kickoff meeting was held at District main offices. A summary of hazard mitigation projects was outlined, and expectations were provided to the Steering Committee.
2/27/2020	2nd Steering Committee Meeting	California State and County of Orange/Orange County Fire Authority hazard mitigation plans were discussed. Steering Committee discussed hazards of concern and agreed to address several natural, non-natural, and scenario hazards in the East Orange County Water District hazard mitigation plan. A field tour of District facilities was held prior to the meeting.
3/26/2020	3rd Steering Committee Meeting (Virtual)	Hazard scenarios were discussed and consensus was reached on a mission/vision statement. Planning the Phase 1 public meeting was deferred due to emerging COVID-19 pandemic. Steering Committee members were given homework of selecting five district-specific goals that would be most relevant to the District.
4/23/2020	4th Steering Committee Meeting (Virtual)	Risk assessment draft and maps were discussed, and the Steering Committee passed a motion to accept five proposed HMP goals. Draft survey proposed to be sent to District customers.
5/28/2020	5th Steering Committee Meeting (Virtual)	Preliminary exposure analysis results were discussed. Objectives for the plan were finalized and scheduled to be voted on at next Steering Committee meeting. HMP survey was launched, with 10 responses at meeting time. The Phase 1 public engagement meeting was projected to take place in July.
6/25/2020	6th Steering Committee Meeting (Virtual)	An update was provided on risk assessment results, including mapping and preliminary estimates of vulnerability. A survey status update was presented. Plans were made for the next virtual meeting.
7/23/2020	7th Steering Committee Meeting (Virtual)	An update was provided on risk assessment results. The Steering Committee reviewed the draft action plan and plan mitigation strategy. A survey status update was presented. Plans for public review of the draft document were discussed.
8/4/2020	Public Meeting (Virtual)	An on-line public meeting was held to explain plan findings about hazards of concern and potential mitigation actions.
8/14/2020	Public Outreach	Initiate 2-week final public comment period for review of the draft plan
8/28/2020	Public Outreach	Closure of 2-week Final Public Comment period
9/1/2020	Plan Review and Approval	Plan sent to Cal OES for review and approval pending adoption
9/17/2020	Plan Review and Approval	Plan approvaed by FEMA
TBD	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 East Orange County Water District, founded in 1961, encompasses an area of more than 15 square miles in East Orange and North Tustin. The District is a member of the Orange County Water District, which oversees and manages the local groundwater basin. It is also a member of the Municipal Water District of Orange County (MWDOC), which is a member of the Metropolitan Water District of Southern California (Metropolitan). The District is, therefore, entitled to receive Colorado River and Northern California imported water through the distribution facilities of the Metropolitan system. The District, acting in its wholesale capacity, provides this imported water service to four other local jurisdictions as well as its own retail water service area. Additionally, the District provides local wastewater collection service.

3.1 DISTRICT HISTORY

3.1.1 Southern California Water System Overview

Settlers who arrived in the 1700s in the area that is Orange County today relied heavily on surface water from the Santa Ana River. With only a single source of water, local communities were severely impacted by periods of drought and flood. The introduction of groundwater as a water source released the region from the limitations of the Santa Ana River allowing rapid growth in the area. However, the groundwater aquifer became over-pumped, so that another water source was needed (MWDOC, 2020).

In 1928, 13 Southern California cities joined to form the Metropolitan Water District of Southern California to import water from the Colorado River. Metropolitan's supplemental water supplies encouraged other Orange County water providers to collaborate creating the Coastal Municipal Water District (Coastal) in 1941 and MWDOC in 1951. In 1999, Coastal and MWDOC merged to become the third largest Metropolitan member agency, which assigns voting power based on total assessed value. Metropolitan today consists of 12 member water agencies and 14 city water departments (MWDOC, 2020).

MWDOC today is a wholesale water supplier and resource planning agency serving over 3.2 million Orange County residents through 28 retail water agencies (14 city water departments and 14 water districts). Local water supplies provided through management of the groundwater basin by the Orange County Water District meet 75 percent of Orange County's total water demand. To meet the remaining demand, MWDOC purchases imported water through Metropolitan from the Colorado River and from California's State Water Project in the north. MWDOC distributes this water to its member agencies, which in turn provide retail water services to the public (MWDOC, 2020).

3.1.2 Creation and Development of the District

The District was founded under the principles of local community service and fiscal discipline, which it maintains to this day. The District operates under the County Water District Law (Section 30000 of the California Water Code) as an independent special district and is governed by a Board of Directors elected to four-year terms by the voters within the District.

When formed it 1961, the District served as a wholesale water provider to other water agencies. In July 1985, the District assumed the operations of the County of Orange Waterworks District No. 8, which until that time had been one of the District's wholesale customers. In August 2016, the Orange County Sanitation District transferred ownership of the Local Service Area 7 wastewater system to the District.

3.2 SERVICE AREAS

3.2.1 Wholesale Zone Water Service Area

The District provides wholesale water to the following agencies:

- City of Tustin
- City of Orange
- Irvine Ranch Water District
- Golden State Water Company

The total population served by the Wholesale Zone (including the District's own retail customers, described below) is approximately 90,000. The service area in which this population lives is in eastern and central Orange County, encompassing the City of Tustin, a portion of the City of Orange, and the unincorporated communities of East Orange, North Tustin, East Tustin, Red Hill, Lemon Heights, Cowan Heights, Orange Park Acres and Panorama Heights. Generally speaking, most of the District lies east of the Costa Mesa Freeway (I-55), north of the Santa Ana Freeway (I-5), west of Jamboree Road and south of Santiago Canyon Road. Figure 3-1 shows the District's wholesale water service area.

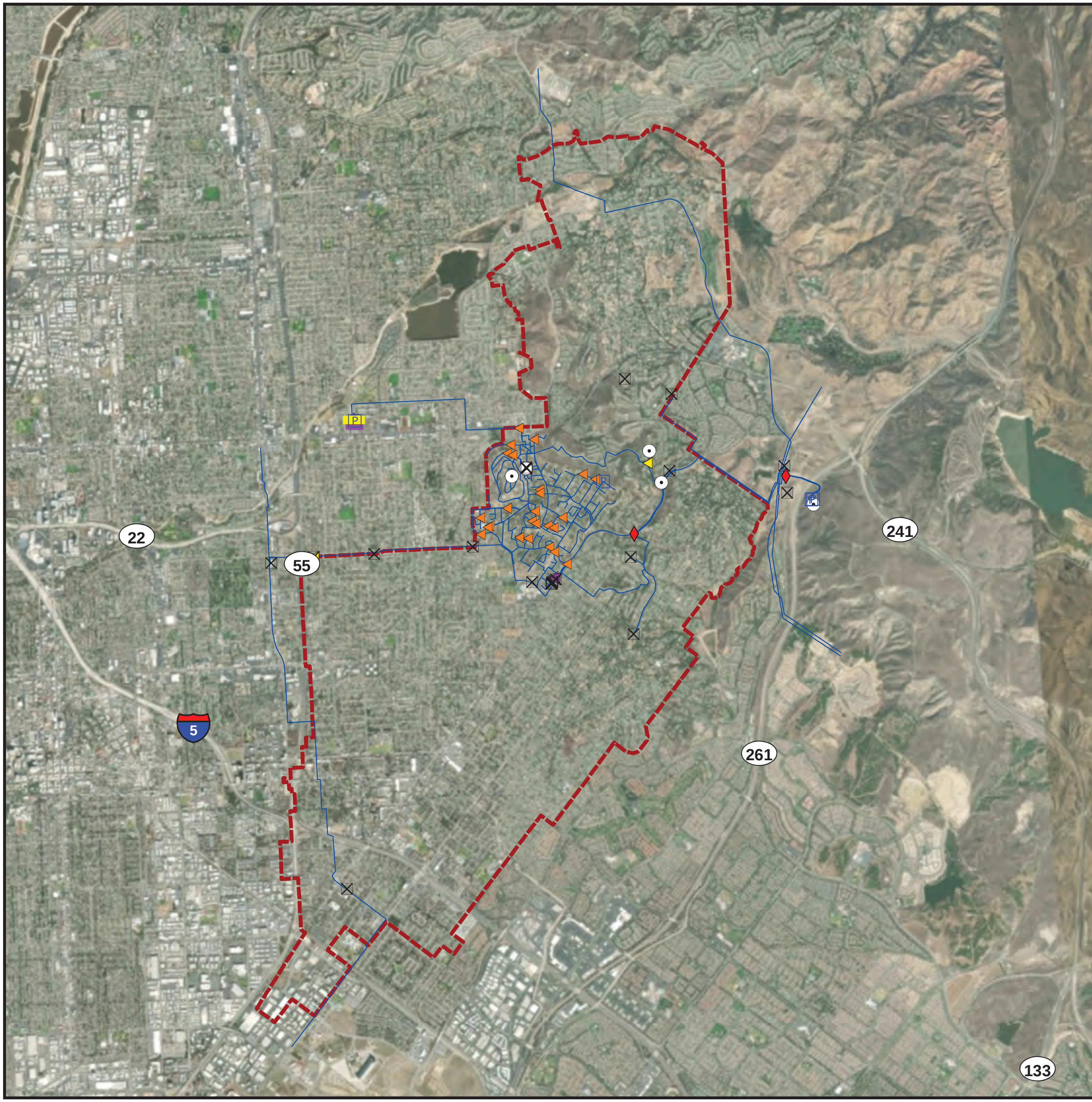
3.2.2 Retail Zone Service Area

Upon acquiring the County of Orange Waterworks District No. 8, the District named this service area the "Retail Zone" to distinguish it from the District's wholesale operation. The Retail Zone services approximately 1,200 connections and a population of approximately 3,500.

The Retail Zone system lies within the central portion of the Wholesale Zone, on the western side of the District about equidistant from the northern and southern boundaries. Most of the Retail Zone lies within the unincorporated community of Panorama Heights, generally bounded on the west by Hewes Avenue, on the south by Foothill Boulevard, on the east by Newport Boulevard and Crawford Canyon Road and on the north by Chapman Avenue. The Retail Zone is shown on Figure 3-2.

3.2.3 Wastewater Service Area

The District has named the service area of the former Orange County Sanitation District Local Service Area 7 wastewater system "Improvement District 1" or "the Sewer Zone." The system serves approximately 19,000 connections and serves a population of approximately 81,000. The service area includes the East Orange, Cowan Heights, Lemon Heights, Panorama Heights, and North Tustin areas and portions of the City of Tustin. These services are for transmission only, and do not include treatment. The wastewater service area is shown on Figure 3-3.



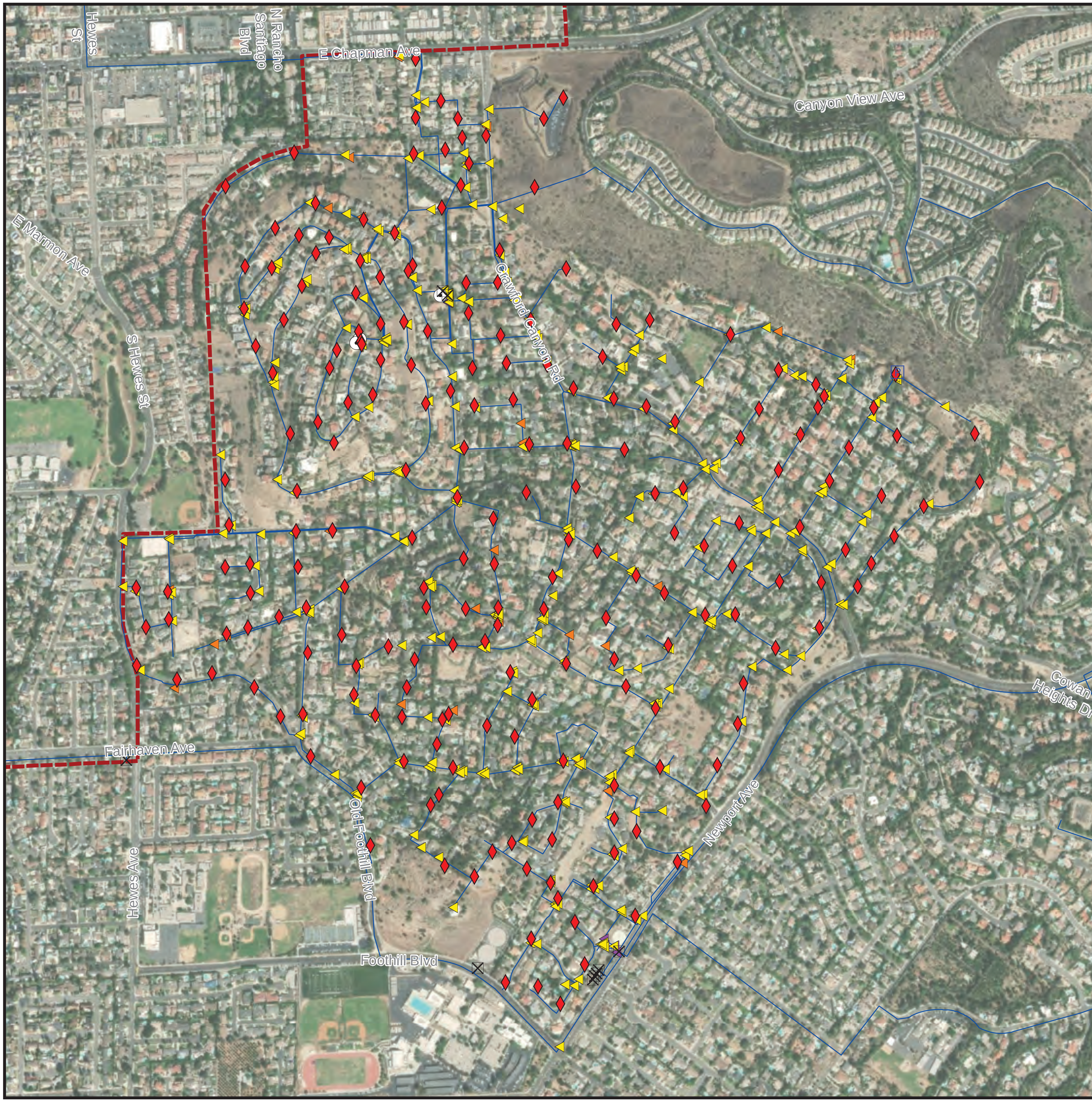
East Orange County Water District

Figure 3-1. District Wholesale Water Service Area

Map Data Sources: East Orange County Water District

East Orange County Water District

Figure 3-2. District Retail Water Service Area



Pump Station
System Connection
Hydrant
Tank
System Valve
Control Valve - Altitude
Control Valve - Air Release
Control Valve - GVC
Potable Water System Pipelines
Water District Boundary

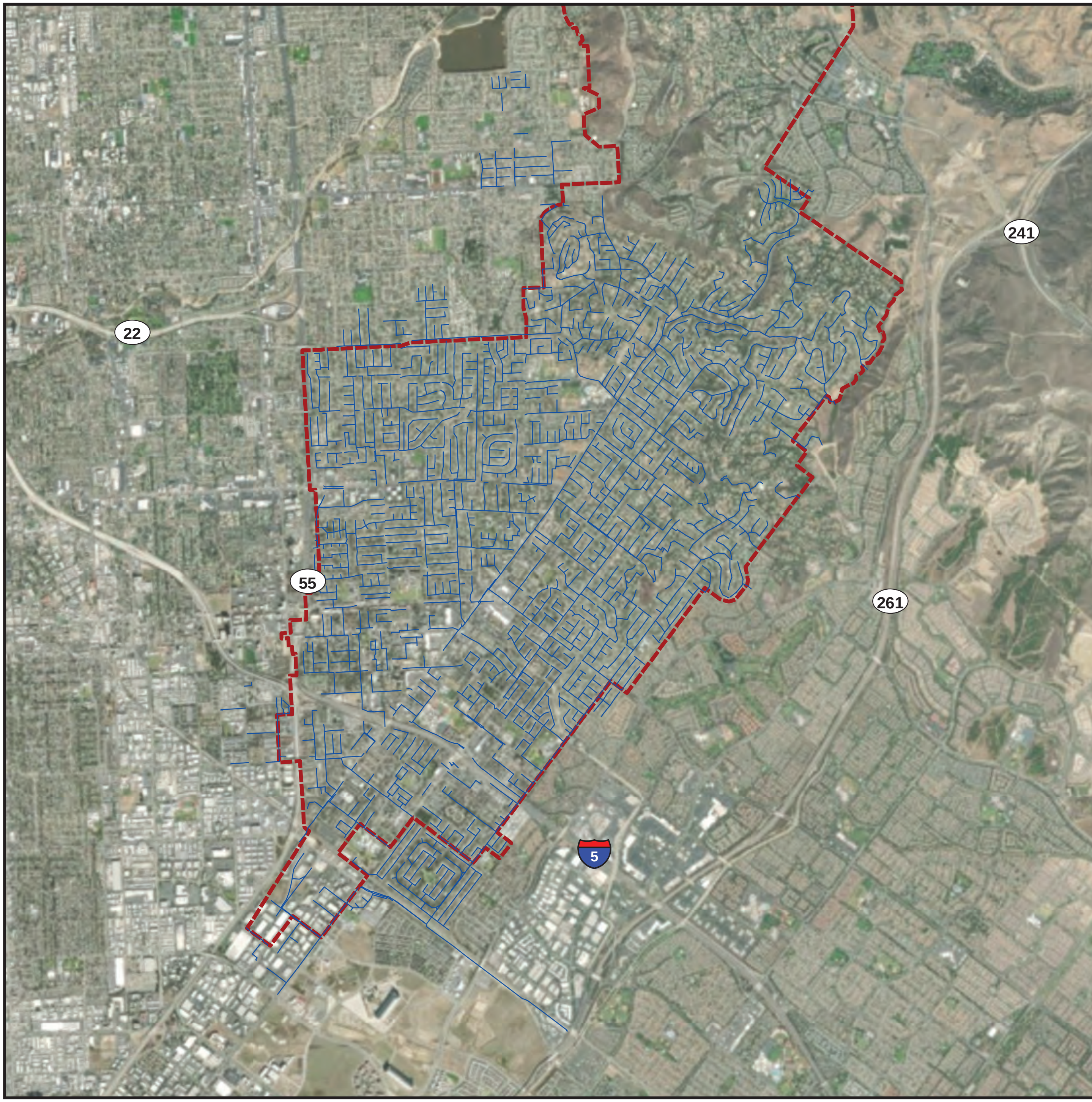
0 0.1 0.2
Miles

N
W E
S

EOCWD EAST ORANGE COUNTY WATER DISTRICT

TETRA TECH

Map Data Sources:
East Orange County Water District



East Orange County Water District

Figure 3-3. District Retail Wastewater Service Area

Waste Water System Pipelines

Water District Boundary

0 0.5 1

Miles

N
W E
S

EOCWD EAST ORANGE COUNTY WATER DISTRICT

TETRA TECH

Map Data Sources: East Orange County Water District

3.3 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. The key assets generally consist of buildings, wells, pump, tanks, and pipelines, which are defined for this plan as the District's critical facilities. Table 3-2 summarizes the District's critical assets and their value.

Table 3-1. East Orange County Water District Assets

Asset	Estimated Replacement Costs
Structures	
Administrative Building	$3,500,000[a]
Employee Facility	$1,500,000
Maintenance Yard—Enclosed Storage Fac	$800,000
Total	*$5,800,000*
Wells, Pumps and Tanks	
Retail Zone Well E1	$2,500,000
Retail Zone Well W1	$2,500,000
East Well Pump Station Pump/Motor/Elect/Controls	$1,000,000
West Well—Pump Station Pump Motor/Elect Controls	$5,000
Vista Panorama—Pump Station	$150,000
Barrett Site Pump Station	$350,000
11.5 MG Andres Reservoir	$18,500,000
1 MG Newport Blvd Reservoir	$3,500,000
Barrett Reservoir	$1,500,000
6MG Peters Canyon Reservoir	$10,000,000
Panorama Heights Reservoir	$1,200,000
Panorama Hydro Tank	$40,000
Total	*$41,245,000*
Pipes	
Retail Zone	$80,471,481
Wholesale Zone	$35,615,601
Sewer Zone	$740,200,000
Total	*$856,287,082*
Total Value for all District Assets	$903,332,082

a. Value shown is the cost for replacing the Administrative building to full compliance with codes and standards required by the City of Orange. The existing structure has been grandfathered and is not in compliance with current city codes and standards.

3.4 ADMINISTRATION

The District is governed by a five-member board of directors that are elected to serve 4-year terms. Day-to-day administration and operations are managed by a General Manager. The Board of Directors will adopt this plan once approval pending adoption has been granted by FEMA, and the General Manager will oversee its implementation.

3.5 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 3-2 lists declared hazard events whose effective area included the District service area (declared events within Orange County). Such a declaration does not necessarily indicate that any District assets were damaged by the event.

Table 3-2. Presidential Disaster Declarations with Affected Area Including the District Service Area

Type of Event	Date	Disaster Declaration	Counties Impacted[a]
COVID-19 Pandemic	03/22/2020	DR-4482	All California Counties
Wildfires	10/10/2017	DR-4344	Butte, Lake, Mendocino, Napa, Nevada, Orange, Solano, Sonoma, Yuba
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
Winter Storms, Flooding, and Debris and Mud Flows	01/26/2011	DR-1952	Inyo, Kern, Kings, Madera, Mariposa, Orange, Riverside, San Diego, San Luis Obispo, Santa Barbara, Tulare
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 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
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 Storms/Flooding	01/04/1997	DR-1155	Alameda, Alpine, Amador, Butte, Calaveras, Colusa, Contra Costa, Del Norte, El Dorado, Fresno, Glenn, Humboldt, Kings, Lake, Lassen, Madera, Marin, Mariposa, Mendocino, Merced, Modoc, Mono, Monterey, Napa, Nevada, Placer, Plumas, Sacramento, San Benito, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Solano, Sonoma, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, 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

Type of Event	Date	Disaster Declaration	Counties Impacted[a]
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
Snow Storm, Heavy Rain, High Winds, Flooding, Mudslide	02/25/1992	DR-935	Kern, Los Angeles, Orange, San Bernardino, Ventura
Severe Storms, High Tides, Flooding	02/05/1988	DR-812	Los Angeles, Orange, San Diego, Santa Barbara, Ventura
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
Urban Fire	04/24/1982	DR-657	Orange
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
Landslides	10/09/1978	DR-566	Orange
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
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

a. All declarations include Orange County

3.6 PHYSICAL CHARACTERISTICS

3.6.1 Topography

The topography of the service area generally slopes from the northeast to the southwest. Elevations range from around 70 feet above mean sea level to 900 feet above mean sea level. In the southern portion of the service area, the slopes are more gradual and constant. Generally north of 17th Street, the slopes start to steepen and there are hills and valleys throughout the communities of Lemon Heights, Cowan Heights, and Panorama Heights. Future sewer system expansion in the Cowan Heights area is expected to require privately owned sewer lift station facilities (EOCWD, 2018).

3.6.2 Soils and Geology

The 1986 Orange County Hydrology Manual identifies four distinct soil groups, as summarized in Table 3-3. Most soils in the District service area are Groups B, C, and D. The southern portion of the City of Tustin consists primarily of Group B soils. The northern portion of the City of Tustin and unincorporated County areas consist of a mix of Group B, C, and D soils (EOCWD, 2017).

Table 3-3. Identified Soil Types in the Orange County Area

Soil Group	Soil Description
A	Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well-drained sands or gravels. These soils have a high rate of water transmission.
B	Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained sandy-loam soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
C	Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of silty-loam soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.
D	High runoff potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Source: OC Public Works, 1986

3.6.3 Climate

The area has predominantly a Mediterranean climate with year-round pleasant weather. On average, August tends to be the warmest month and December the coolest. Winters are usually mild with no freezing temperatures. As with many areas of California, micro-climates in the District are possible. Table 3-4 summarizes key climate data in the area of the District.

Table 3-4. Average Orange County Climate Data

	Santa Ana Fire Station	Tustin Irvine Ranch
Period of record	1906 - 2016	1981-2010
Annual Average Minimum Temperature	52.0º F	51.5º F
Annual Average Maximum Temperature	75.8º F	76º F
Average Annual Mean Temperature	63.85º F	63.75º F
Maximum Temperature	112º F, June 14, 1917	111º F, September 26, 1963
Minimum Temperature	22º F, December 31, 1918	18º F, January 21, 1937
Average Annual Precipitation	13.69”	14.31”
One Date Maximum Precipitation	4.69”, February 16, 1927	5.17”, December 6, 1997

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 (WRCC, 2014).

3.7 DEVELOPMENT PROFILE

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 3-5 presents existing land uses in the sewer service area, as listed in the District's 2018 Sewer Master Plan.

Table 3-5. Land Use within the Sewer Service Area

Land Use	Planning Area	
	Area (acres)	% of total
Residential		
Low Density Residential	4126.6	66.2
Medium Density Residential	33.7	0.5
High Density Residential	605.5	9.7
Mobile Home Park	54.3	0.9
Commercial/Industrial		
Community Commercial	418.0	6.7
Old Town Commercial	51.9	0.8
Professional Office	49.8	0.8
Industrial	148.6	2.4
Other		
Agriculture	32.0	0.5
Church	36.4	0.6
Open Space	21.6	0.3
Park	43.5	0.7
Public	53.4	0.9
Public—Water Facilities	12.4	0.2
Right-of-Way	107.2	1.7
School	298.1	4.8
Special Care	4.0	0.1
Undevelopable Protected Land	24.2	0.4
Vacant	107.8	1.7
Total Service Area	6,229.1	100.0

The predominant land use in the sewer service area is low density residential housing, which makes up about 66 percent of the service area. High density residential uses are concentrated in the southern portion of the service area, often adjacent to commercial areas. Commercial and industrial land uses make up about 11 percent of the service area. The primary commercial and business uses are located on the westerly end of 17th Street, Newport Avenue south of La Colina Drive, 1st Street west of Newport Avenue, Old Town Tustin, and Redhill Avenue near the 5 Freeway. The portion of the service area south of Edinger Avenue between the 55 Freeway and Redhill Avenue also has come commercial land uses mixed with industrial land uses (EOCWD, 2018).

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 Orange County that interface with the District service area.

Balanced development is a primary goal in the City of Tustin. There is a lack of commercial services in certain geographic areas, such as the Irvine Business Center, which warrants consideration of additional commercial designations. In previous decades, land use patterns encouraged Tustin residents to rely on the automobile to commute to work and shopping. Pedestrian orientation is now encouraged in select areas of the City. The City has the opportunity to purchase surplus freeway parcels and develop them with uses which capitalize on their freeway accessibility. The Tustin Legacy Specific Plan will continue to guide future development on 1,533 acres in the City of Tustin.

The intermixing of land uses in some areas without adequate buffering has resulted in land use incompatibilities, such as those related to physical scale, noise, and traffic. Specific types and examples of incompatible land uses include the following:

- Obtrusive industrial uses adjacent to residential development;
- Commercial uses abutting residential development without adequate buffering;
- High-density residential adjacent to lower residential densities without adequate buffering;
- Noise sensitive uses adjacent to freeways, highways and railroads.

The market trend for mixed-use housing opportunities within a walkable downtown as well as within the Red Hill Avenue commercial area has created a desire for a mix of compatible commercial, office and residential uses. New development, if not regulated, can interfere with public vistas and views of the surrounding hillsides, public monuments, and other important viewsheds.

The unincorporated North Tustin, Cowan Height, Lemon Heights, Panorama Heights, and Orange Park Acres areas have a well-developed, low-density, semi-rural character; however, this is changing due to the State of California's approval of accessory dwelling units, which cannot be regulated at the local level. For a 10,000-square-foot property in the EOCWD service area, a property owner can locate up to four accessory dwelling units on the site. EOCWD is currently studying the effect this will have on sewer service provision as water use shifts from outdoor use (which recharged groundwater supplies) to indoor use, which will be discharged to the sewer system; the local sewer system was not designed for this density.

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 (Press-Telegram, 2015).

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 encompass most of the City of Tustin, an eastern portion of the City of Orange, and the unincorporated area of North Tustin. The following demographic profiles are based on census data available for the City of Tustin and the North Tustin Census Designated Place (CDP; an unincorporated area designated for analysis by the U.S. Census Bureau).

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 were the City of Tustin and the North Tustin CDP. The Census Bureau's estimated 2018 population is 80,140 for Tustin and 24,736 for North Tustin.

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 Tustin from 1995 to 2018 compared to that of the State of California (California Department of Finance, 2017).

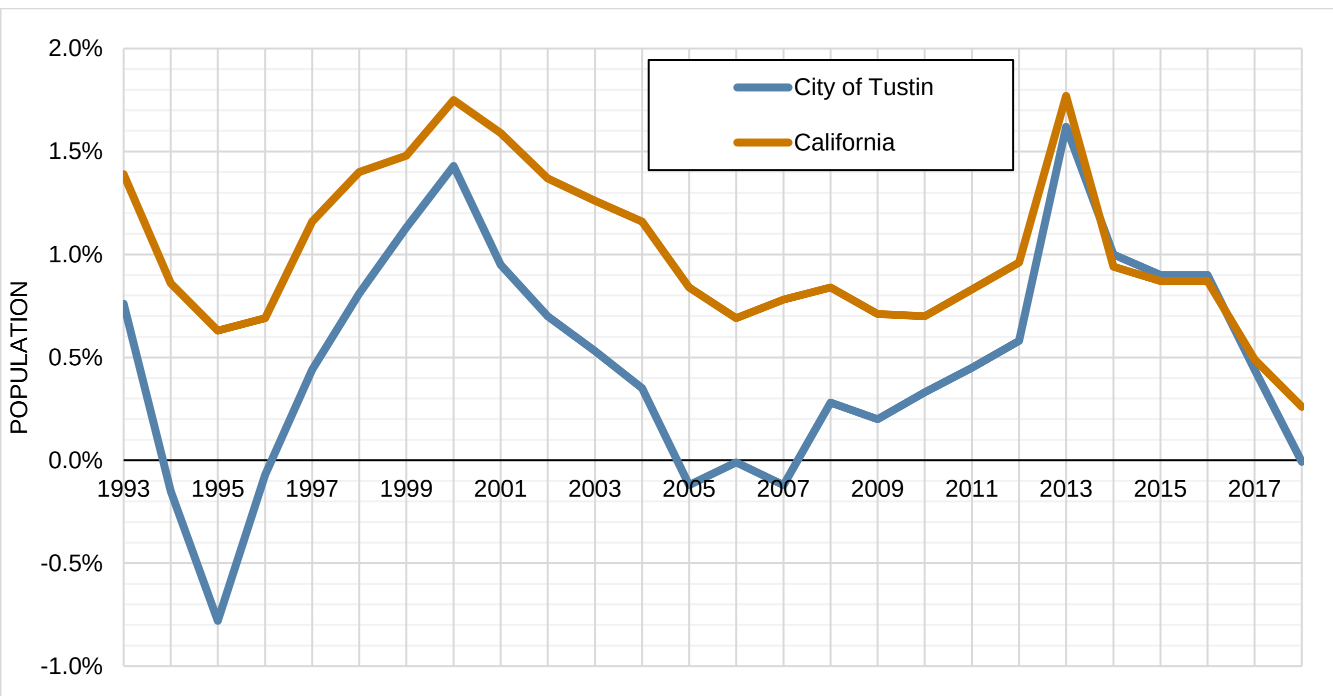


Figure 3-4. California and City of Tustin Population Growth

Between 2000 and 2018, California's population grew by 18.68 percent (about 0.98 percent per year) while Tustin's population increased by 10.4 percent (0.55 percent per year). The City and the state both experienced peak population growth in 2000, with the annual growth rate generally slowing from 2000 to 2007. The rate has steadily increased since 2007, reaching a peak in 2013. The City population decreased from 1994 through 1996 and 2005 through 2007. Between 2010 and 2016, the population increased an average of 0.83 percent per year, for a total of 5.78 percent. Table 3-6 shows the population in the Tustin and Orange County from 2000 to 2019.

Table 3-6. Annual Population Data

Year	City of Tustin	Orange County	Year	City of Tustin	Orange County
2000	67,504	2,846,289	2010	75,540	3,008,855
2001	68,189	2,871,926	2011	75,771	3,040,125
2002	68,875	2,902,207	2012	76,599	3,076,373
2003	69,455	2,927,118	2013	78,129	3,109,213
2004	69,985	2,948,135	2014	78,347	3,131,411
2005	70,116	2,956,847	2015	79,601	3,155,578
2006	70,880	2,956,334	2016	82,015	3,174,945
2007	71,493	2,960,659	2017	82,372	3,199,509
2008	73,270	2,974,321	2018	81,755	3,213,275
2009	74,340	2,990.805	2019	81,369	3,222,498

Source: California Department of Finance, Demographic Research Unit

3.8.2 Age Distribution

As a group, the elderly 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 residents 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 basic necessities. 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 and Figure 3-6 for the City of Tustin and the North Tustin CDP. Based on the most recent 5-year estimates from the U.S. Census Bureau's American Community Survey (2014-2018), 9.9 percent of Tustin and 23.6 percent of the North Tustin CDP areas' populations are 65 or older. According to U.S. Census data, 29.5 percent of Tustin's and 28.6 percent of North Tustin CDP's over-65 population have disabilities of some kind and 13 percent (Tustin) and 2.9 percent (North Tustin CDP) have incomes below the poverty line. Tustin's population includes 13.5 percent who are 14 or younger. Among children under 18, 16.5 percent are below the poverty line. North Tustin CDP's population includes 11.5 percent who are 14 or younger. Among children under 18 in the area, 3 percent are below the poverty line.

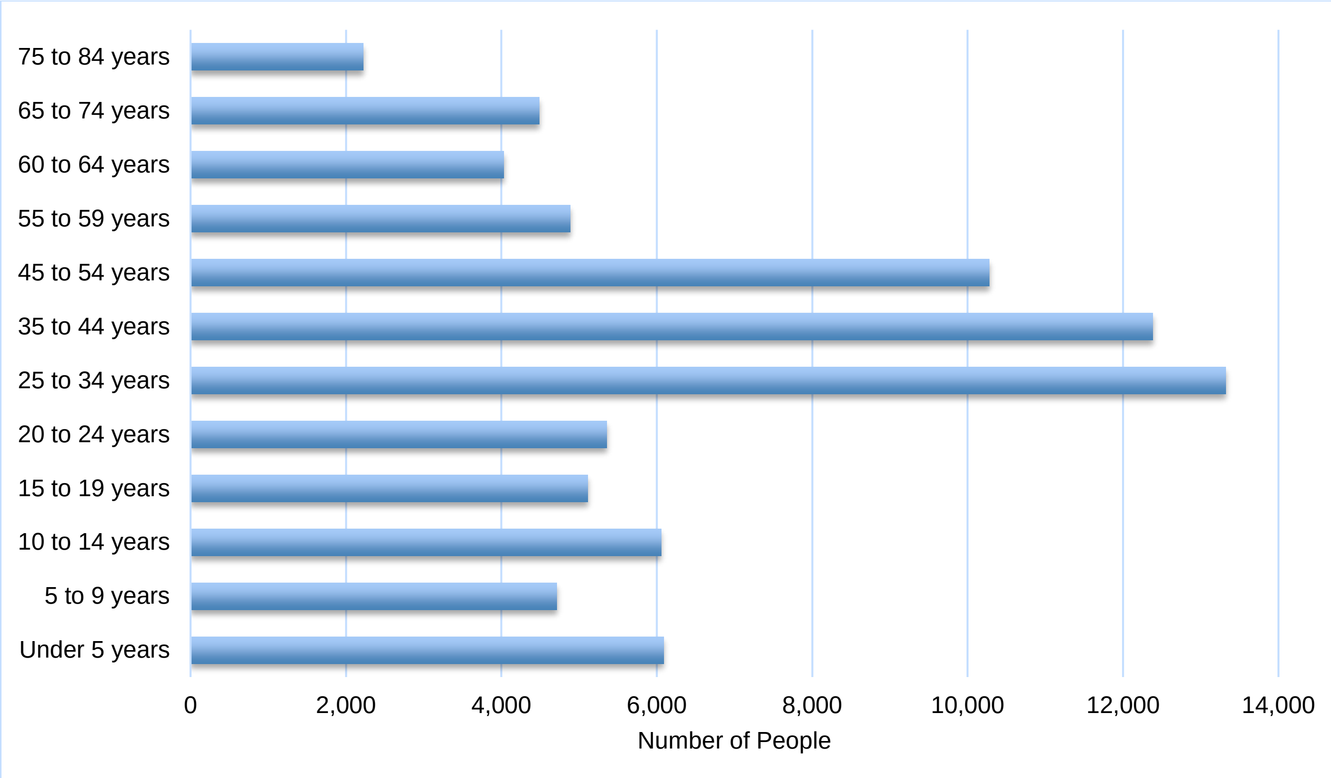


Figure 3-5. Age Distribution in the City of Tustin

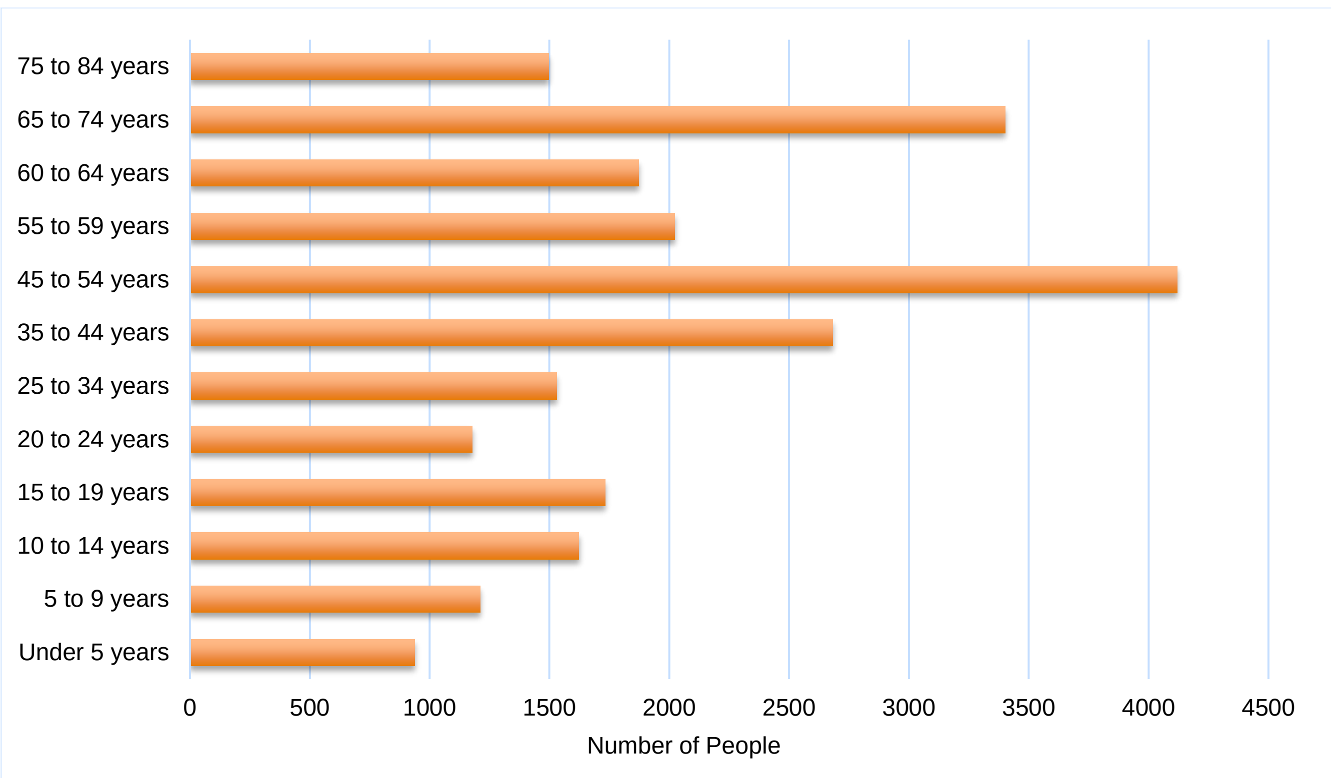


Figure 3-6. Age Distribution in the North Tustin CDP

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 3-7 and Figure 3-8 show the U.S. Census 2018 racial distribution in the City of Tustin and the North Tustin CDP, based on race categories defined by U.S. Office of Management and Budget standards. The Census Bureau also reports that 50.5 percent of the City 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.

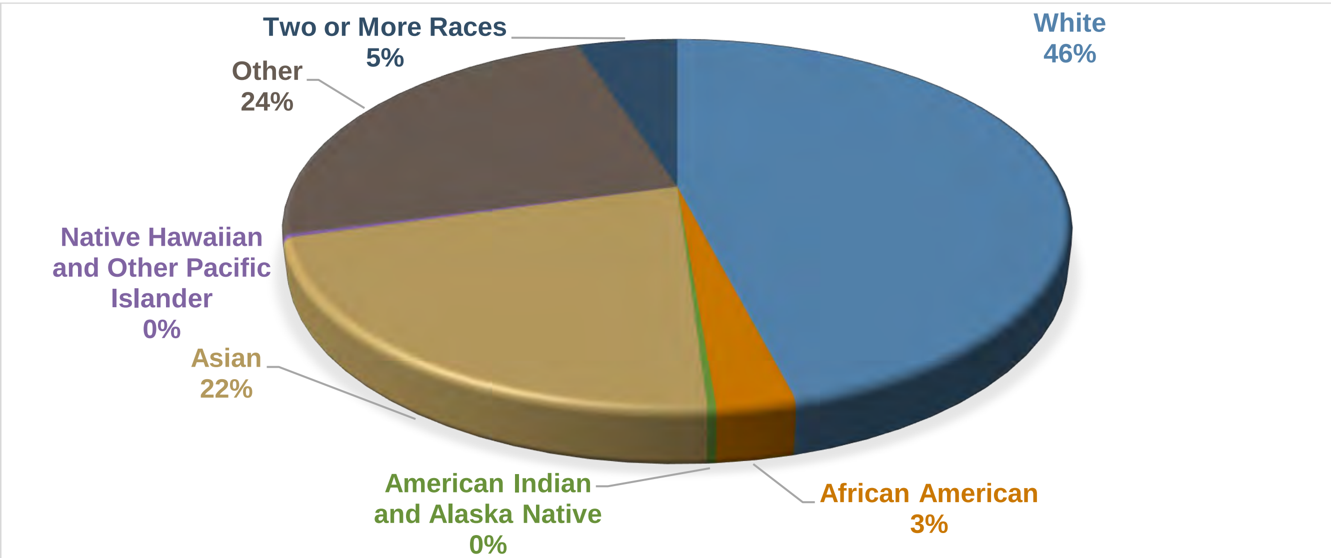


Figure 3-7. City of Tustin Race Distribution

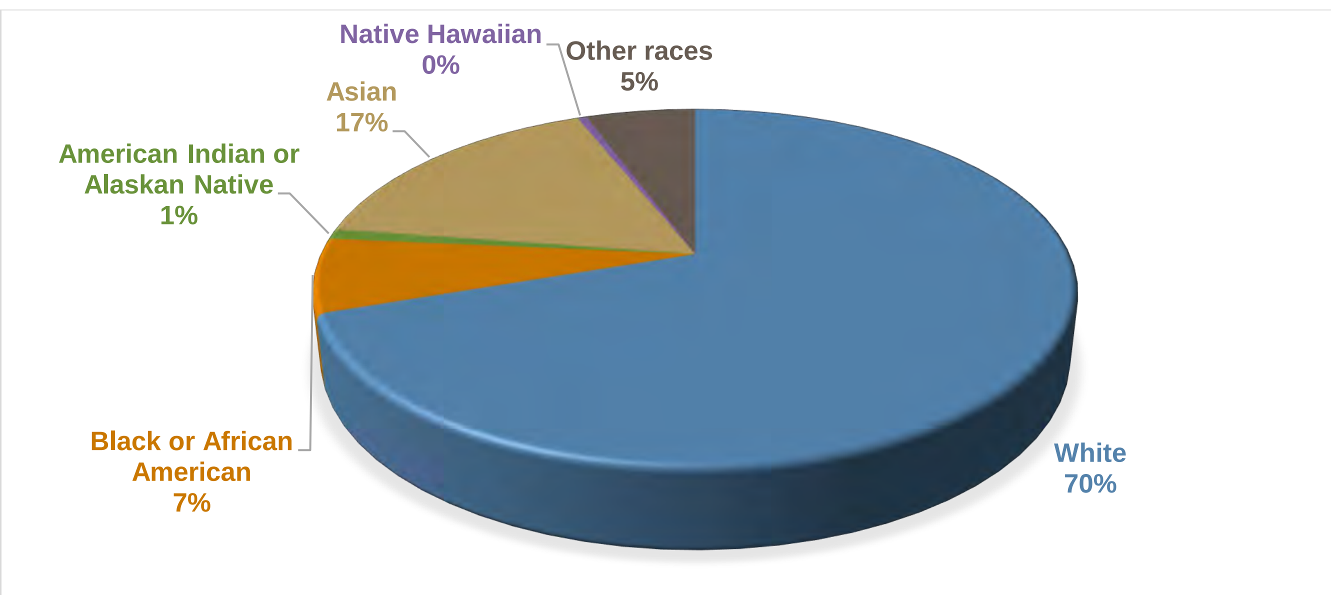


Figure 3-8. North Tustin CDP Race Distribution

According to the U.S. Census, 46.1 percent of families in city of Tustin speak English only at home. 53.9 percent of families speak a language other than English at home; the largest contingent of those families speaks Spanish (33.9 percent).

According to the U.S. Census, 79.8 percent of families in the North Tustin CDP speak English only at home. 20.2 percent of families speak a language other than English at home; the largest contingent of those families speaks Spanish (10.2 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 in order 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 those residents.

According to the 5-year American Community Survey (2014-2018), there are 6,064 individuals in Tustin and 2,595 individuals in North Tustin CDP with some form of disability. These individuals represent 7.6 percent and 10.5 percent of the total population respectively.

3.9 FINANCIAL SUMMARY

The District has five budgets that are planned and administered annually (the District "Fiscal Year" runs from July 1 - June 30); each budget provides a detailed spending plan for each of the major functions performed by the District. A brief explanation of the background behind each budget is discussed below:

- **Wholesale Zone Operating Budget—**These are the funds budgeted for the day-to-day operation of the "Wholesale Zone," so called because these facilities provide imported (from Northern California and the Colorado River) water on a wholesale cost basis. These costs include everything from the costs the District pays for the water itself, to the materials, tools and equipment used to repair facilities, to the salaries and benefits of the employees working on the wholesale zone. This imported water is supplied to five "retail" water agencies: the City of Tustin, Golden State Water Company (Cowan Heights/Lemon Heights area), the District's own "Retail Zone," the City of Orange and Irvine Ranch Water District (emergency use only).
- **Wholesale Zone Capital Improvement Program Budget**—These funds are used solely for build, replace or rehabilitate capital facilities like reservoirs and pipelines.
- **Retail Zone Operating Budget**—These funds are budgeted, similar to the Wholesale Zone Operating Budget, for the day-to-day operations of the District's "Retail Zone," where water is provided directly to consumers in the unincorporated Vista Panorama area of Orange County.
- **Retail Zone Capital Improvement Program Budget**—Like the Wholesale Zone CIP, these funds are used to pay for the building, replacement or rehabilitation of large capital facilities.
- **Wastewater Operating Budget—**The District currently collects and transports sewage from approximately 19,000 sewer connections. The District's wastewater service fees are collected on each property owner's property tax bill on an annual basis.

Each of these identified funding sources could be the source of local contributions for federal grants that require a local match. It is the District's intention with the completion of this Hazard Mitigation Plan to leverage state and federal grant funding as much as possible to increase the resilience of the District.

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. 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.
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.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
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.
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.

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
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 HMP.
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 SSOs 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 jurisdictions plans provide information and guidance relevant to hazard mitigation planning for the District:

- Orange County Emergency Operations Plan
- County of Orange / Orange County Fire Authority Hazard Mitigation Plan (Orange County, 2015)
- City of Orange Hazard Mitigation Plan (City of Orange, 2016)
- City of Tustin Hazard Mitigation Plan (City of Tustin, 2018)
- Orange County Regional Water and Wastewater Multi-Hazard Mitigation Plan (MWDOC, 2019)

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 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 21. 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. Every code can be amended, and every plan can be updated. This adaptability is considered to be an overarching District capability that is acknowledged by this reference.

4.3.1 Retail Zone Water Conservation Ordinance (No. 2009-01)

Ordinance No. 2009-01 seeks to minimize or avoid the effect and hardship of potential shortages of water to the greatest extent possible. To that end, it establishes a Water Conservation Program for the Retail Zone designed to reduce water consumption (demand) through conservation; enable effective water supply planning; assure reasonable and beneficial use of water; and prevent waste of water and maximize efficient use in the District (EOCWD, 2009).

The ordinance establishes two types of actions to achieve their goals. The first are permanent water conservation standards designed to alter behaviors related to water-use efficiency during non-shortage conditions. The second are three levels of potential response to escalating water supply shortages which the East Orange County Water District Board may choose to implement during times of declared water shortage or water emergency. The three levels of response consist of increasing water use restrictions as a result of worsening drought conditions, emergencies, and/or decreasing supplies.

4.3.2 District Urban Water Management Plan

Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act require 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 to prepare, adopt, and file an Urban Water Management Plan (UWMP) with the California Department of Water Resources (DWR) every five years in the years ending in zero and five.

This UWMP provides a detailed summary of present and future water resources and demands within the District's service area and assesses the District's water resource needs (EOCWD, 2015). Specifically, the UWMP provides water supply planning for a 25-year planning period in five-year increments and identifies water supplies needed to meet existing and future demands. The demand analysis must identify supply reliability under three hydrologic conditions: a normal year, a single dry year, and multiple-dry years. The District's 2015 UWMP updates the 2010 UWMP in compliance with the requirements of the Act as amended in 2009, and includes a discussion of:

- Water Service Area and Facilities
- Water Sources and Supplies
- Water Use by Customer Type
- Demand Management Measures
- Water Supply Reliability
- Planned Water Supply Projects and Programs
- Water Shortage Contingency Plan
- Recycled Water Use

The District's 2020 UWMP process is underway, with the consultant being selected. The state granted an extension of all agencies to June 2021 for completion of the UWMP.

4.3.3 District Sewer System Management Plan

State law requires local sewer agencies to create and implement sewer system management plans as part of their efforts to prevent sanitary sewer overflows. (State Water Resources Control Board Order No. 2006-0003-DWQ). The District's *Sewer System Management Plan* meets the requirements of the state order (EOCWD, 2019).

4.3.4 District Strategic Plan

The District's *Five-Year Strategic Plan* was originally developed in 2015 and is updated on a two-year basis under the guidance of the Board of Directors and senior management representing all of the District's functions. In the most recent update (EOCWD, 2019a), the focus was on key issues the District faced in the next five-year planning horizon and beyond. The Board refined goal areas that represent the key District commitments to the community:

- **Goal 1: Water and Sewer Service Reliability—**The District will provide safe, reliable and environmentally sustainable water and sewer services and infrastructure to meet the needs of the community
- **Goal 2: Community Representation and Engagement—**The District will provide responsive local governance, value and outreach to the communities it serves
- **Goal 3: Financial Integrity—**The District will manage financial assets to provide and
- maintain reliable water services
- **Goal 4: Professional Workforce—**The District will maintain work force expertise to ensure service quality, continuity, and reliability

The Board adopted the updated plan on June 21, 2019.

4.3.5 Retail Zone Master Plan

The 2015 *Retail Zone Master Plan* provides a baseline database of information about infrastructure assets of the Retail Zone, assesses current conditions, and develops a capital improvement program (CIP). The CIP guides the District in the planning, development, and budgeting of Retail Zone water system improvement projects required to meet system performance criteria for existing retail customers as well as to support anticipated demands through 2040. In addition, the CIP in this plan includes a prioritized schedule of the rehabilitation and replacement of existing infrastructure. This plan was used as a source of information on district assets for the hazard mitigation planning effort, as well as the identification of projects in the Retail Zone.

4.3.6 Wholesale Zone Master Plan

The *Wholesale Zone Master Plan* provides information about the District's Wholesale Zone system under existing and future conditions through 2040. The Master Plan provides a baseline database of information about infrastructure assets of the Wholesale Zone, assesses current conditions, and develops a CIP that will guide the District in the planning, development, and budgeting of Wholesale Zone water system improvement projects. This plan was utilized as a source of information on district assets for the hazard mitigation planning effort as well as the identification of projects in the Wholesale Zone.

4.3.7 Sewer Master Plan

The 2018 *Sewer Master Plan* contains an evaluation of the capacity of the sewer system under existing and future development conditions, and identification of deficiencies that need to be addressed. To perform this work, a detailed hydraulic model was developed, and sewer system condition information was reviewed and compiled to develop recommendations for future inspections and improvements. The results were compiled into a 20-year CIP for the sewer system.

4.3.8 AWIA Plan

Concurrent with the development of this hazard mitigation plan, the District was developing its plan pursuant to the directives if the America's Water Infrastructure Act of 2018 (AWIA). The primary objectives of the AWIA are to improve drinking water and water quality, deepen infrastructure investments, enhance public health and quality of life, increase jobs, and bolster the economy. The AWIA provisions are the most far-reaching changes to the Safe Drinking Water Act since the 1996 Amendments, with over 30 mandated programs. The AWIA requires community water systems serving more than 3,300 people to develop or update risk assessments and emergency response plans. The law specifies the components that the risk assessments and emergency response plans must address and establishes deadlines by which water systems must certify to EPA completion of the risk assessment and emergency response plan.

It is the District's intent to integrate these two plans where feasible so that they can work in concert as they strive to meet their individual objectives. Information from both planning efforts was utilized to support the end product for both efforts. It is the District's intention to implement and maintain both plans in concert moving forward after both plans have been reviewed and approved by their respective oversight agencies (EPA and FEMA).

4.3.9 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	Accessible or Eligible to Use?
Capital Improvements Project Funding	Yes
Authority to Levy Taxes for Specific Purposes	Yes
User Fees for Water, Sewer, Gas or Electric Service	Yes
Incur Debt through General Obligation Bonds	Yes
Incur Debt through Special Tax Bonds	Yes
State-Sponsored Grant Programs	Yes
Federal-Sponsored Grant Programs	Yes
Other	N/A

4.3.10 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.

4.3.11 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 4-4. Administrative and Technical Capability

Staff/Personnel Resources	Available?	Department/Agency/Position
Planners or engineers with knowledge of water supply infrastructure	Yes	Engineering Manager can perform or can contract for this service
Planners or engineers with an understanding of natural hazards	Yes	Contract for service
Staff with training in benefit/cost analysis	Yes	Contract for service
Personnel skilled or trained in GIS applications	Yes	Engineering Manager can perform or contract for service
Scientist familiar with natural hazards in local area	Yes	Contract for service
Emergency manager	Yes	General Manager
Grant writers	Yes	General Manager can perform or contract for service
Other	N/A	N/A

Table 4-5. Education and Outreach Capability

Criterion	Response
Do you have a public information officer or communications office?	Yes, General Manager and Contractor, CommunicationsLAB
Do you have personnel skilled or trained in website development?	Yes. Contract for this service (CommunicationsLAB)
Do you have hazard mitigation information available on your website? • If yes, briefly describe.	Yes https://www.eocwd.com/hazardmitigationplan
Do you use social media for hazard mitigation education and outreach? • If yes, briefly describe.	Yes District uses Facebook, Twitter and Instagram
Do you have any citizen boards or commissions that address issues related to hazard mitigation? • If yes, briefly describe.	Yes Citizen Advisory Committee was utilized for the development of this plan
Do you have any other programs already in place that could be used to communicate hazard-related information? • If yes, briefly describe.	Yes - AlertOC District is part of County-wide Emergency Notification System; County provides related advertising of the system and provides hazard-related information
Do you have any established warning systems for hazard events? • If yes, briefly describe.	Yes SCADA System, County Emergency Operations Center, AlertOC

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. As mentioned above, the District has already begun this integration process with the concurrent planning efforts for the AWIA plan and this 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 master plans for the Wholesale, Retail and Sewer Zones.

- Future updates to the Sewer System Management Plan
- Future updates to the Urban Water Management 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 20.

Part 2. Risk Assessment

5. HAZARDS OF CONCERN

The Steering Committee considered the full range of natural hazards that could impact the planning area and then ranked 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:

- Dam failure
- Drought
- Earthquake
- Flood
- Landslide
- Severe weather
- Space weather (effects on earth caused by conditions in space)
- Wildfire

6. RISK ASSESSMENT METHODOLOGY

The risk assessments in this hazard mitigation plan describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. 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:
  - 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 structures, facilities, and systems to determine which of them would be exposed to each hazard. For each identified hazard of concern, the best available existing data delineating a hazard area was selected. Data sets were evaluated based on scale, age and source. Additionally, data available in a GIS-compatible format with coverage of the full extent of the planning area were preferentially selected for use in the analysis.
- Assess the vulnerability of exposed facilities—Vulnerability of 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, dam failure and earthquake hazards. Outputs similar to those from Hazus were generated for other hazards, using maps generated by the Hazus program.

6.1 MAPPING

A review of national, state and county databases was performed to locate available spatially based data relevant to this planning effort. Maps were produced using GIS software to show the spatial extent and location of identified hazards when such data was available. These maps are included in the hazard profile chapters of this document.

6.2 HAZARD RISK MODELING

6.2.1 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 and floods.

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, critical facility, transportation and utility lifeline, 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.

6.2.2 Levels of Detail for Evaluation

Hazus provides default data for inventory, vulnerability 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.

6.2.3 Application for This Plan

The following hazards were evaluated using Hazus:

- **Flood**—A Level 2 user-defined analysis was performed for the District's facilities and infrastructure in flood zones. Current flood mapping for the planning area was used to delineate flood hazard areas and estimate potential losses from the 1-percent-annual-chance and 0.2-percent-annual-chance flood event (commonly known as the 100-year and 500-year floods). To estimate damage that would result from a flood, Hazus uses pre-defined relationships between flood depth at a structure and resulting damage, with damage given as a percent of total replacement value. Curves defining these relationships have been developed for damage to structures and for damage to typical contents within a structure. By inputting flood depth data and known structure replacement cost values, dollar-value estimates of damage were generated.
- **Dam Failure**—A Level 2 analysis was run using the flood methodology described above. The analysis assessed the mapped inundation areas for failure of four dams: Santiago Dam, Peters Canyon Dam, Villa Park Dam, and the Lower Peters Canyon Retarding Basin.
- **Earthquake**—A Level 2 analysis was performed to assess earthquake exposure and vulnerability for four scenario events and one probabilistic event:
    - A Magnitude-6.4 Anaheim scenario event on the Norwalk Fault with an epicenter 12 miles northwest of the City of Tustin.

- A Magnitude-7.2 event on the Newport-Inglewood fault with an epicenter 21.5 miles west northwest of the City of Tustin.
- A Magnitude-6.6 event on the Peralta Hills fault with an epicenter 10 miles north of the City of Tustin.
- A Magnitude-7.0 event on the Whittier fault with an epicenter 13 miles north of the City of Tustin.
- The standard Hazus 500-year probabilistic event.

6.3 RISK ASSESSMENT WITHOUT MODELING

For most of the hazards evaluated in this risk assessment, historical data was not adequate to model future losses. However, GIS is able to map hazard areas and calculate exposures if geographic information is available on the locations of the hazards and inventory data. A qualitative analysis was conducted for some hazards using the best available data and professional judgment. The risk assessment for drought was more limited and qualitative than the assessment for the other hazards of concern because drought does not affect structures.

6.4 SOURCES OF DATA USED IN HAZUS MODELING

6.4.1 Building and Cost Data

Replacement cost values and detailed structure information were derived from facilities and infrastructure data provided by the District. Buildings, wells, pump stations, tanks, and pipelines were loaded into Hazus for analysis. The exposure of other infrastructure, including valves, hydrants, and connections, to the hazards was analyzed using GIS overlays.

6.4.2 Hazus Data Inputs

The following hazard datasets were used for the Hazus Level 2 analysis conducted for the risk assessment:

- **Flood**—The effective Digital Flood Insurance Rate Map (DFIRM) for the planning area was used to delineate flood hazard areas and estimate potential losses from the 0.2-percent-annual-chance flood event. Using the DFIRM floodplain boundaries, and the U.S. Geological Survey (USGS) 3-meter digital elevation model data, a flood depth grid was generated and integrated into the Hazus model.
- **Dam Failure**—Dam inundation depth grids for Santiago Dam and Villa Park Dam provided by the California Department of Water Resources were integrated into the Hazus model.
- **Earthquake**—Earthquake ShakeMaps and probabilistic data prepared by the USGS were used for the analysis of this hazard. National Earthquake Hazard Reduction Program (NEHRP) soils and liquefaction zones from the California Department of Conservation, and the California Geological Survey’s landslide susceptibility data were also integrated into the Hazus model.

6.4.3 Other Local Hazard Data

Locally relevant information on hazards was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others. Data sources for specific hazards were as follows:

- **Landslide**— Data on susceptibility to deep-seated landslides was provided by the California Geological Survey. Areas categorized as having very high, high, moderate, and low susceptibility were used in the exposure analysis.
- **Wildfire**—Fire risk data was acquired from the California Department of Forestry and Fire Protection (CAL FIRE). Areas categorized as very high, high, and moderate were used in the exposure analysis.

6.4.4 Data Source Summary

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

Table 6-1. Hazus Model Data Documentation

Data	Source	Date	Format
Facilities and infrastructure data including buildings, wells, pump stations, tanks, valves, hydrants, connections and pipelines	East Orange County Water District	2020	Digital (GIS) format
Effective Digital Flood Insurance Rate Map [Orange County DFIRM effective date of 3/21/2019 with last LOMR incorporated 11/15/2019]	FEMA	2019	Digital (GIS) format
Earthquake ShakeMaps	USGS Earthquake Hazards Program website	2017	Digital (GIS) format
Liquefaction zones	California Department of Conservation	2001	Digital (GIS) format
NEHRP Soils	California Department of Conservation	2008	Digital (GIS) format
Dam Breach Inundation Maps (Santiago Dam, Villa Park Dam, Peters Canyon Dam, Peters Detention Basin)	California Department of Water Resources	Downloaded 2020	Digital (GIS) format
Susceptibility to Deep-Seated landslides	California Geological Survey	2011	Digital (GIS) format
Fire Severity Zones	CAL FIRE	2008	Digital (GIS) format
3-meter Digital Elevation Model	USGS	Downloaded 2020	Digital (GIS) format

6.5 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 residents have 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. DAM FAILURE

7.1 GENERAL BACKGROUND

7.1.1 Definitions

A dam is an artificial barrier that has the ability to store water, wastewater, or liquid-borne materials for many reasons—flood control, human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, or pollution control. Many dams fulfill a combination of these functions. They are an important resource in the United States.

Dams can be classified according to their purpose, construction material, slope, cross-section, or means of controlling seepage. Materials used to construct dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, plastic, rubber, and combinations of these. Regulatory oversight of dams is assigned to various agencies (see Appendix B):

- FEMA monitors dams under the National Dam Safety Act
- The Federal Energy Regulatory commission promotes safety of power-producing dams through its Dam Safety Program
- The U.S. Army Corps of Engineers operates and maintains hundreds of dams nationwide and is responsible for safety inspections of dams that meet size and storage limitations specified in the National Dam Safety Act.
- California's Division of Safety of Dams, Department of Water Resources monitors the Dam Safety Program at the state level and maintains a working list of dams in the state.

7.1.2 Dam Hazard Ratings

Dam failure can be catastrophic to all life and property downstream. The U.S. Army Corps of Engineers developed the classification system shown in Table 7-1 for the hazard potential of dam failures. The rating system is based on the potential consequences of a dam failure; it does not address the probability of such failures.

7.1.3 Causes of Dam Failures

Dam failures in the United States typically occur in one of four ways:

- Overtopping of the primary dam structure, which accounts for 34 percent of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30 percent of all dam failures.
- Failure due to piping and seepage accounts for 20 percent of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10 percent of all failures.

Table 7-1. Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: U.S. Army Corps of Engineers, 1995

The remaining 6 percent of failures are due to miscellaneous causes such as earthquakes, landslides, sabotage, or equipment malfunction. Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable through regular inspections. Terrorism and vandalism are concerns that all operators of public facilities plan for; these threats are under continuous review by public safety agencies.

7.2 HAZARD PROFILE

7.2.1 Past Events

According to the 2018 California State Hazard Mitigation Plan, there have been nine dam failures in the state since 1950, none of which occurred in Orange County. Overtopping caused two of the failures, and the others were caused by seepage or leaks. California has had about 45 failures of non-federal dams. The most common cause of failure was overtopping.

7.2.2 Location

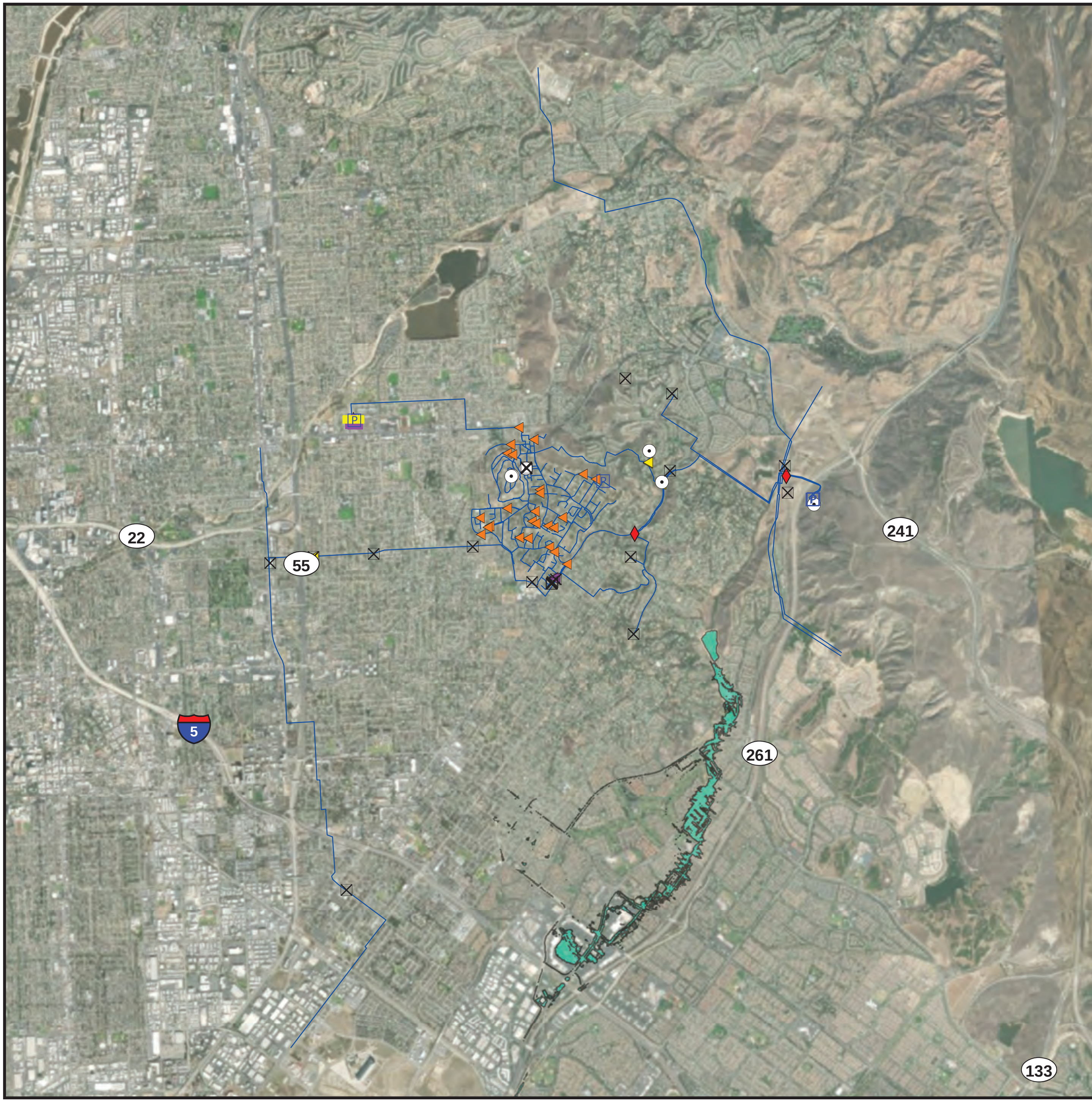
According to the National Inventory of Dams, there are 44 dams in Orange County. The locations and inundation areas of dams that have the potential to impact the District should they fail are shown in Figure 7-1 to Figure 7-8. Table 7-2 lists the basic characteristics of these dams.

Frequency

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides and excessive rainfall and snowmelt. There is a “residual risk” associated with dams that remains after safeguards have been implemented. The residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of dam failure is low in today’s regulatory environment. For the risk ranking in this plan, the District chose to assign a probability value of medium (an event to likely occur within 100 years) to account for increased frequency due to the impacts from climate change.

East Orange County Water District

Figure 7-1. Water System Facilities and Lower Peters Canyon Retarding Basin Inundation Area



Building
Pump Station
Enclosed Storage Facility
System Connection
Hydrant
Production Well
Tank
System Valve
Control Valve - Altitude
Control Valve - Air Release
Control Valve - GVC
Potable Water System Pipelines
Inundation Area

0 0.5 1
Miles

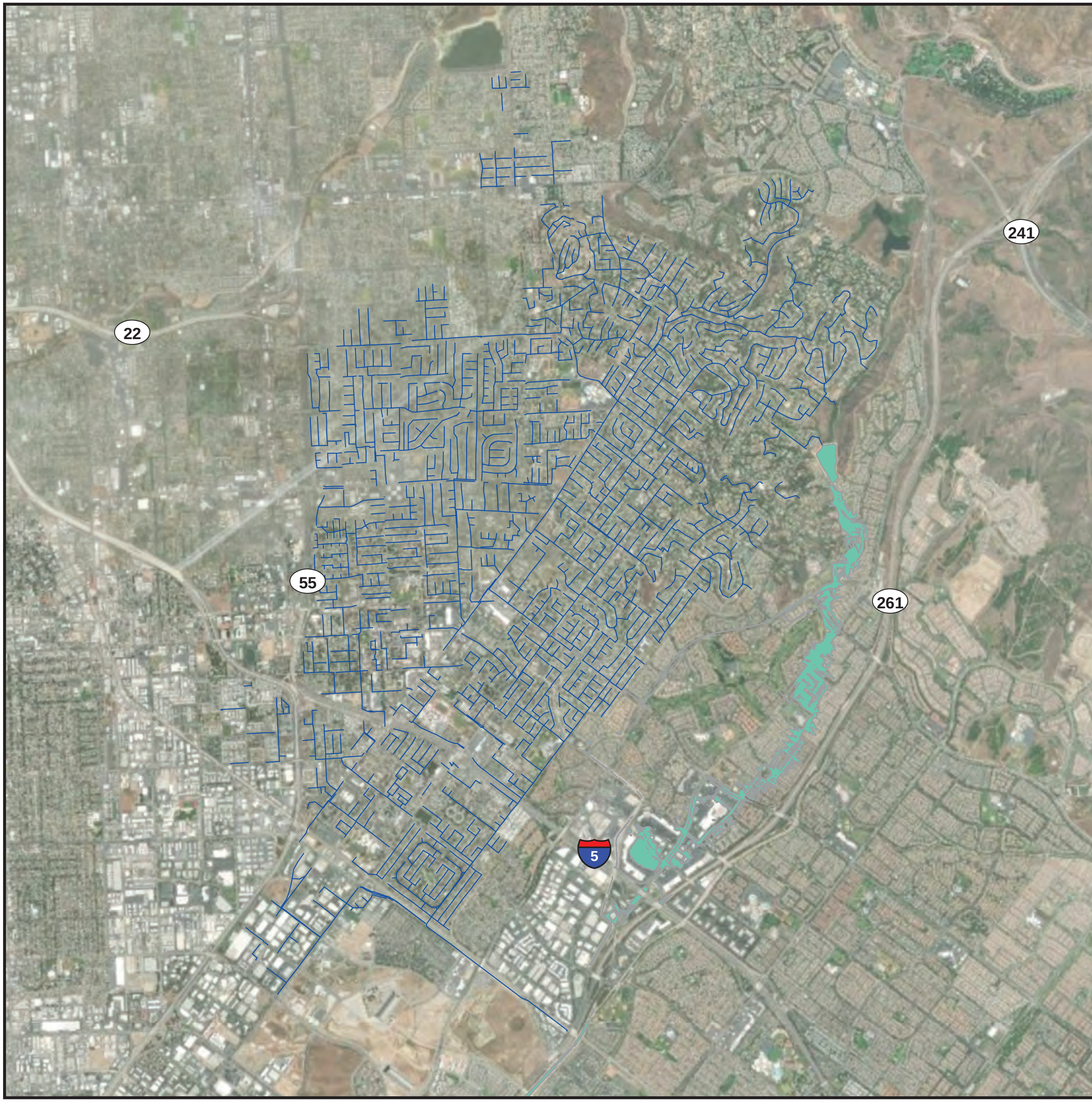
N
W E
S

EOCWD EAST ORANGE COUNTY WATER DISTRICT
TETRA TECH

Map Data Sources:
East Orange County Water District &
California Department of Water Resources

East Orange County Water District

Figure 7-2. Wastewater System Facilities and Lower Peters Canyon Retarding Basin Inundation Area



Waste Water System Pipelines

Inundation Area

0 0.5 1

Miles

N W E S

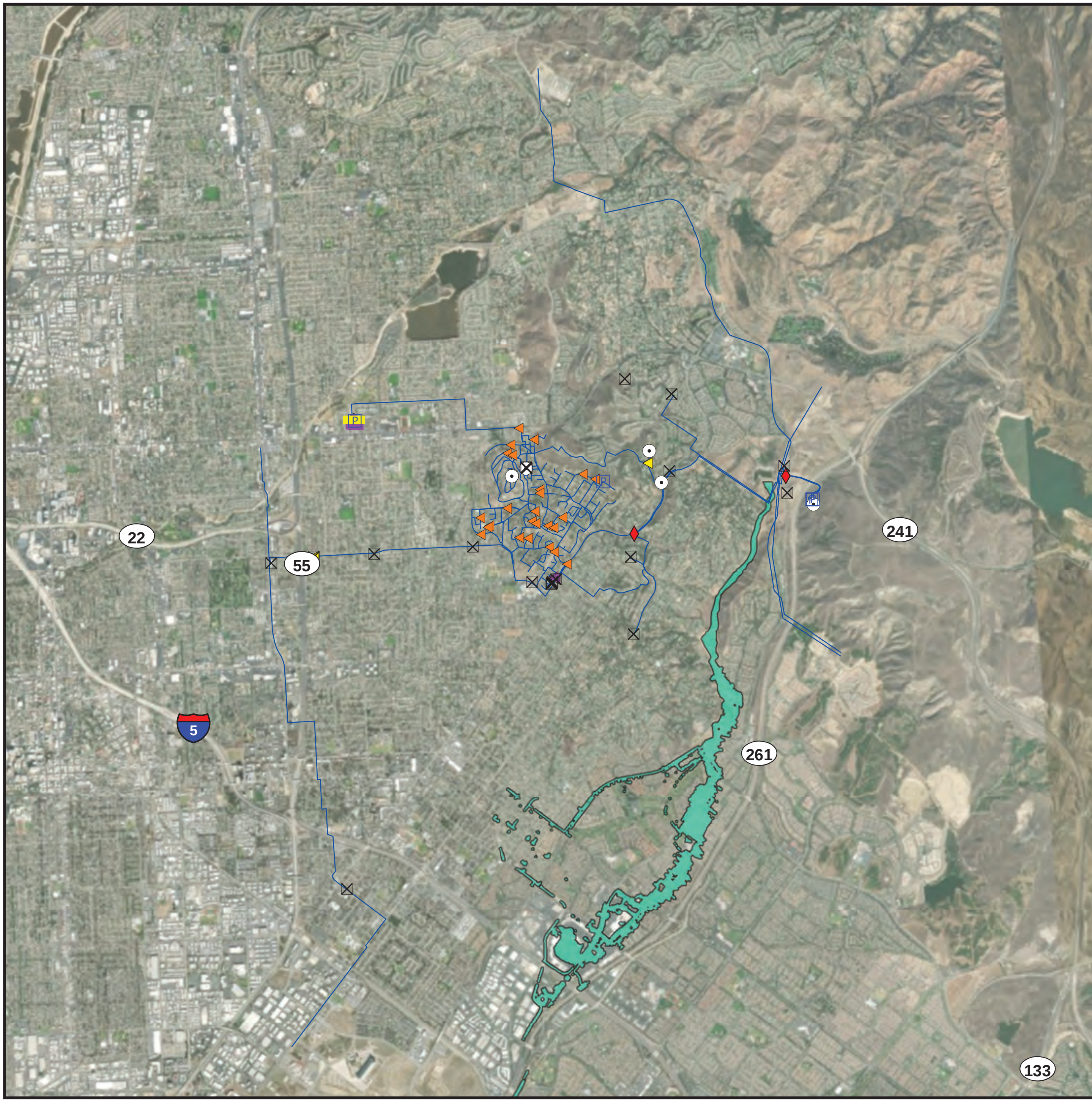
EOCWD EAST ORANGE COUNTY WATER DISTRICT

TETRA TECH

Map Data Sources:
East Orange County Water District & California Department of Water Resources

East Orange County Water District

Figure 7-3. Water System Facilities & Peters Canyon Dam Inundation Area



- Building
- Pump Station
- Enclosed Storage Facility
- System Connection
- Hydrant
- Production Well
- Tank
- System Valve
- Control Valve - Altitude
- Control Valve - Air Release
- Control Valve - GVC
- Potable Water System Pipelines
- Inundation Area

0 0.75 1.5

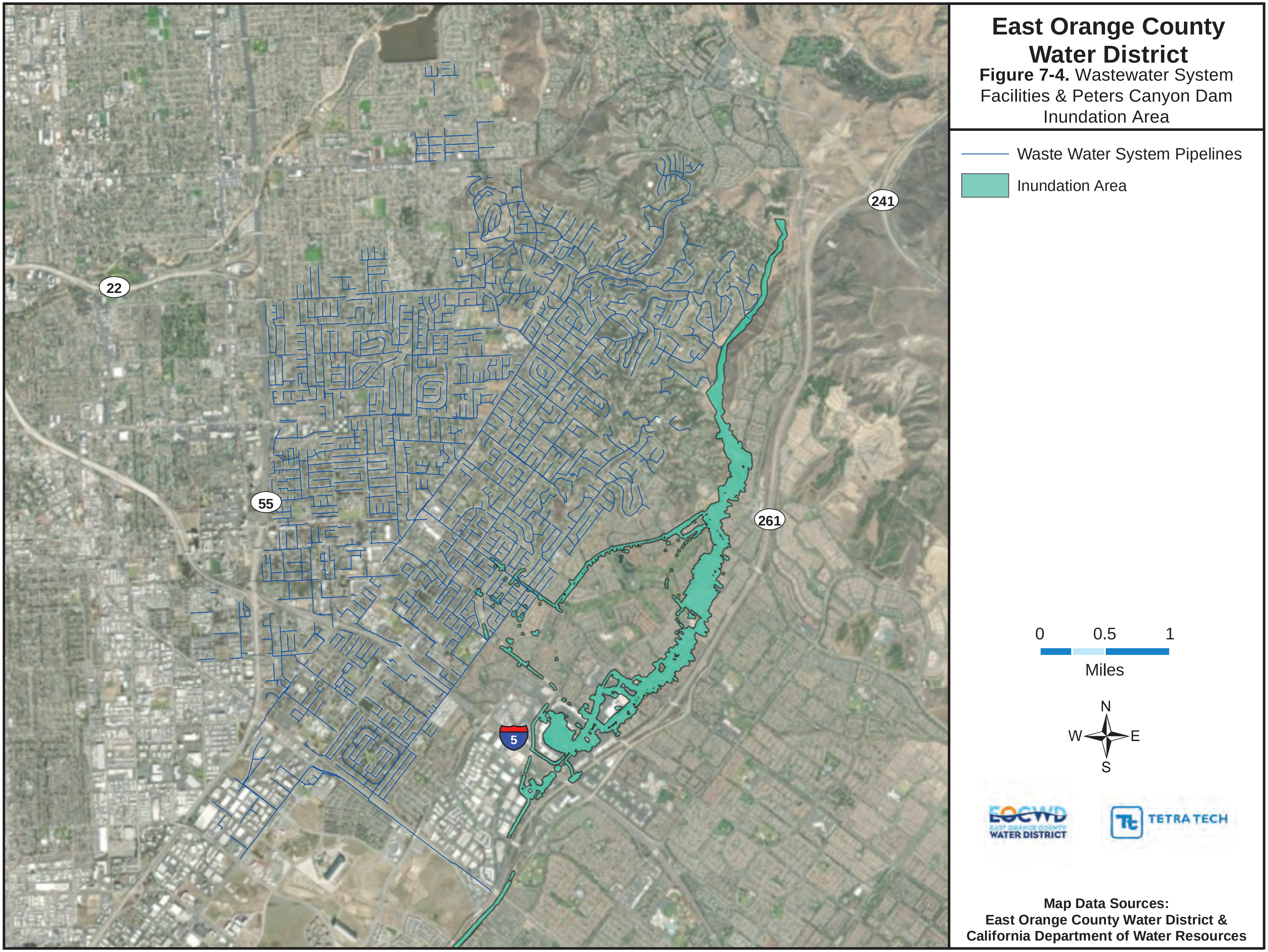
Miles

N
W E
S

EOCWD EAST ORANGE COUNTY WATER DISTRICT

TETRA TECH

Map Data Sources:
East Orange County Water District &
California Department of Water Resources


22
55
241
261
5
East Orange County
Water District
Figure 7-4. Wastewater System Facilities & Peters Canyon Dam Inundation Area
Waste Water System Pipelines
Inundation Area
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Miles
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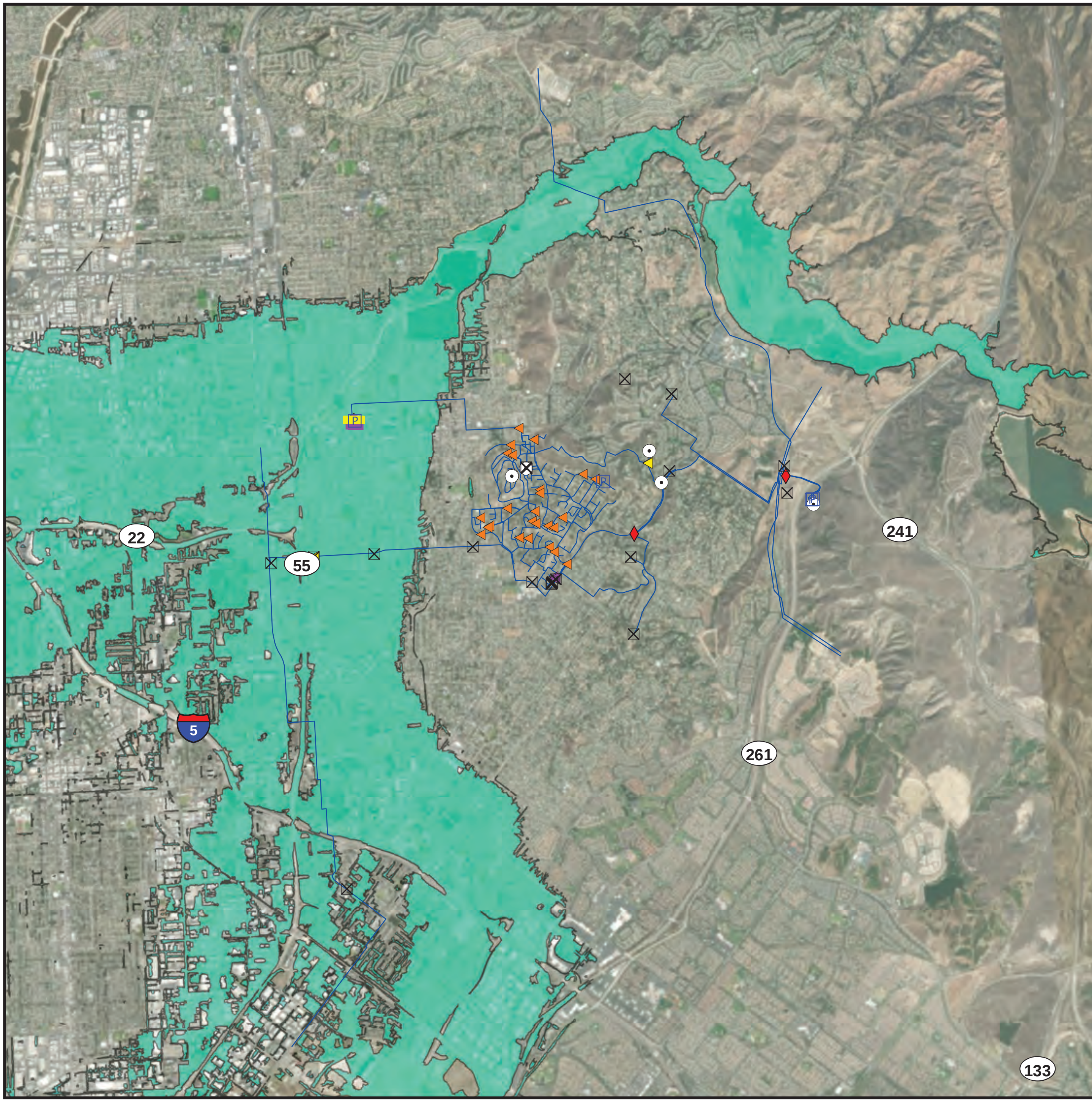
EOCWD
EAST ORANGE COUNTY
WATER DISTRICT
TETRA TECH
Map Data Sources:
East Orange County Water District &
California Department of Water Resources

East Orange County Water District

Figure 7-5. Water System Facilities and Santiago Creek Dam Inundation Area



Building
Pump Station
Enclosed Storage Facility
System Connection
Hydrant
Production Well
Tank
System Valve
Control Valve - Altitude
Control Valve - Air Release
Control Valve - GVC
Potable Water System Pipelines
Inundation Area

0 0.75 1.5
Miles

N
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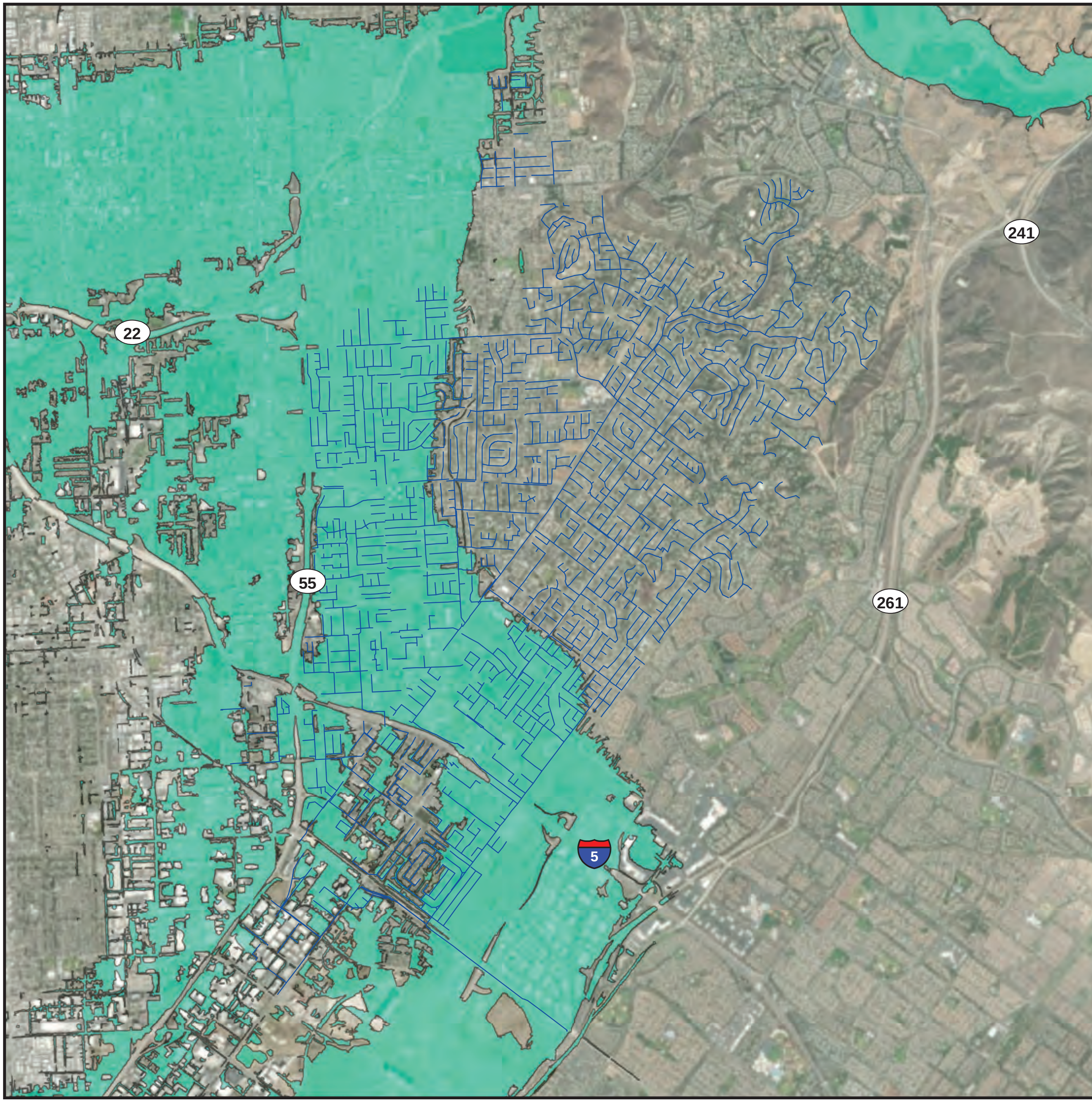
EOCWD EAST ORANGE COUNTY WATER DISTRICT

TETRA TECH

Map Data Sources:
East Orange County Water District &
California Department of Water Resources

East Orange County Water District

Figure 7-6. Wastewater System Facilities and Santiago Creek Dam Inundation Area



Waste Water System Pipelines

Inundation Area

0 0.5 1

Miles

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W E
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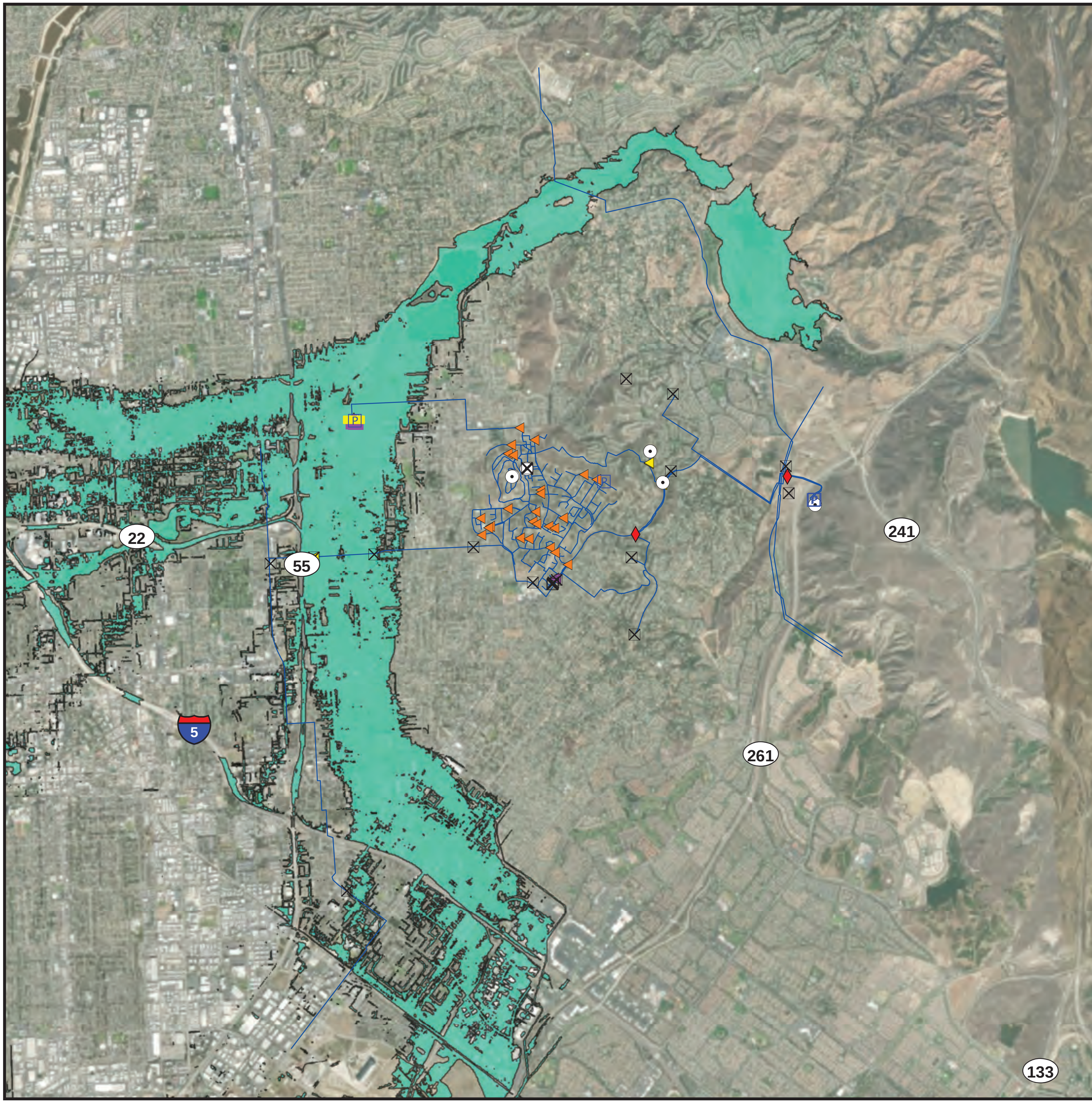
EOCWD EAST ORANGE COUNTY WATER DISTRICT

TETRA TECH

Map Data Sources:
East Orange County Water District &
California Department of Water Resources



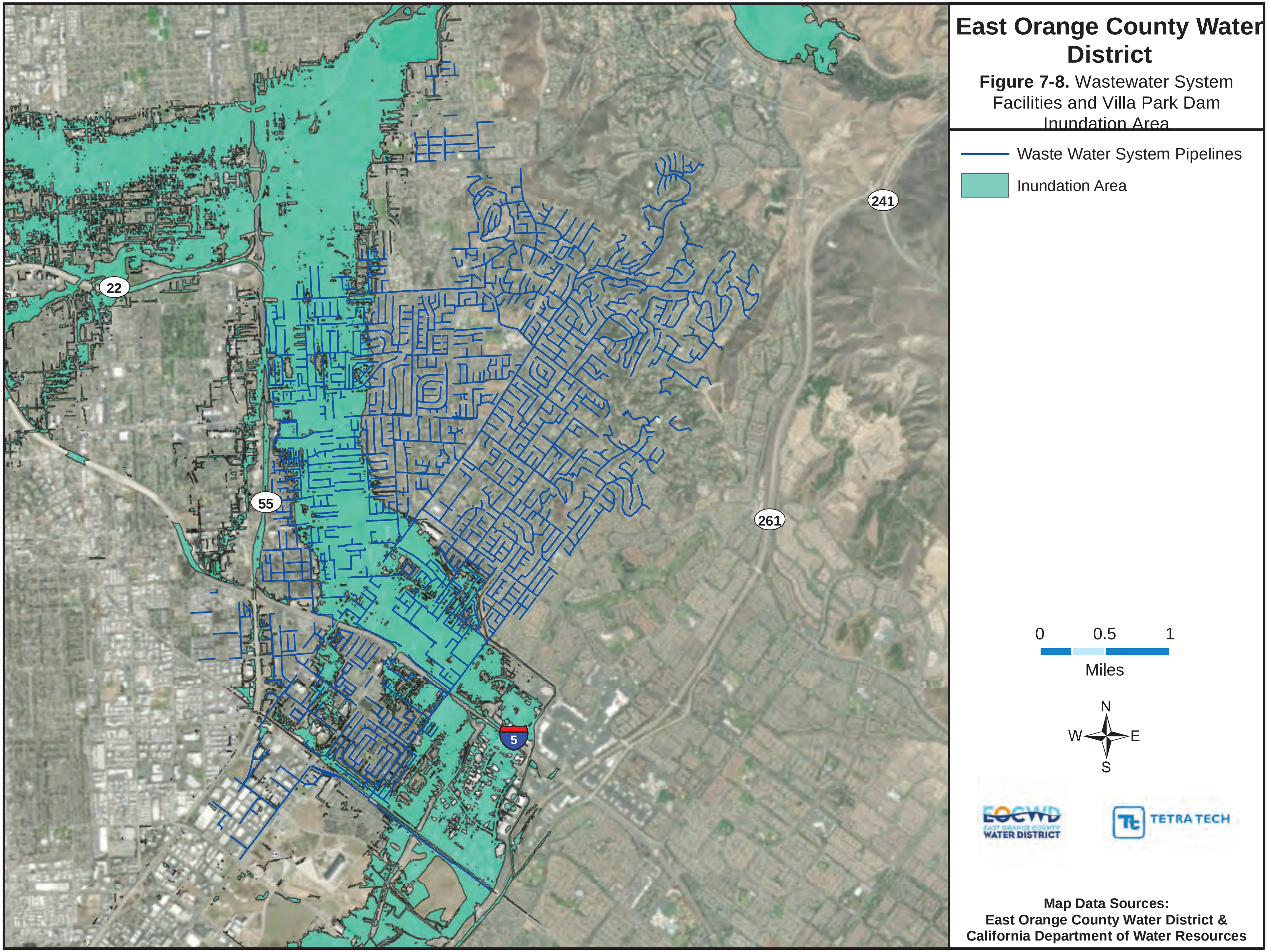
East Orange County Water District

Figure 7-7. Water System Facilities and Villa Park Dam Inundation Area

Map Data Sources:
East Orange County Water District & California Department of Water Resources

East Orange County Water District

Figure 7-8. Wastewater System Facilities and Villa Park Dam Inundation Area



Map Data Sources:
East Orange County Water District &
California Department of Water Resources

Table 7-2. Dams with Potential to Impact in the District

Name	Lower Peters Canyon Retarding Basin	Peters Canyon	Santiago	Villa Park
Hazard Potential	High	High	High	High
Water Course	Peters Canyon Wash	Peters Canyon	Santiago Creek	Santiago Creek
Owner	County of Orange	County of Orange	Serrano Water District & Irvine Ranch Water District	County of Orange
Year Built	1990	1932	1933	1963
Dam Type	Earth	Earth	Earth	Earth
Crest Length (feet)	1,166	580	1,425	1,475
Height (feet)	52	54	136	118
Storage Capacity (acre-feet)	206	1,090	25,000	15,600
Drainage area (sq. mi.)	2.15	0	63.1	83.4

7.2.3 Severity

Table 7-2 lists the hazard rating of dams with the potential to impact the District, using the Army Corps of Engineers rating system shown in Table 7-1. These hazard ratings indicate the potential severity of dam failure impacts in the District.

7.2.4 Warning Time

Warning time for dam failure depends on the cause of the failure. In case of extreme precipitation or snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until the reservoir is empty or the breach resists further erosion. Concrete dams also tend to begin with a partial breach. The time of breach formation ranges from a few minutes to a few hours (U.S. Army Corps of Engineers, 1997).

The County of Orange has a system for warning citizens in the event of an emergency, including dam failure. AlertOC is a mass notification system designed to keep Orange County residents and businesses informed of emergencies and certain community events. By registering with AlertOC, residents can receive time-sensitive messages from the county or the city in which they live or work, sent to their home, cell or business phone. Text messages may also be sent to cell phones, e-mail accounts and hearing-impaired receiving devices.

7.2.5 Secondary Hazards

Dam failure can cause severe downstream flooding. Overland flows from dam breech are likely to transport large amounts of debris, which can impact District assets such as buildings, wells, pumps and pipe casings. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on streams, and destruction of downstream habitat. Dam failure may worsen the severity of a drought by releasing water that might have been used as a potable water source.

7.3 EXPOSURE

The risk assessment for dam failure evaluated District assets that lie within the mapped inundation areas for failure of four dams: Santiago Dam, Peters Canyon Dam, Villa Park Dam, and the Lower Peters Canyon Retarding Basin. It was assumed that underground pipelines are not at risk from dam failure inundation, so only above-ground structures were identified.

The analysis found that no District assets are exposed to the dam failure inundation areas for Peters Canyon Dam or the Lower Peters Canyon Retarding Basin. Table 7-3 summarizes the number of each type of structure found to be within the mapped inundation area for the Santiago and Villa Park dam failure scenarios. Figure 7-9 shows these results as the percent of total planning area structures of each type.

Table 7-3. Number of District Structures Exposed to the Dam Failure Hazard

	Number of Exposed Structures	
	Santiago Dam Inundation Area	Villa Park Dam Inundation Area
Building	2	2
Control Valve—Air Release	0	0
Control Valve—Altitude	0	0
Control Valve—GVC	0	0
Enclosed Storage Facility	1	1
Hydrant	1	1
Production Well	2	2
Pump Station	1	1
System Connection	3	2
System Valve	2	0
Tank	0	0
Total	12	9

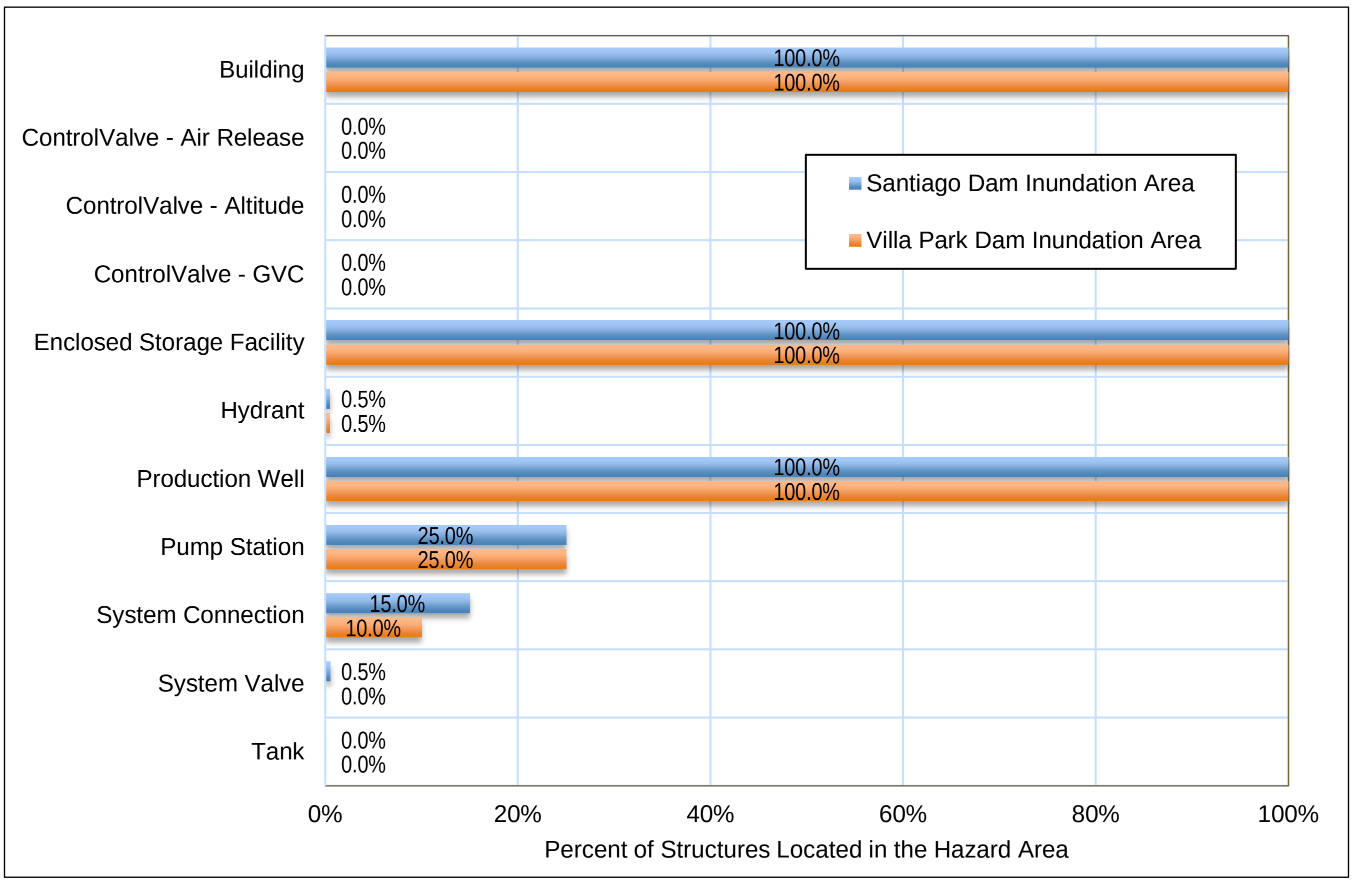


Figure 7-9. Percent of District Structures Exposed to the Dam Failure Hazard

An exposure analysis was also performed for the District's pipeline assets. While most of these assets are underground, and not susceptible to impacts from overland flows associated with dam failures, there are sections of pipelines that are exposed as they cross drainageways and channels. The exact location of these exposed pipelines was not available in a geospatial dataset to support this exposure analysis. The analysis found that 20 percent of the District's potable water pipelines and 71 percent of the District's wastewater pipelines cross a dam inundation area.

7.4 VULNERABILITY

The flood module of Hazus was used for a Level 2 assessment of vulnerability to dam failure. Hazus estimated damage to critical District assets in the dam failure inundation zones. Detailed results for each facility are provided in Appendix C; overall results for the entire district are summarized in Table 7-4.

Table 7-4. Estimated Overall Damage to Critical Facilities from Dam Failure

	Damage as % of Total Value		Loss Value of Damage		
	Structure	Contents	Structure	Contents	Total
Villa Park Dam Failure Scenario	34.9%	52.2%	$4,453,461	$654,450	$5,286,788
Santiago Dam Failure Scenario	43.7%	72.3%	$5,523,824	$1,160,582	$6,684,405

7.5 DEVELOPMENT TRENDS

The demand for critical District services may increase with growth in the surrounding area. Repair or replacement of District assets will be governed by codes and standards applied by the County of Orange, the City of Orange or the City of Tustin, depending on the location of the asset. 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. The County of Orange as well as the cities of Orange and Tustin 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 dam failure inundation.

7.6 SCENARIO

An earthquake in the region could lead to liquefaction of soils around a dam. This could occur without warning during any time of the day. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of a dam.

While the probability of dam failure is very low, the probability of flooding associated with changes to dam operational parameters in response to climate change is higher. Dam designs and operations are developed based on hydrographs from historical records. If these hydrographs experience significant changes over time due to the impacts of climate change, dam design and operations may no longer be valid for the changed condition. This could have significant impacts on dams that provide flood control. Specified release rates and impound thresholds may have to be changed. This would result in increased discharges downstream of these facilities, increasing the probability and severity of flooding.

7.7 ISSUES

Flooding as a result of a dam failure would significantly impact properties and populations in the inundation zones. There is often limited warning time for such failures. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Important issues associated with dam failure hazards include the following:

- The average loss from the dan failure scenarios modeled represent 55.4 percent of the total replacement costs of the critical assets modeled.
- The District has significant exposure and vulnerability of critical assets to dam failure. This exposure and vulnerability should be taken into account as the District replaces of retrofits theses assts.
- Federally regulated dams have an adequate level of oversight and sophistication in the development of EAPs for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.
- Most dam failure mapping required at federal levels requires determination of the probable maximum flood. While the probable maximum flood represents a worst-case scenario, it is generally the event with the lowest probability of occurrence. For non-federally regulated dams, mapping of dam failure scenarios that are less extreme than the probable maximum flood but have a higher probability of occurrence can be valuable to emergency managers and community officials downstream of these facilities. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Addressing security concerns and the need to inform the public of the risk associated with dam failure is a challenge for public officials.

8. DROUGHT

8.1 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.

8.1.1 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.

8.1.2 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 8-1 shows this index for the week ending July 4, 2020.
- The ***Palmer Z Index*** measures monthly short-term drought. Figure 8-2 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 8-3 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 8-4 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 8-5 shows the 24-month Standardized Precipitation Index map for July 2018 to June 2020.

Source: NOAA, NWS. 2020

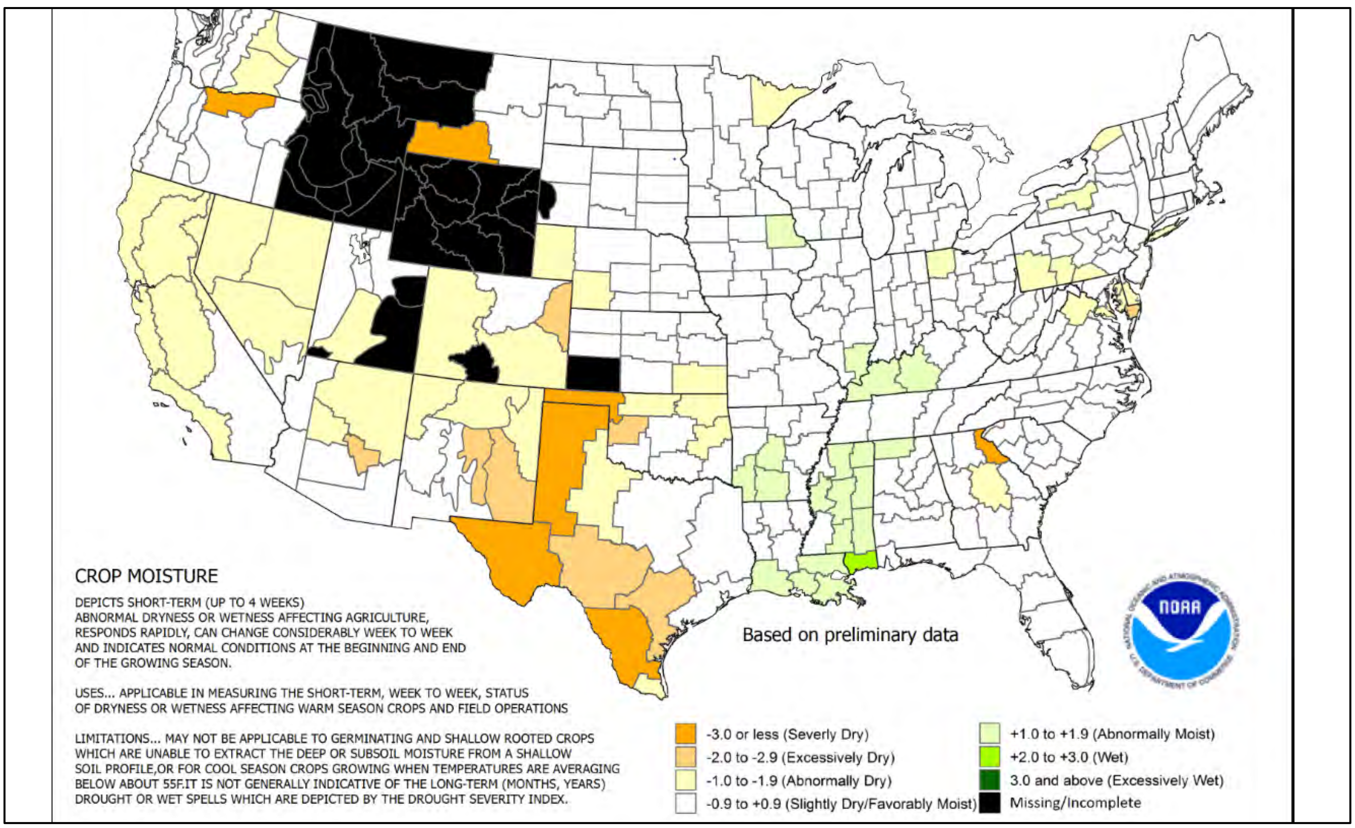


Figure 8-1. Crop Moisture Index for Week Ending July 4, 2020

Source: NOAA, NWS. 2020a

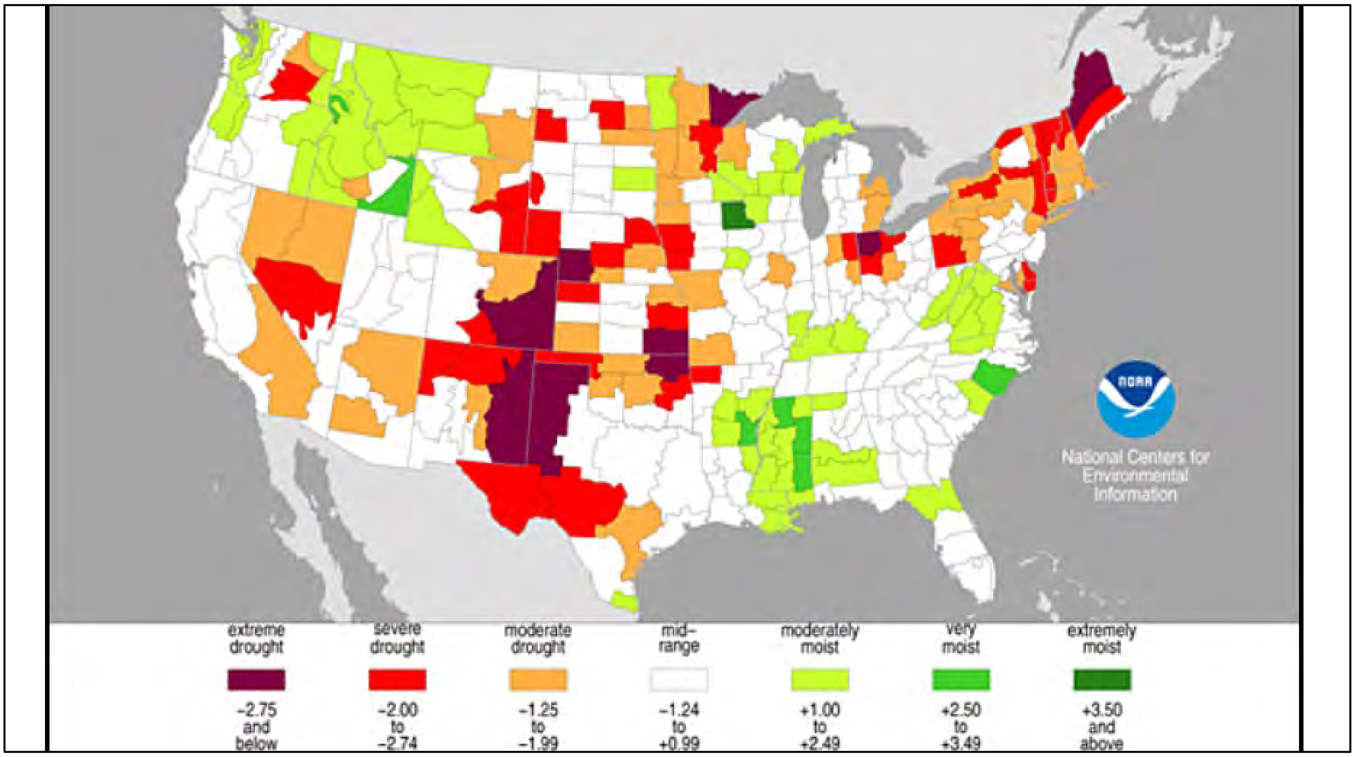


Figure 8-2. Palmer Z Index Short-Term Drought Conditions (June 2020)

Source: NOAA, NWS. 2020b

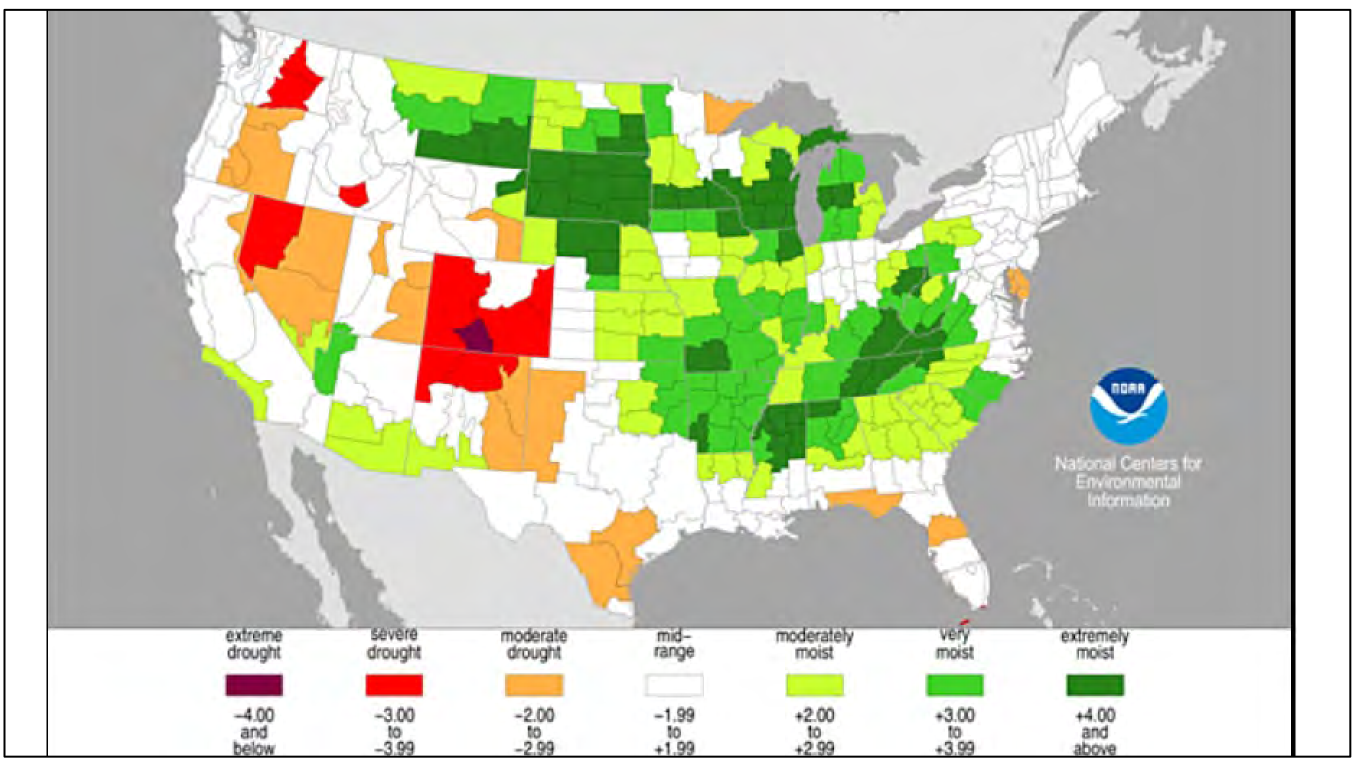


Figure 8-3. Palmer Drought Severity Index (June 2020)

Source: NOAA, NWS. 2020c

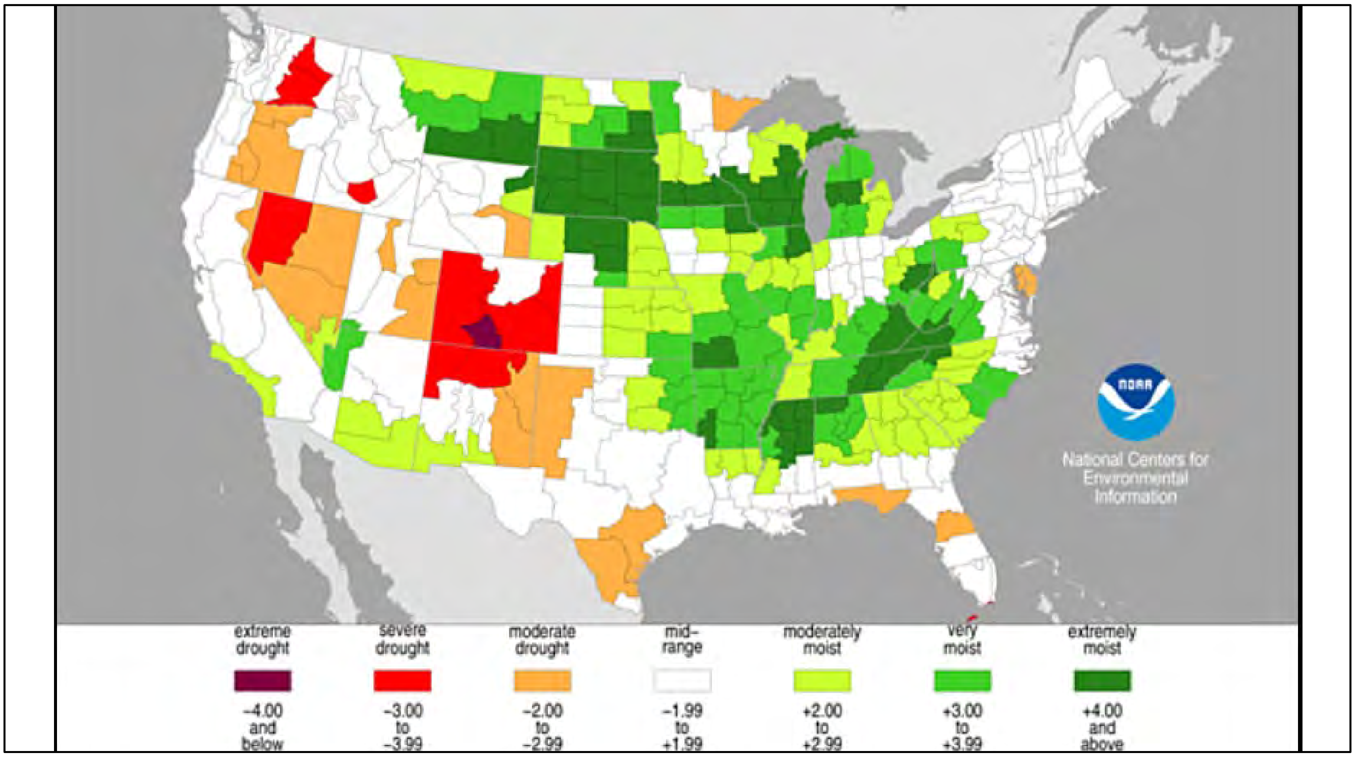


Figure 8-4. Palmer Hydrological Drought Index (June 2020)

Source: NOAA, NWS. 2020d

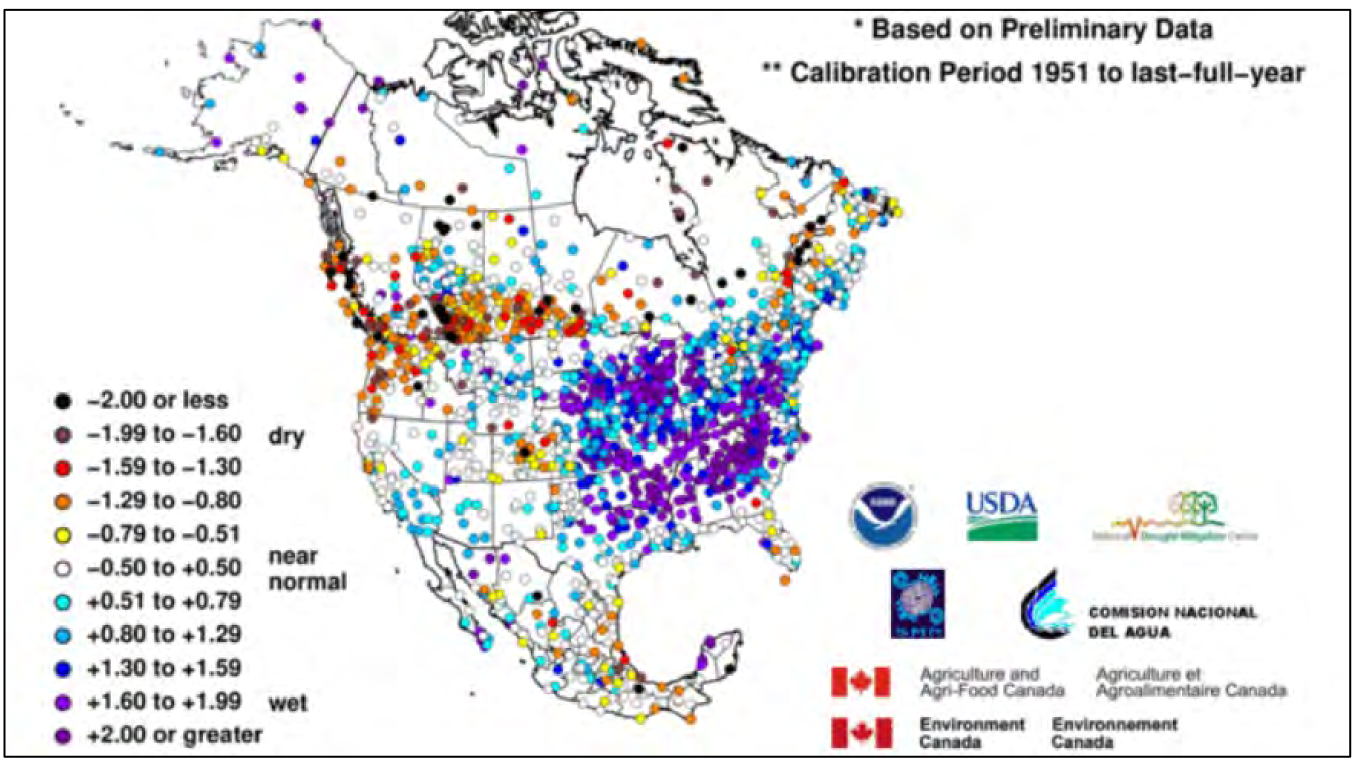


Figure 8-5. 24-Month Standardized Precipitation Index (July 2018 – June 2020)

8.1.3 Local Water Supply

The District provides imported water (purchased from MWDOC/Metropolitan) to the four retail water agencies listed above, as well as its own retail zone. The primary source of water for these agencies is groundwater purchased through the Orange County Water District (OCWD); the imported water supplements the groundwater and provides supply reliability.

The OCWD, servicing north and central Orange County, refills the Orange County Groundwater Basin with many different water supplies: water from the Santa Ana River, which includes rainfall, snowmelt and treated wastewater from upstream water users; local rainfall; and imported water from the Colorado River and Northern California. (see Figure 8-6 and Figure 8-7):

- About 200 million gallons per day of wastewater, from more than 2.5 million customers, is sent to the Orange County Sanitation District (OCSD), where it is treated. Some of the treated wastewater is discharged into the Pacific Ocean, but about 130 million gallons of it is sent to OCWD's Groundwater Replenishment System (GWRS) where it is purified to exceed drinking water standards. The GWRS water is then put back into the basin where it blends with all the other water supplies and is ultimately reused again, and again and again.
- Thanks to OCWD's innovative water management program, north and central Orange County communities can pump about 75 percent of their water demands from the basin without causing damage to this large aquifer. They get the remaining 25 percent of their needs from imported supplies.
- Metropolitan supplies the imported water through its local subsidiary member agency, the Municipal Water District of Orange County (MWDOC). Nineteen retail water agencies, including East Orange County Water District and the five entities it serves, and city water departments deliver a blend of these waters to north and central Orange County residents and businesses.

8.1.4 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 8-1 shows the state drought management program stages mandated to water right holders.

Table 8-1. 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

8.2 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.

Source: Municipal Water District of Orange County, 2017

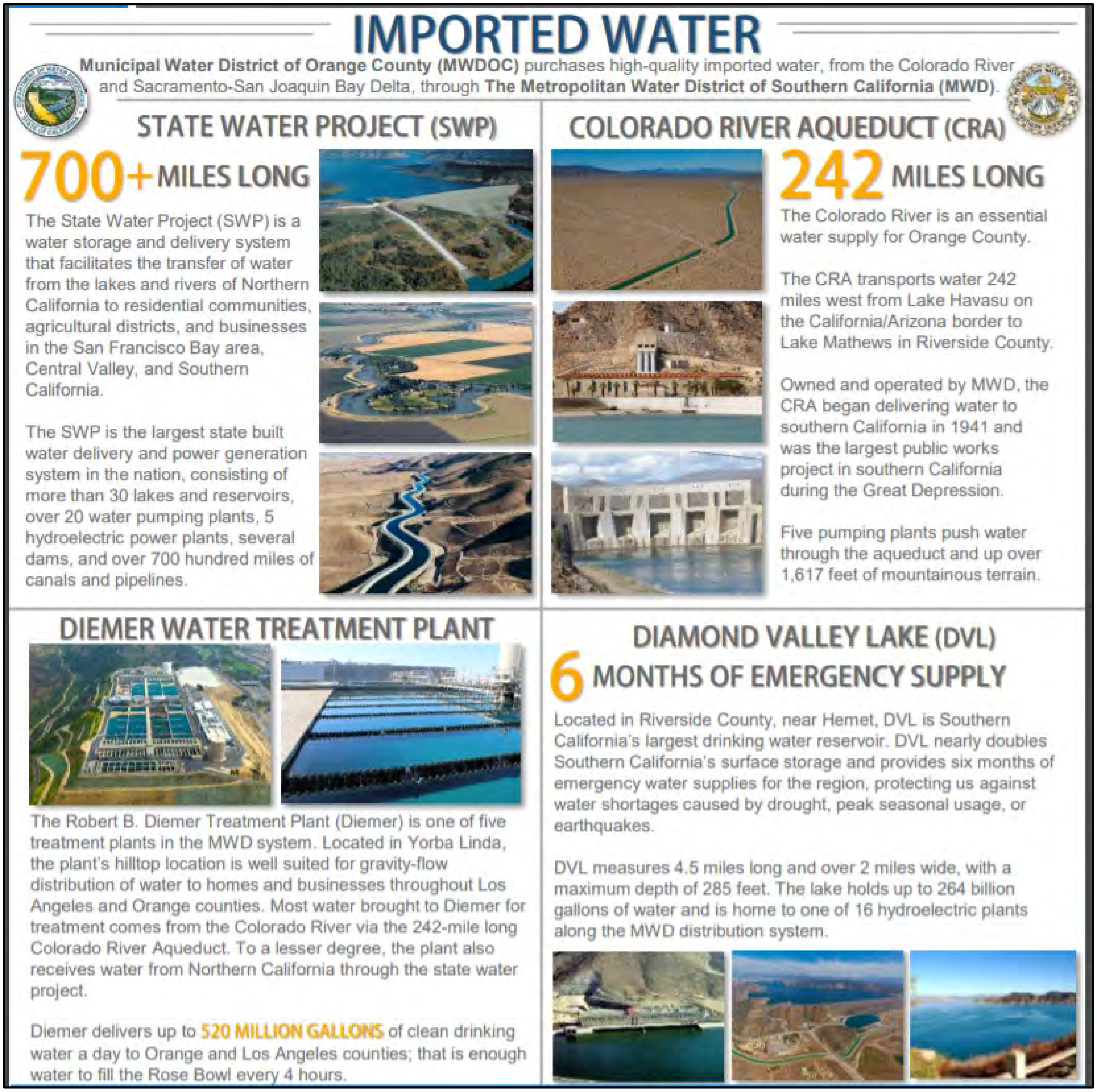


Figure 8-6. District Imported Water Supply Sources

Source: Municipal Water District of Orange County, 2017

Figure 8-7. District Local Water Supply Sources

8.2.1 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 Orange 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 Orange 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 East Orange County 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 36 impacts from droughts that specifically affected the City of Tustin from 1970 through December 2019. The following are the categories and reported number of impacts (note that some impacts have been assigned to more than one category):

- Agriculture—6
- Business and Industry—5
- Energy—0
- Fire—2
- Plants and Wildlife—3
- Relief, Response, and Restrictions—28
- Society and Public Health—10
- Tourism and Recreation—1
- Water Supply and Quality—28.

8.2.2 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. 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.

8.2.3 Frequency

Historical drought data for the planning area indicate there have been four significant multi-year droughts in the last 40 years (1976 to 2016). For approximately 12 of the last 40 years, Orange County has been included in various levels of drought. This equates to a drought every three years on average, or a 30 percent chance of a drought in any given year. As temperatures increase, the probability of future droughts will likely increase as well.

8.2.4 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.

8.2.5 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 depends on 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.

8.2.6 Secondary Impacts

The secondary impact most commonly 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. Wildfire is discussed further in Chapter 13.

8.3 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 district 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.

Critical facilities as defined for this plan will continue to be operational during a drought.

8.4 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 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 Orange, the City of Orange or the City of Tustin, depending upon the location of the asset.

8.5 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.

8.6 ISSUES

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

- 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.

9. EARTHQUAKE

9.1 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.

9.1.1 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 9-1. 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 9-1. 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

9.1.2 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. 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).

9.1.3 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 9-2 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 9-2. 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.

9.1.4 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 9-1 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, 2020

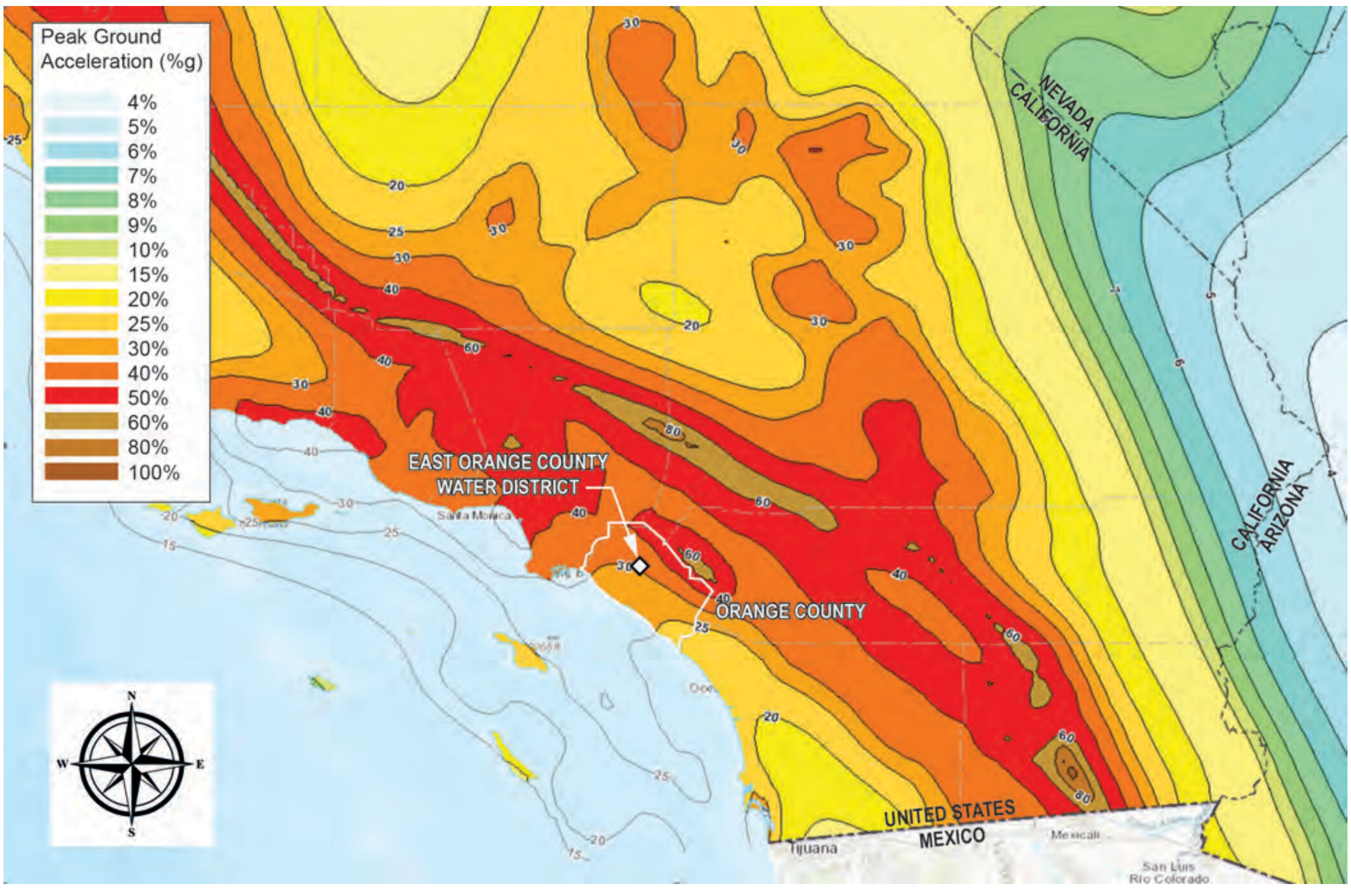


Figure 9-1. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years in Southern California

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).

9.2 HAZARD PROFILE

9.2.1 Past Events

Orange County has been included in one FEMA declaration for earthquakes: the 1994 Northridge Earthquake (DR-1008). Table 9-3 lists earthquakes of magnitude 5.0 or greater within a 100-mile radius of the planning area.

Table 9-3. 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 Earthquakes	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

Source: Southern California Earthquake Data Center, 2020

The most recent damaging earthquake event affecting Southern California 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.

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.

9.2.2 Location

Faults

Earthquakes are considered a major threat to Orange County due to the proximity of several fault zones, notably including the San Andreas Fault Zone and the Newport-Inglewood Fault Zone. A significant earthquake along one of the major faults 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 9-2 that could affect Orange County include the San Andreas Fault, the Newport-Inglewood Fault, the Whittier Fault, the Elsinore Fault, and the San Jacinto Fault. Smaller faults include the Norwalk Fault, and the El Modena and Peralta Hills Faults. In addition, newly studied thrust faults, such as the San Joaquin Hills Fault and the Puente Hills Fault (not shown on map) could also have a significant impact on the County. Information on these fault zones is provided in the following sections.

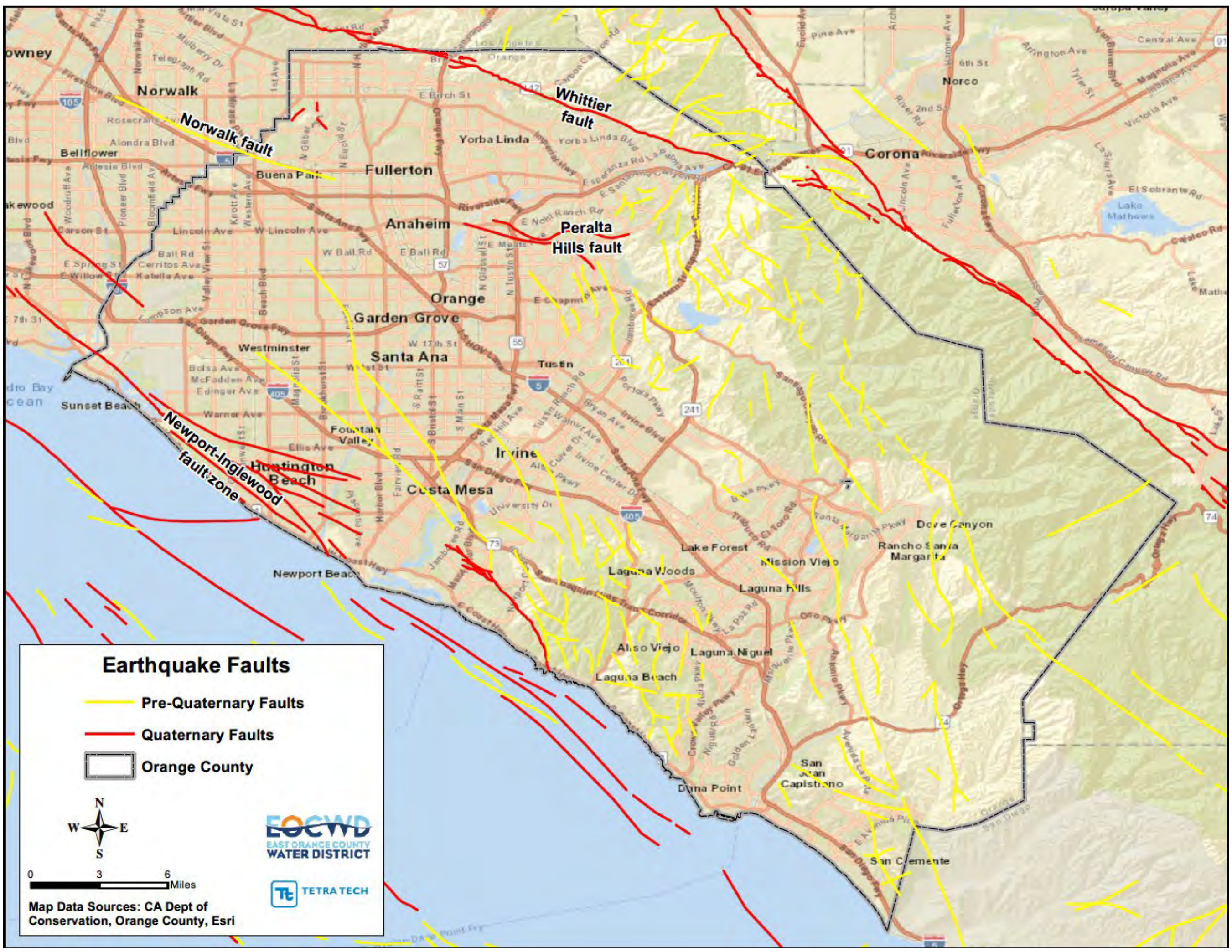


Figure 9-2. Earthquake Fault Zones in Orange County

Newport-Inglewood Fault Zone

Extends from the Santa Monica Mountains southeastward through the western part of Orange County to the offshore area near Newport Beach and was the source of the destructive 1933 Long Beach earthquake (magnitude 6.4), which caused 120 deaths and considerable property damage. During the past 60 years, numerous other shocks ranging from magnitude 3.0 to 5+ have been recorded. The Southern California Earthquake Center reports probable earthquake Magnitudes for the Newport-Inglewood fault to be in the range of 6.0 to 7.4.

Norwalk Fault

The Norwalk fault is buried beneath alluvial deposits but has been recognized from subsurface oil and well and water well data. The Norwalk fault extends from Norwalk in Los Angeles County to the south edge of the West Coyote Hills near Anaheim. The “Whittier” earthquake of 1929 was attributed to the Norwalk fault by Charles Richter. The offset of the alluvial deposits or the presence of geomorphic features, which would suggest the fault is active, have not been established. It should be noted that because the fault is buried, the data available regarding the location of the Norwalk fault is approximate, and in some areas inconclusive.

Peralta Hills Fault

The Peralta Hills fault is an approximately east-west trending, north dipping, thrust fault that has displaced the Miocene Puente Formation at least 40 feet over Quaternary terrace deposits. Various consultants have studied the fault, and its length and activity are subject to debate within the geologic community. One interpretation of the fault is that the westerly trace of the fault extends concealed beneath alluvium west of SR-55 (Bryant and Fife, 1982). According to this interpretation, the northerly trace of the El Modeno fault either terminates at the Peralta Hills fault or continues beneath it to the north. Based on their own work and the work of others, Bryant and Fife have concluded that the Peralta Hills fault has ruptured the ground surface in Holocene time (the scientific name for the current geological time period), and may be capable of generating an earthquake of moment magnitude in the range of 6.0 to 7.0. In addition, Bryant and Fife have recommended that the Peralta Hills fault be included under the Alquist-Priolo Earthquake Fault Zone Act.

The Whittier Fault Zone

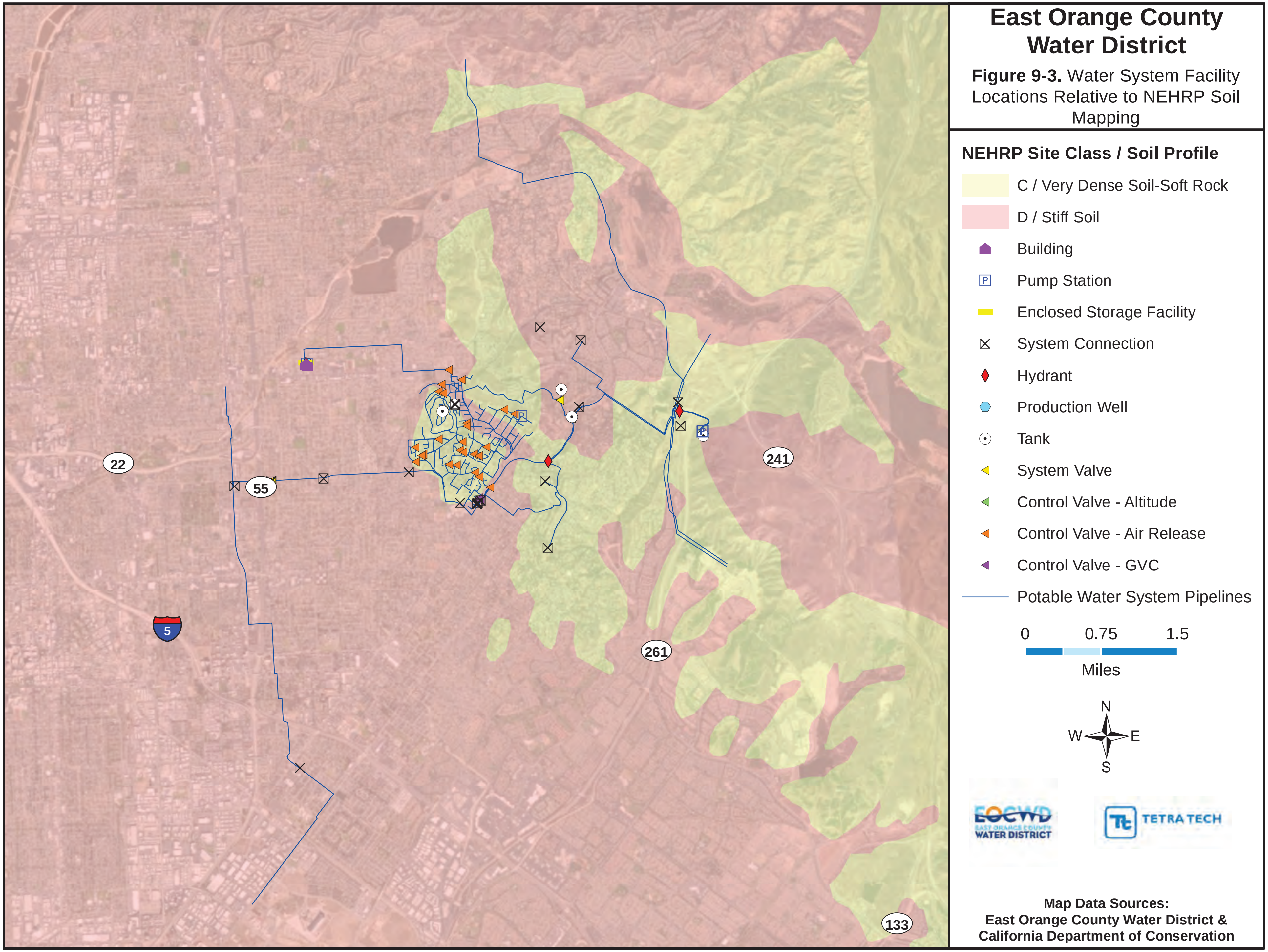
The Whittier fault zone extends approximately 24 miles from Whittier Narrows in Los Angeles County, southeasterly to Santa Ana Canyon where it merges with the Elsinore fault zone. The Whittier fault zone averages 1,000 to 2,000 feet in width and is made up of many sub-parallel and en-echelon fault splays, which merge and branch along their course. Available information indicates that the Whittier fault zone is active and may be capable of generating an earthquake of magnitude of 6.8 accompanied by surface rupture along one or more of its fault traces.

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 9-3 and Figure 9-4, 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 are shown on Figure 9-5 and Figure 9-6, respectively.

East Orange County Water District

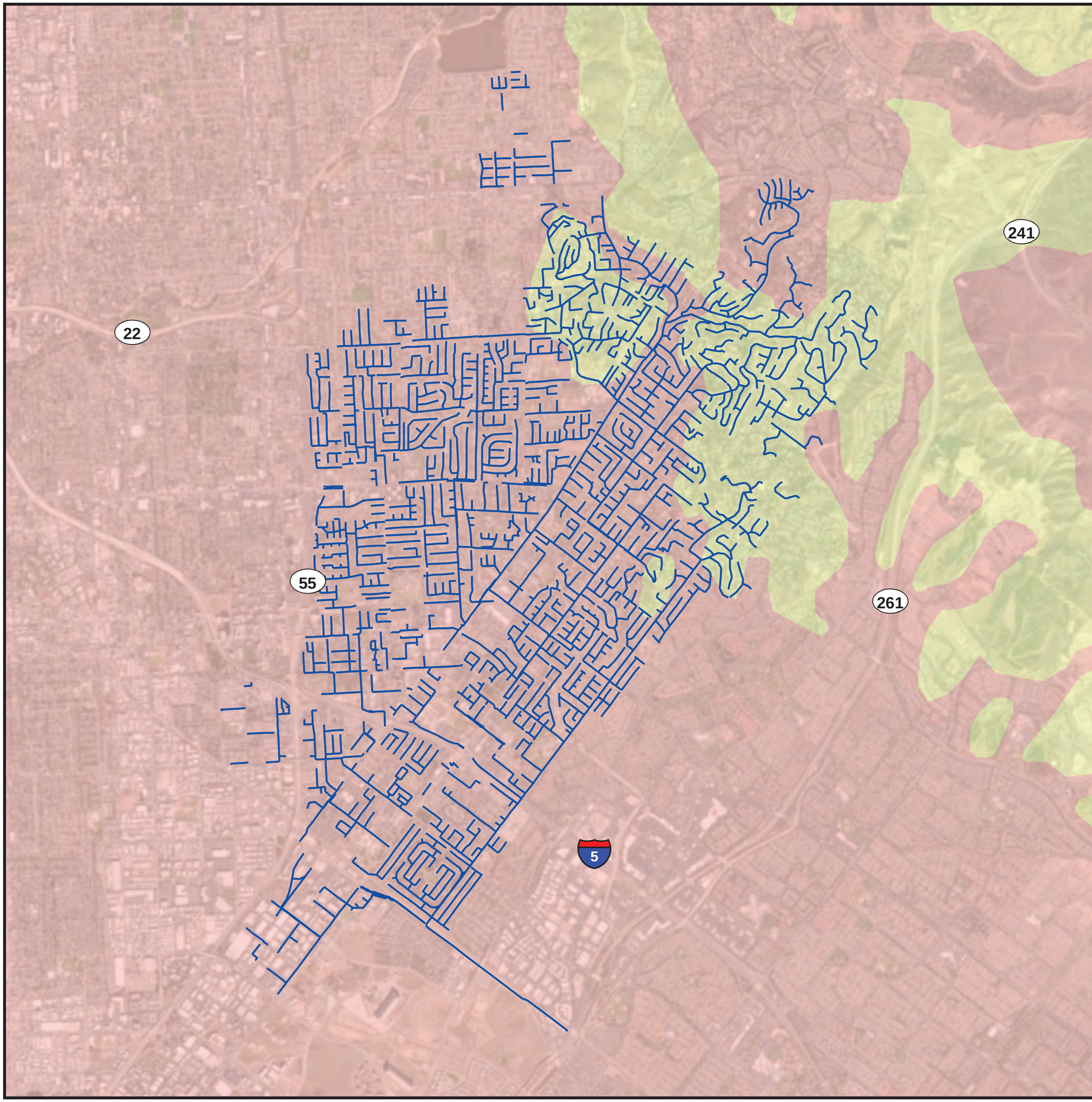
Figure 9-3. Water System Facility Locations Relative to NEHRP Soil Mapping



Map Data Sources:
East Orange County Water District &
California Department of Conservation

East Orange County Water District

Figure 9-4. Wastewater System Facility Locations Relative to NEHRP Soil Mapping



Soils

NEHRP Site Class / Soil Profile

C / Very Dense Soil-Soft Rock

D / Stiff Soil

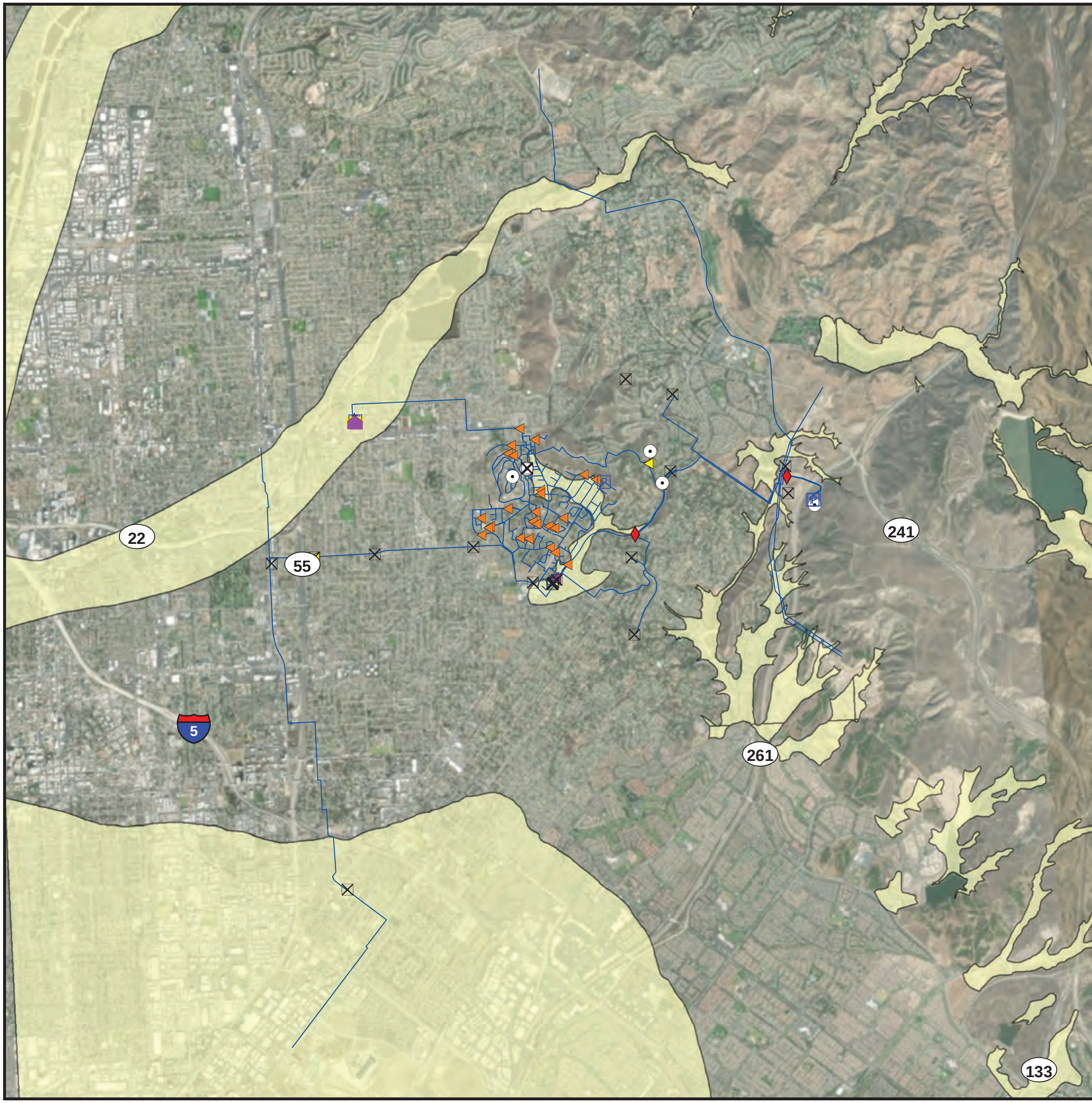
Waste Water System Pipelines

0 0.5 1

Miles

N
W E
S

Map Data Sources:
East Orange County Water District & California Department of Conservation



East Orange County Water District

Figure 9-5. Water System Facility Locations Relative to Liquefaction Susceptibility Mapping

Building

Pump Station

Enclosed Storage Facility

System Connection

Hydrant

Production Well

Tank

System Valve

Control Valve - Altitude

Control Valve - Air Release

Control Valve - GVC

Potable Water System Pipelines

Liquification Zone

0 0.75 1.5

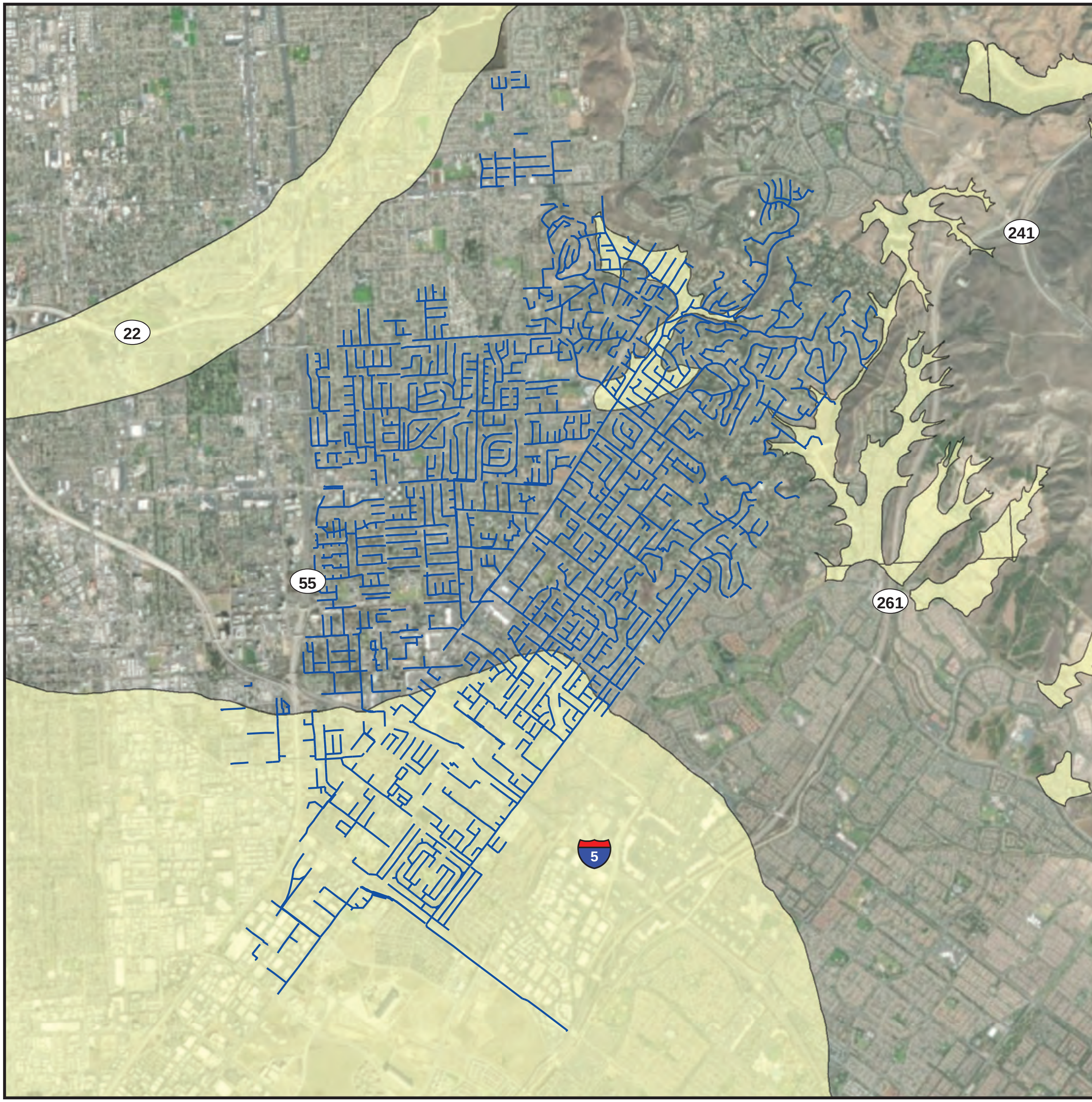
Miles

N
W E
S

Map Data Sources:
East Orange County Water District &
California Department of Conservation

East Orange County Water District

Figure 9-6. Wastewater System Facility Locations Relative to Liquifaction Susceptibility Mapping



Liquification Zone

Waste Water System Pipelines

0 0.5 1

Miles

N
W E
S

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Map Data Sources:
East Orange County Water District &
California Department of Conservation

9.2.3 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 San Andreas Fault has the potential for experiencing major to great events. The State Hazard Mitigation Plan indicates that in the next 30 years in California there is over a 99-percent probability of a magnitude 6.7 earthquake and a 94-percent probability of a magnitude 7.0 earthquake.

9.2.4 Severity

Potential Earthquake Intensity in the Planning Area

USGS probabilistic mapping is an indication of potential earthquake intensity in an area. Figure 9-1 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 (see Section 9.1.2 for an explanation of PGA).

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.

9.2.5 Warning Time

There is no current reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems would give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, step away from a hazardous material, or shut down a computer system.

9.2.6 Secondary Hazards

Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result 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.

Earthquakes can also trigger tsunamis. Tsunamis significantly damage many locations beyond where the earthquake struck. Coastal communities near the earthquake epicenter that are also vulnerable to tsunamis could experience devastating impacts. 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.

9.3 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 9-4 and Table 9-5 summarize the number of structures and the length of pipeline, respectively, within each of these hazard areas. Figure 9-7 shows these results as the percent of total planning area structures and pipeline of each type.

Table 9-4. Number of District Structures Exposed to the Earthquake Hazard

	Number of Structures in Earthquake Hazard Areas		
	NEHRP Class C Soils	NEHRP Class D Soils	Mapped Liquefaction Areas
Building	0	2	2
Control Valve—Air Release	20	5	3
Control Valve—Altitude	1	0	0
Control Valve—GVC	5	4	4
Enclosed Storage Facility	0	1	1
Hydrant	159	58	45
Production Well	0	2	2
Pump Station	1	3	1
System Connection	7	13	6
System Valve	254	120	86
Tank	3	3	0
Total	450	211	150

Table 9-5. Length of District Pipeline Within Earthquake Hazard Areas

	Length of Pipe in Earthquake Hazard Areas (feet)		
	NEHRP Class C Soils	NEHRP Class D Soils	Mapped Liquefaction Areas
Potable Water Pipelines	138,543	131,750	61,596
Wastewater Pipelines	161,612	756,806	235,287
Total	300,155	888,556	296,883

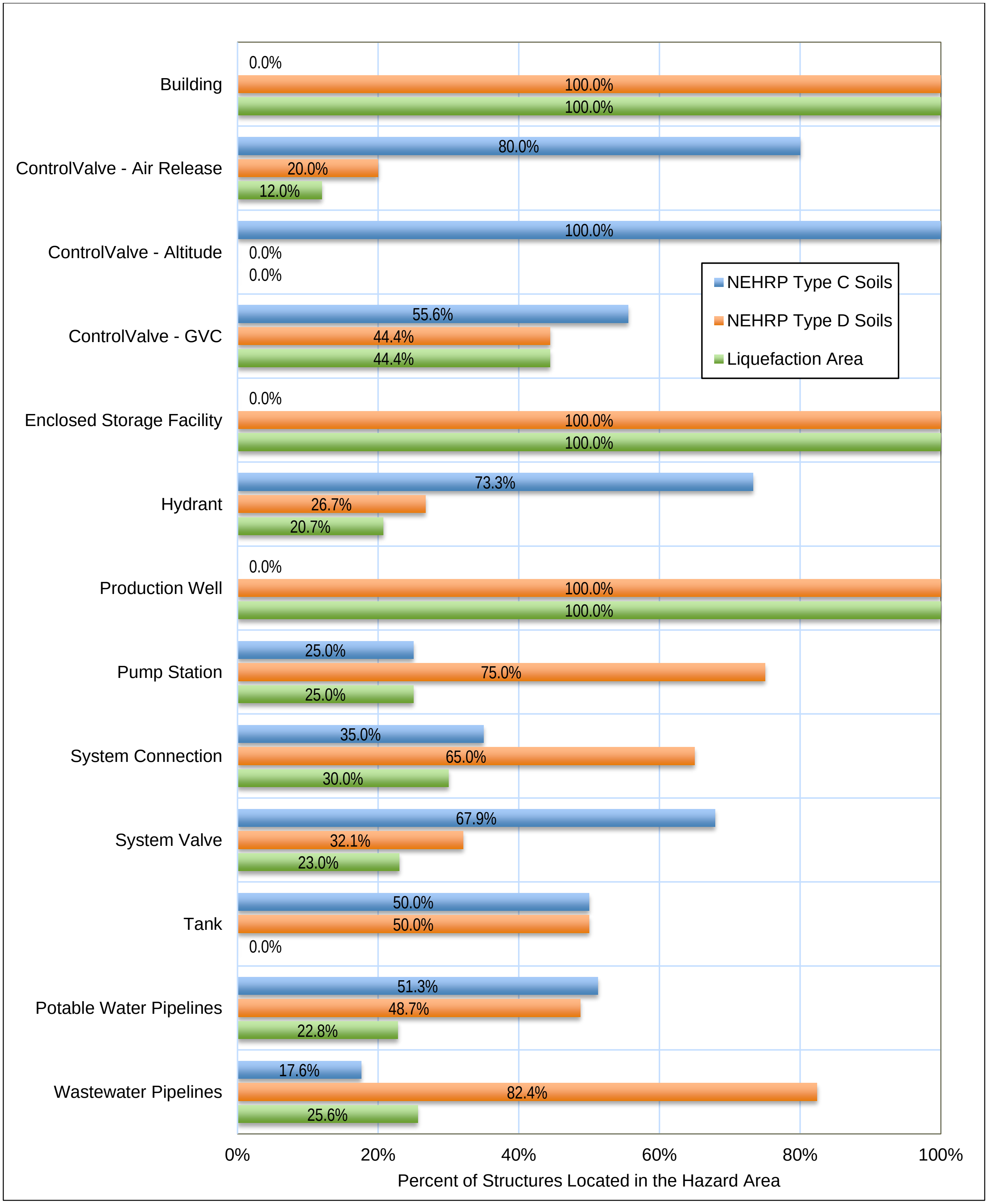


Figure 9-7. Percent of District Structures Exposed to the Earthquake Hazard

9.4 VULNERABILITY

9.4.1 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:

- The standard Hazus 500-year probabilistic event
- A Magnitude-6.4 Anaheim scenario event along the Norwalk Fault zone with an epicenter 12 miles northwest of the City of Tustin (see Figure 9-8 and Figure 9-9)
- A Magnitude-7.2 event on the Newport-Inglewood fault with an epicenter 21.5 miles west northwest of the City of Tustin (see Figure 9-10 and Figure 9-11)
- A Magnitude-6.6 event on the Peralta Hills fault with an epicenter 10 miles north of the City of Tustin (see Figure 9-12 and Figure 9-13)
- A Magnitude-7.0 event on the Whittier fault with an epicenter 13 miles north of the City of Tustin (see Figure 9-14 and Figure 9-15)

Figure 9-16 shows the fault rupture plains for the ShakeMap scenario earthquakes modeled for this assessment.

9.4.2 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 9-6 summarizes the results for structures.

Table 9-6. Earthquake Scenario Loss Estimates for District Structures

	Probability of Damage					Losses (in Dollars)		
	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Structure Damage	Contents Damage	Total Damage
Anaheim-M6.4	19.31%	21.39%	37.09%	15.21%	0.73%	$5,990,193	$352,050	$6,342,243
Whittier-M7.0	5.86%	12.98%	40.88%	36.16%	4.10%	$16,272,226	$727,067	$16,999,293
Peralta Hills-M6.6	2.27%	7.73%	28.81%	47.77%	13.40%	$20,527,392	$1,389,959	$21,917,351
Newport/ Inglewood-M7.2	23.49%	24.27%	37.05%	14.04%	1.12%	$6,847,243	$346,866	$7,194,109
500-Year Probabilistic	8.94%	12.92%	29.45%	37.29%	11.38%	$19,164,362	$748,651	$19,913,013

9.4.3 Level of Damage to Pipelines

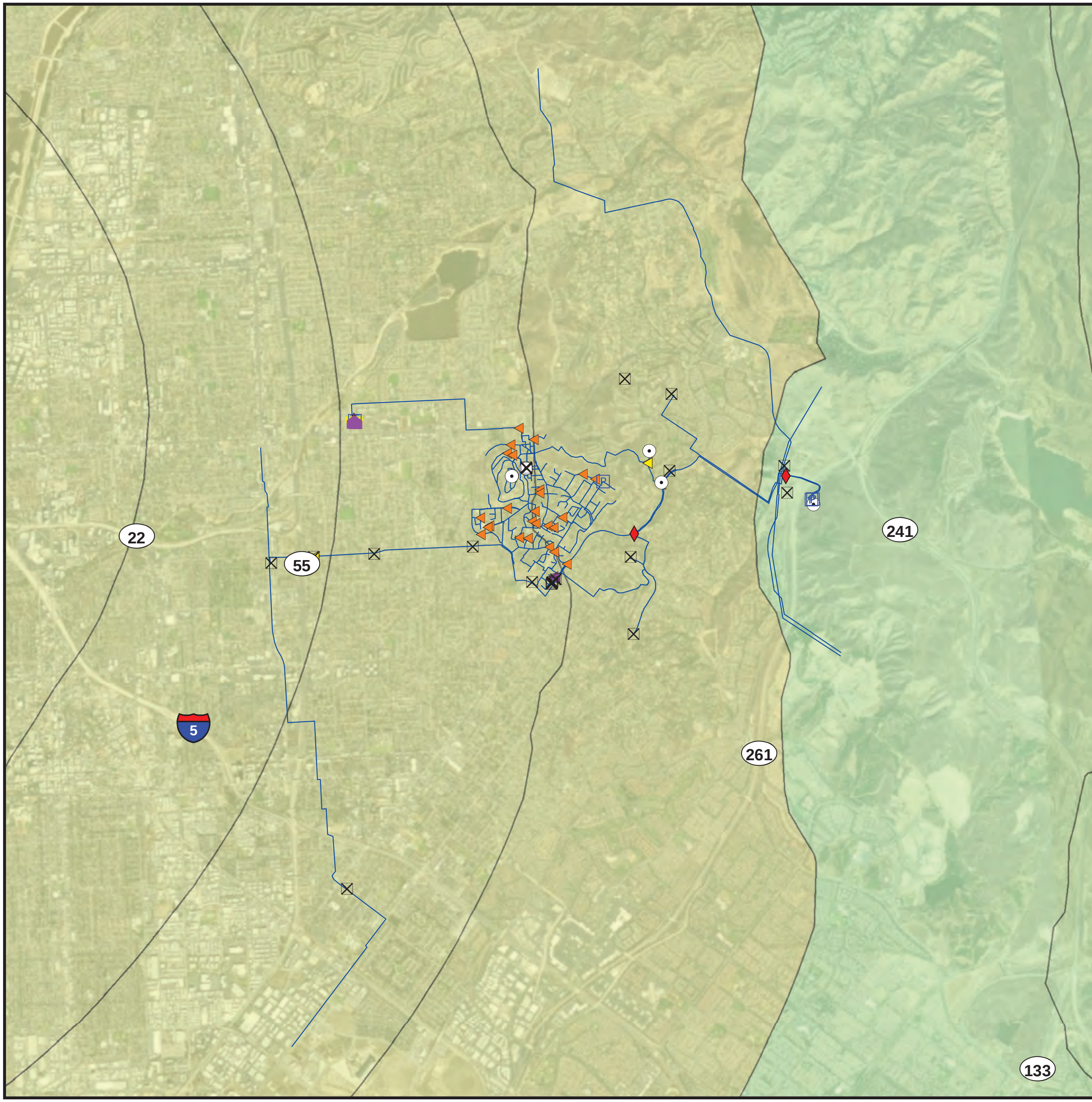
For pipelines, Hazus estimates earthquake damage in several categories: number of repairs needed (leaks and breaks), days required to implement repairs, and economic loss. Table 9-7 summarizes the results for pipelines.

9.4.4 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 District structures was performed for all five earthquake scenarios for each individual facilities found to be damaged. The results are shown in Figure 9-17 through Figure 9-21.

East Orange County Water District

Figure 9-8. Water System Facilities and Anaheim M6.0 Earthquake Scenario



Instrumental Intensity Scale

(Potential Damage/ Percieved Shaking)

- VI (Light/ Strong)
- VII (Moderate/ Very Strong)
- Building
- Pump Station
- Enclosed Storage Facility
- System Connection
- Hydrant
- Production Well
- Tank
- System Valve
- Control Valve - Altitude
- Control Valve - Air Release
- Control Valve - GVC
- Potable Water System Pipelines

0 0.75 1.5
Miles

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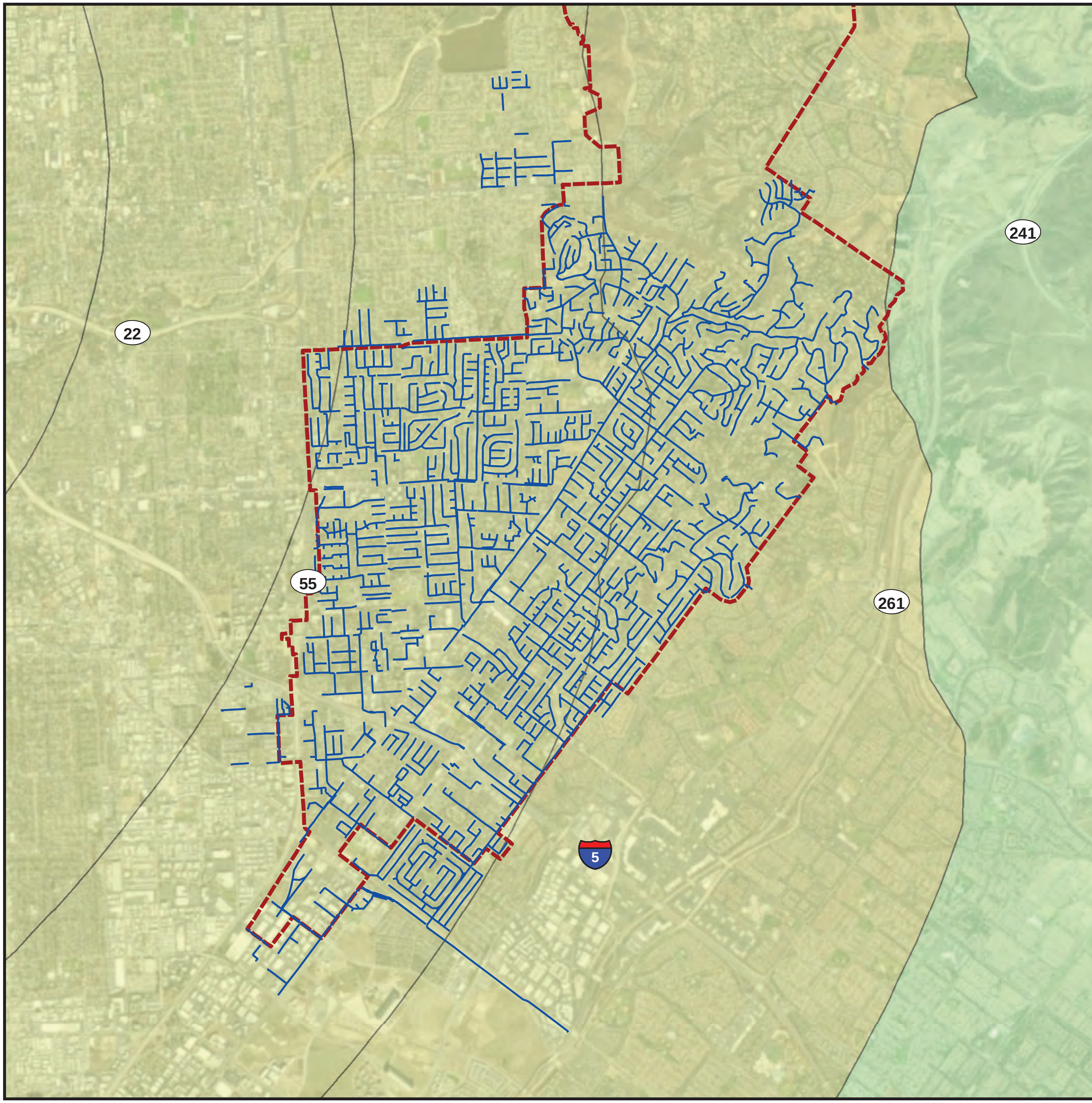
Map Data Sources:
East Orange County Water District & United States Geological Survey

East Orange County Water District

Figure 9-9. Wastewater System Facilities and Anaheim M6.0 Earthquake



Instrumental Intensity Scale

(Potential Damage/ Percieved Shaking)

- VI (Light/ Strong)
- VII (Moderate/ Very Strong)
- Water District Boundary
- Waste Water System Pipelines

0 0.5 1

Miles

N W E S

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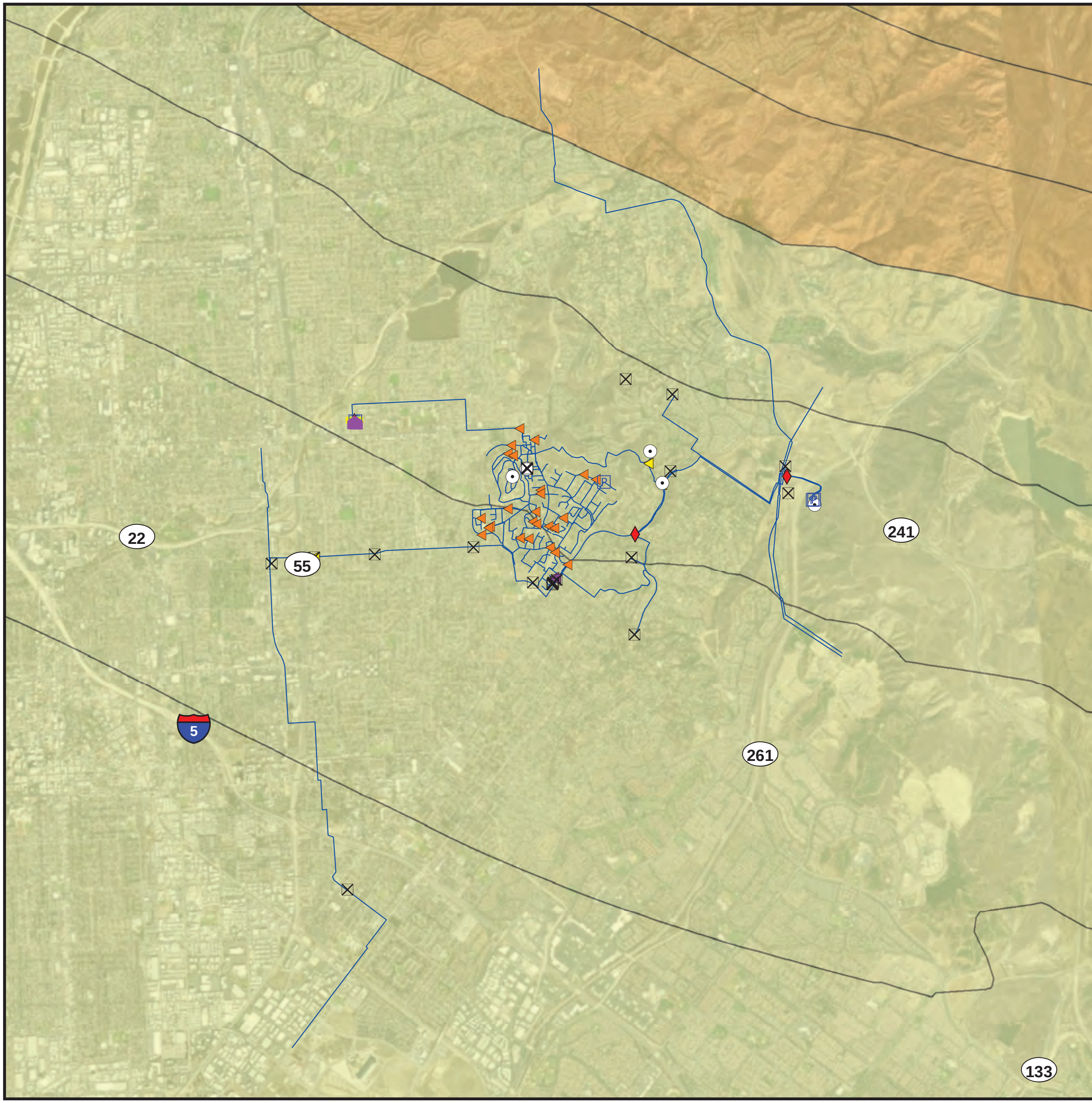
Map Data Sources:
East Orange County Water District & United States Geological Survey

East Orange County Water District

Figure 9-10. Water System Facilities and Whittier M7.0 Earthquake Scenario



Instrumental Intensity Scale

(Potential Damage/ Percieved Shaking)

VII (Moderate/ Very Strong)
VIII (Moderate-Heavy/ Severe)
Building
Pump Station
Enclosed Storage Facility
System Connection
Hydrant
Production Well
Tank
System Valve
Control Valve - Altitude
Control Valve - Air Release
Control Valve - GVC
Potable Water System Pipelines

0 0.75 1.5
Miles

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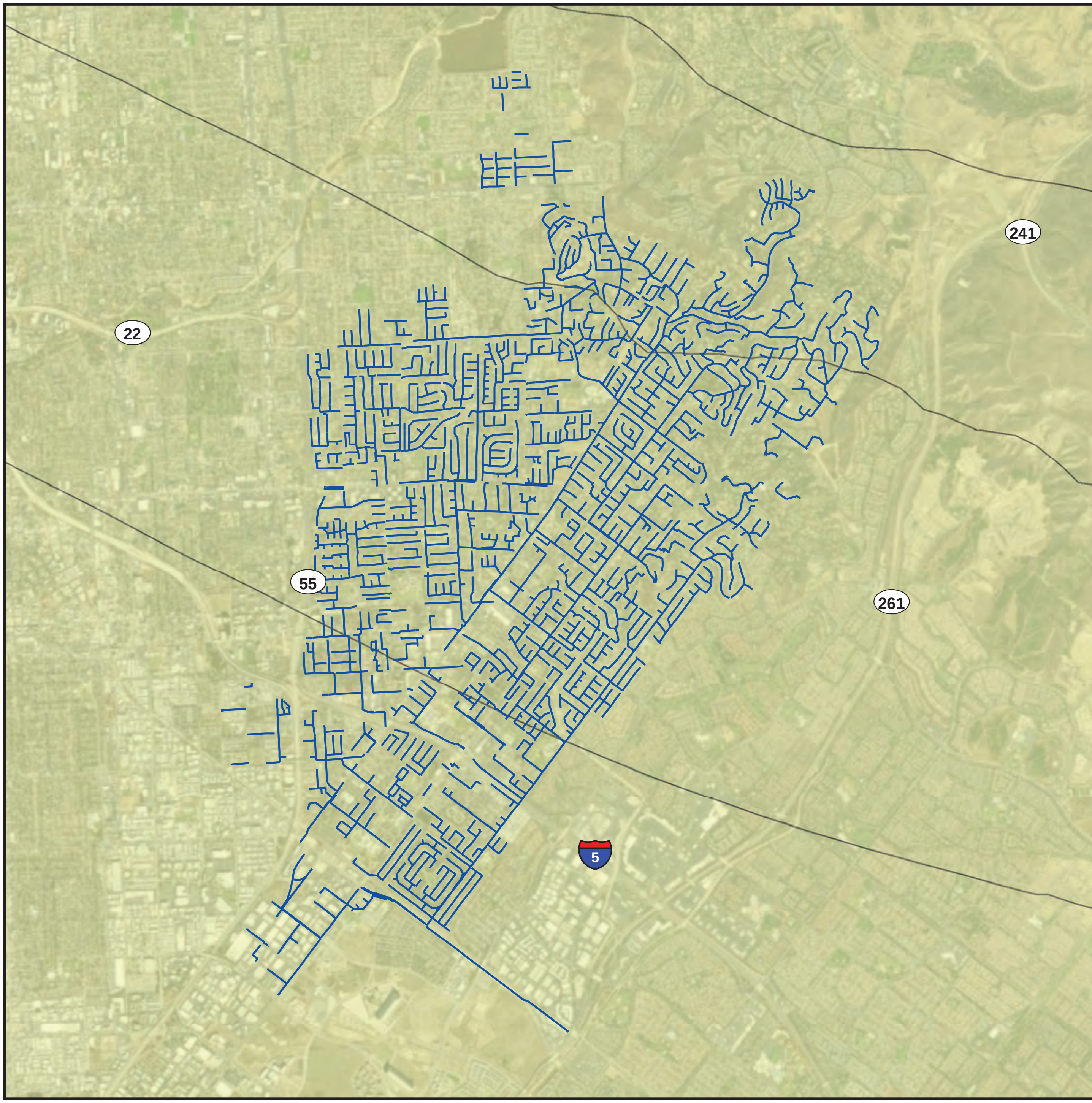
TETRA TECH

Map Data Sources:
East Orange County Water District &
United States Geological Survey

East Orange County Water District

Figure 9-11. Wastewater System Facilities and Whittier M7.0 Earthquake Scenario



Instrumental Intensity Scale

(Potential Damage/ Percieved Shaking)

VII (Moderate/ Very Strong)

Waste Water System Pipelines

0 0.5 1

Miles

N W E S

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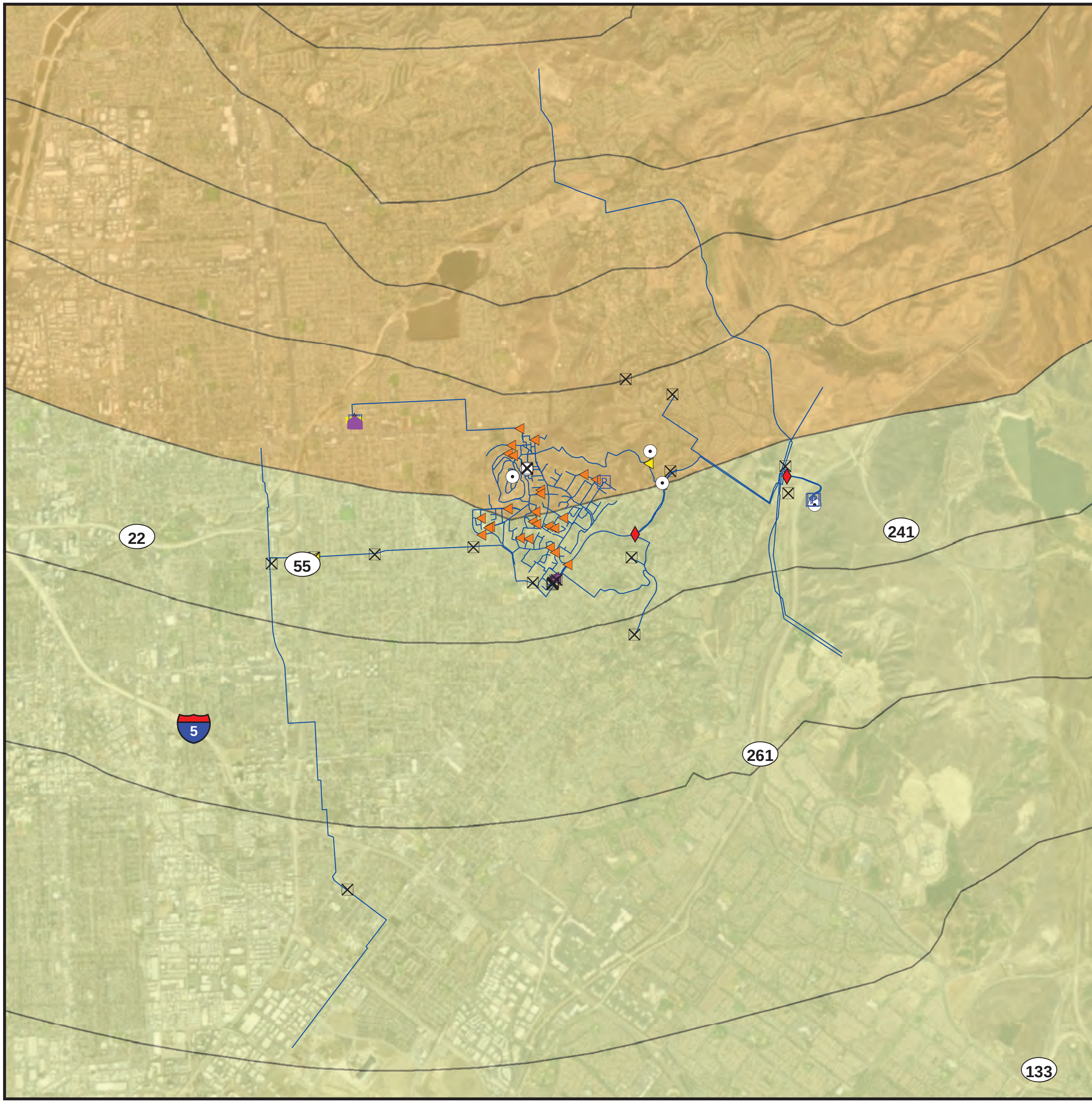
Map Data Sources:
East Orange County Water District &
United States Geological Survey



East Orange County Water District

Figure 9-12. Water System Facilities and Peralta Hills M6.6 Earthquake Scenario

Instrumental Intensity Scale

(Potential Damage/ Percieved Shaking)

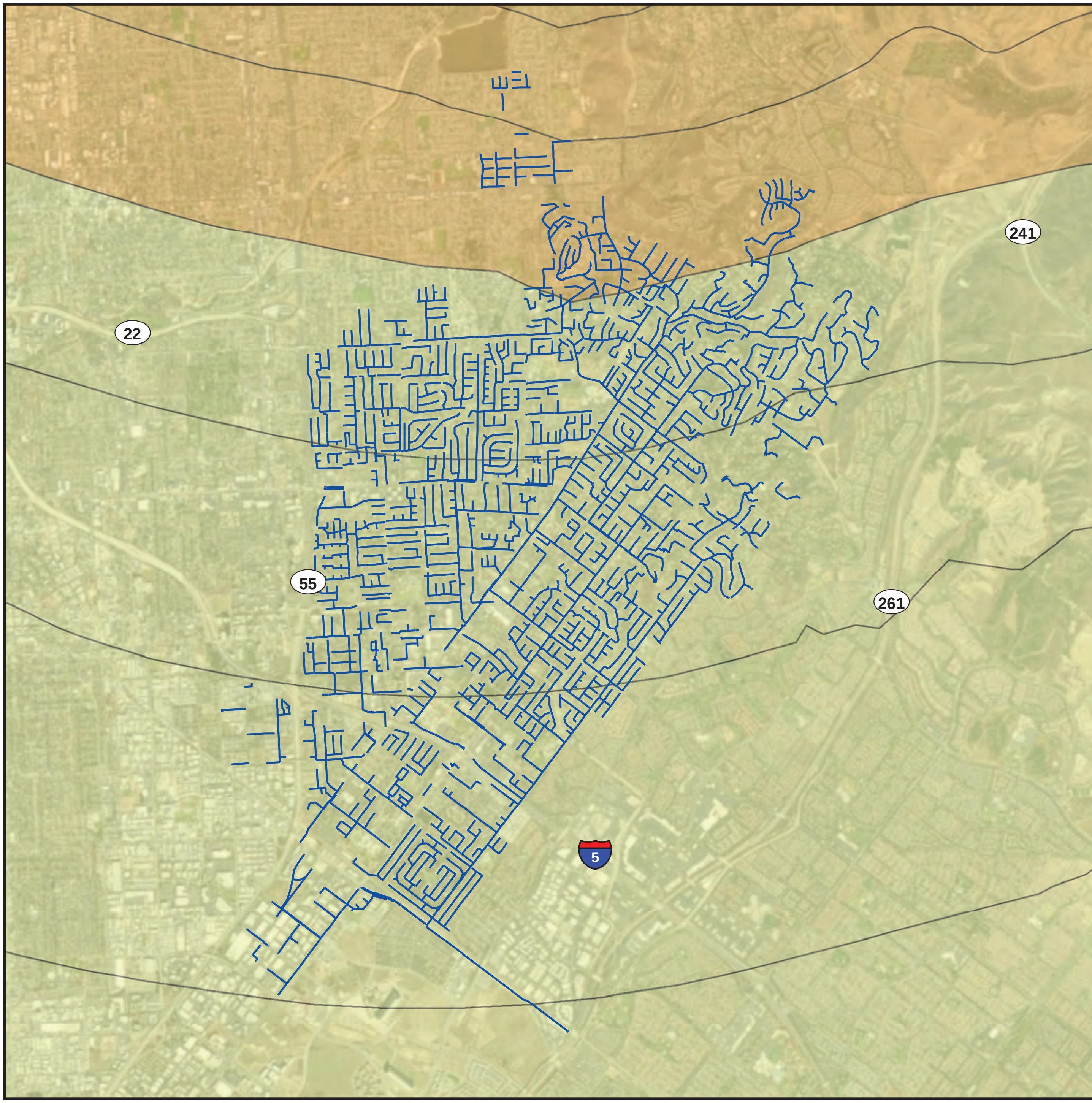
- VII (Moderate/ Very Strong)
- VIII (Moderate-Heavy/ Severe)
- Building
- Pump Station
- Enclosed Storage Facility
- System Connection
- Hydrant
- Production Well
- Tank
- System Valve
- Control Valve - Altitude
- Control Valve - Air Release
- Control Valve - GVC
- Potable Water System Pipelines

0 0.75 1.5

Miles

N W E S

Map Data Sources:
East Orange County Water District &
United States Geological Survey



East Orange County Water District

Figure 9-13. Wastewater System Facilities and Peralta Hills M6.6 Earthquake Scenario

Instrumental Intensity Scale

(Potential Damage/ Percieved Shaking)

- VII (Moderate/ Very Strong)
- VIII (Moderate-Heavy/ Severe)
- Waste Water System Pipelines

0 0.5 1
Miles

N
W E
S

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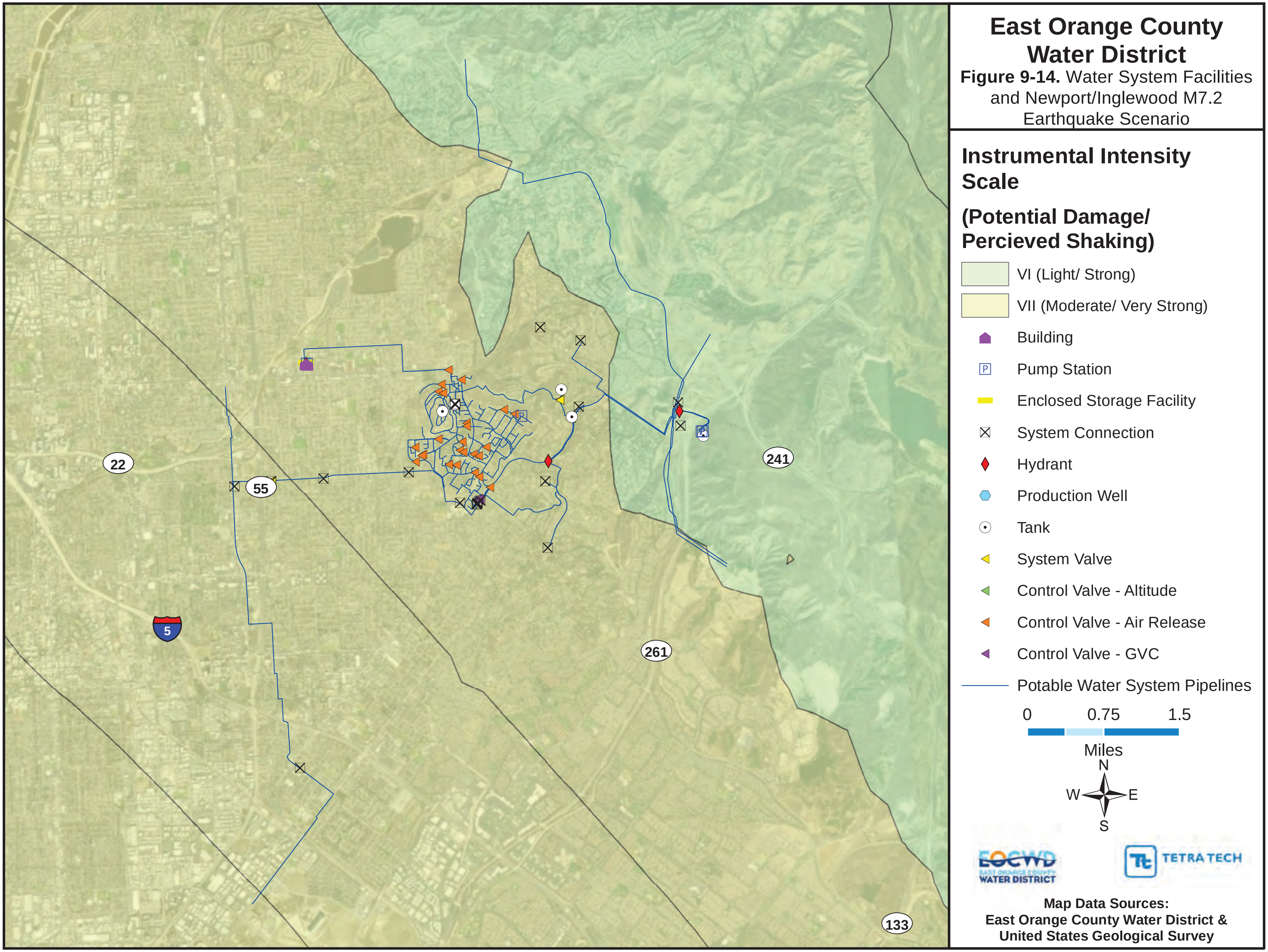
TETRA TECH

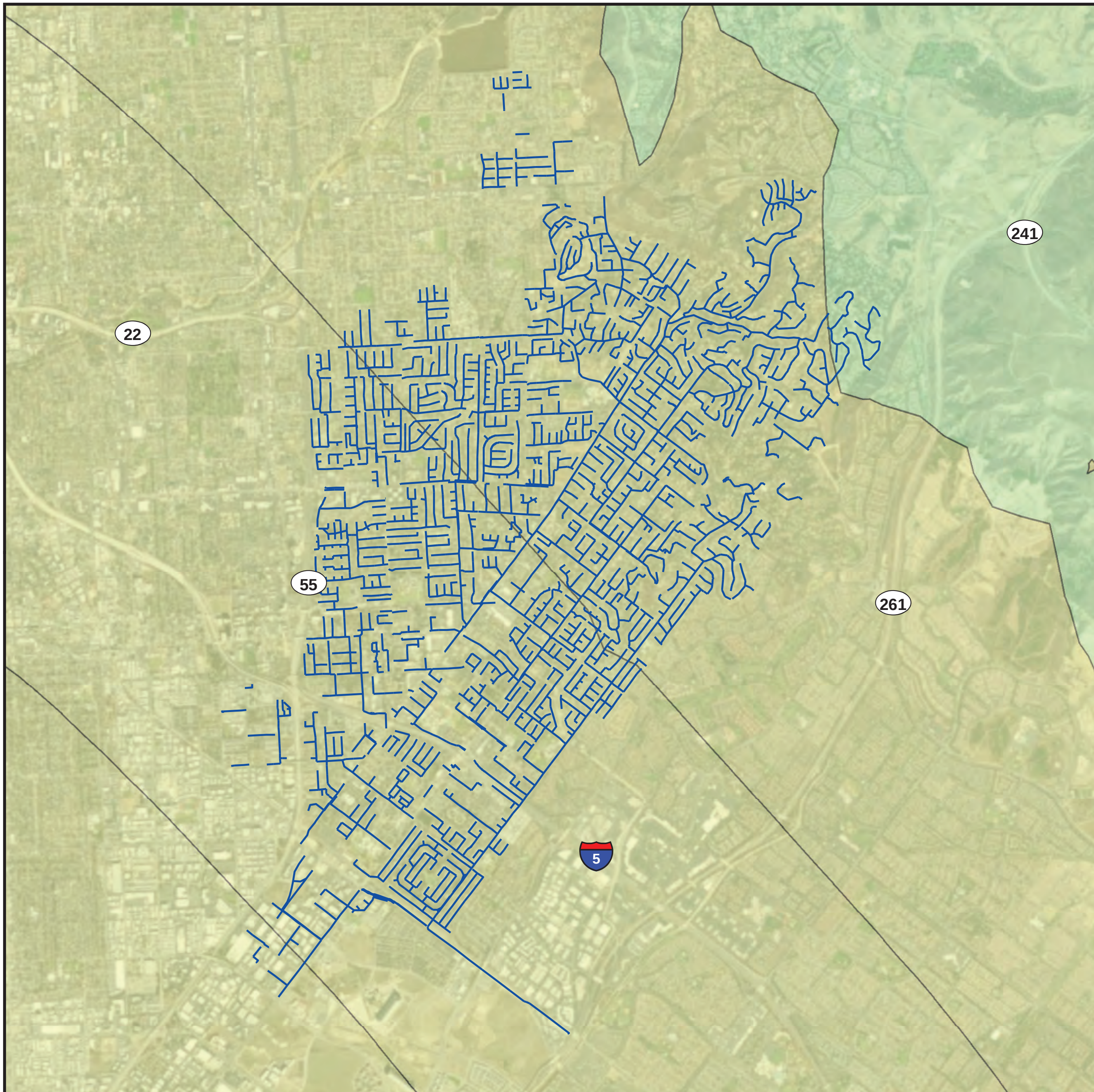
Map Data Sources:
East Orange County Water District & United States Geological Survey



East Orange County Water District

Figure 9-14. Water System Facilities and Newport/Inglewood M7.2 Earthquake Scenario

Map Data Sources:
East Orange County Water District & United States Geological Survey



East Orange County Water District

Figure 9-15. Wastewater System Facilities and Newport/Inglewood M7.2 Earthquake Scenario

Instrumental Intensity Scale

(Potential Damage/ Percieved Shaking)

VI (Light/ Strong)

VII (Moderate/ Very Strong)

Waste Water System Pipelines

0 0.5 1

Miles

N
W E
S

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TETRA TECH

Map Data Sources:
East Orange County Water District &
United States Geological Survey

Figure 9-16. Fault rupture planes for ShakeMap Scenario Events**.**

Table 9-7. 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
Anaheim-M6.4							
Potable Water Pipelines	5.4	1.9	7.4	0.1	0.0	0.1	$40,237
Wastewater Pipelines	27.5	6.9	34.4	0.3	0.1	0.4	$66,649
Whittier -M7.0							
Potable Water Pipelines	13.4	4.5	17.9	0.2	0.1	0.3	$124,424
Wastewater Pipelines	44.8	11.2	56.0	0.4	0.2	0.7	$107,179
Peralta Hills-M6.6							
Potable Water Pipelines	20.3	7.1	27.5	0.3	0.2	0.5	$194,059
Wastewater Pipelines	63.6	15.9	79.6	0.6	0.3	1.0	$150,885
Newport/ Inglewood-M7.2							
Potable Water Pipelines	7.0	2.4	9.4	0.1	0.1	0.1	$51,345
Wastewater Pipelines	41.5	10.4	51.9	0.4	0.2	0.6	$102,366
500-Year Probabilistic							
Potable Water Pipelines	20.2	8.9	29.2	0.3	0.2	0.5	$188,344
Wastewater Pipelines	0.1	0.0	0.1	0.0	0.0	0.0	$258

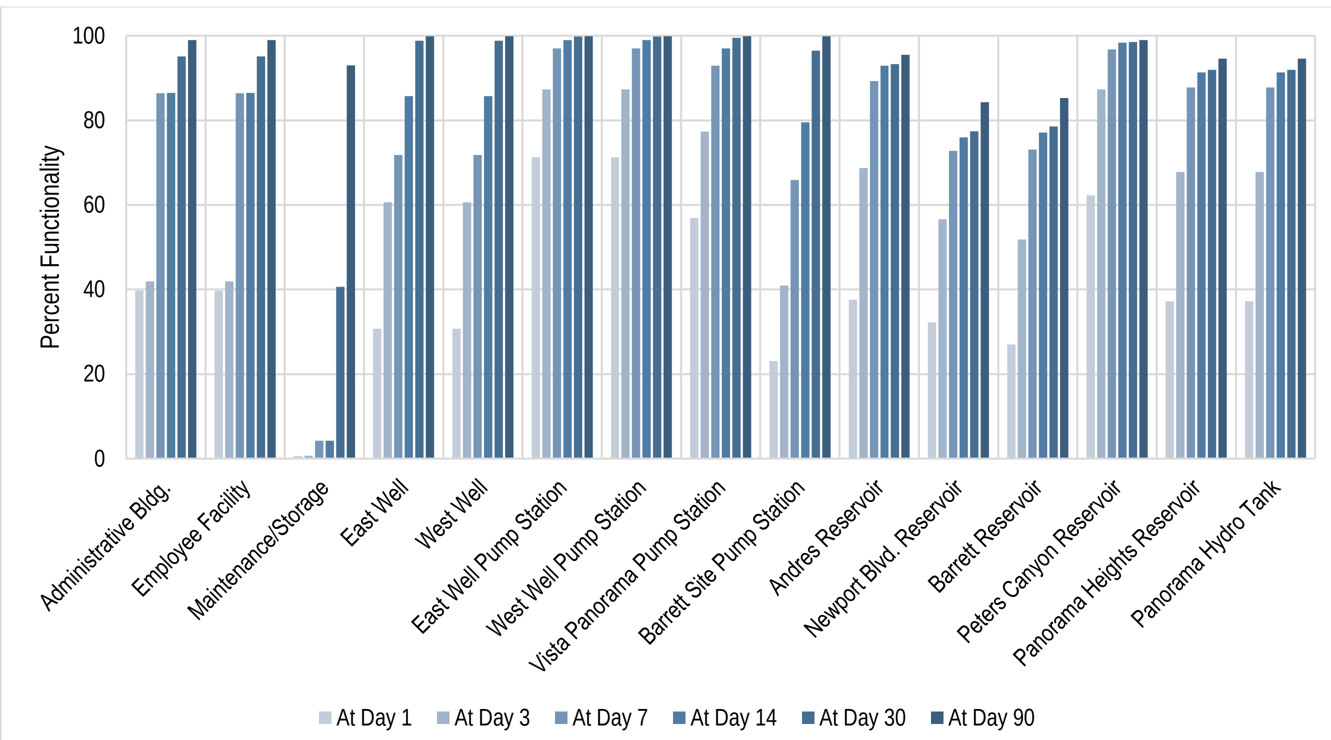


Figure 9-17. Critical Facility Functionality After Anaheim M6.4 Earthquake, by Number of Days Post-Event

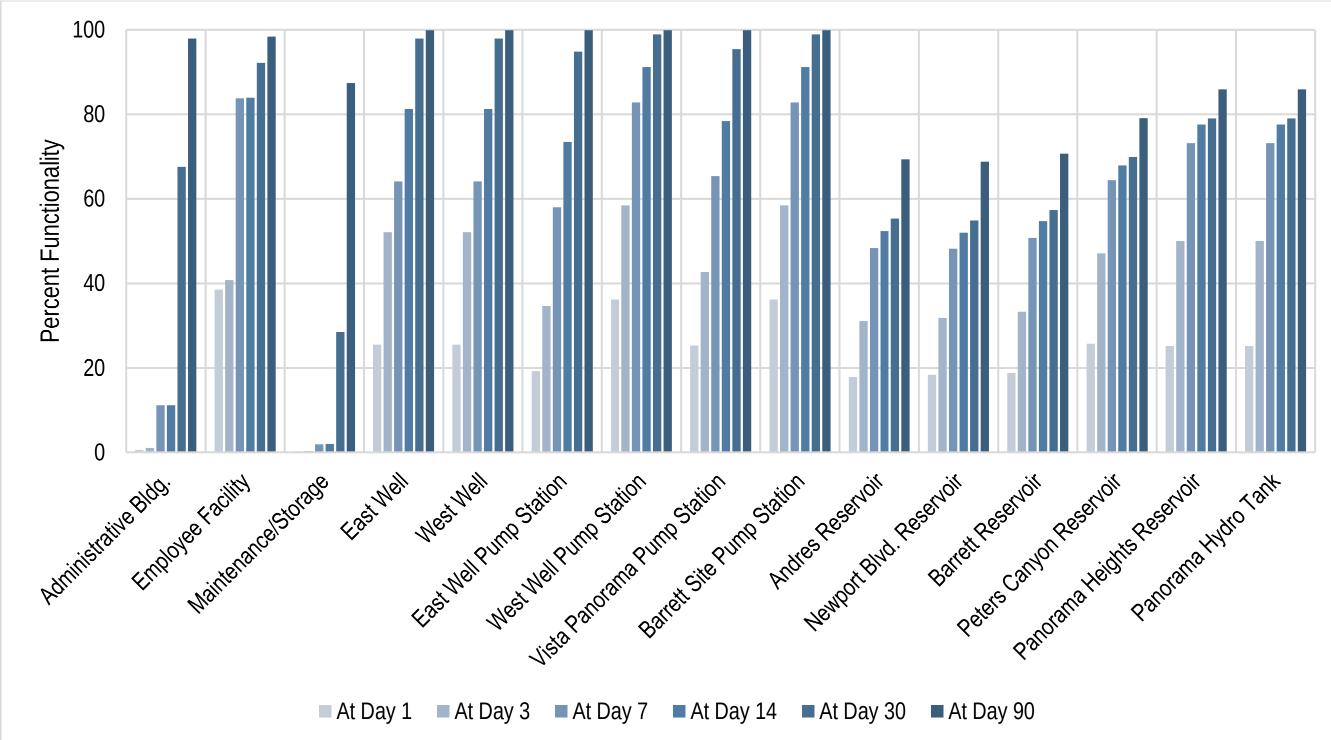


Figure 9-18. Critical Facility Functionality After Whittier M7.0 Earthquake, by Number of Days Post-Event

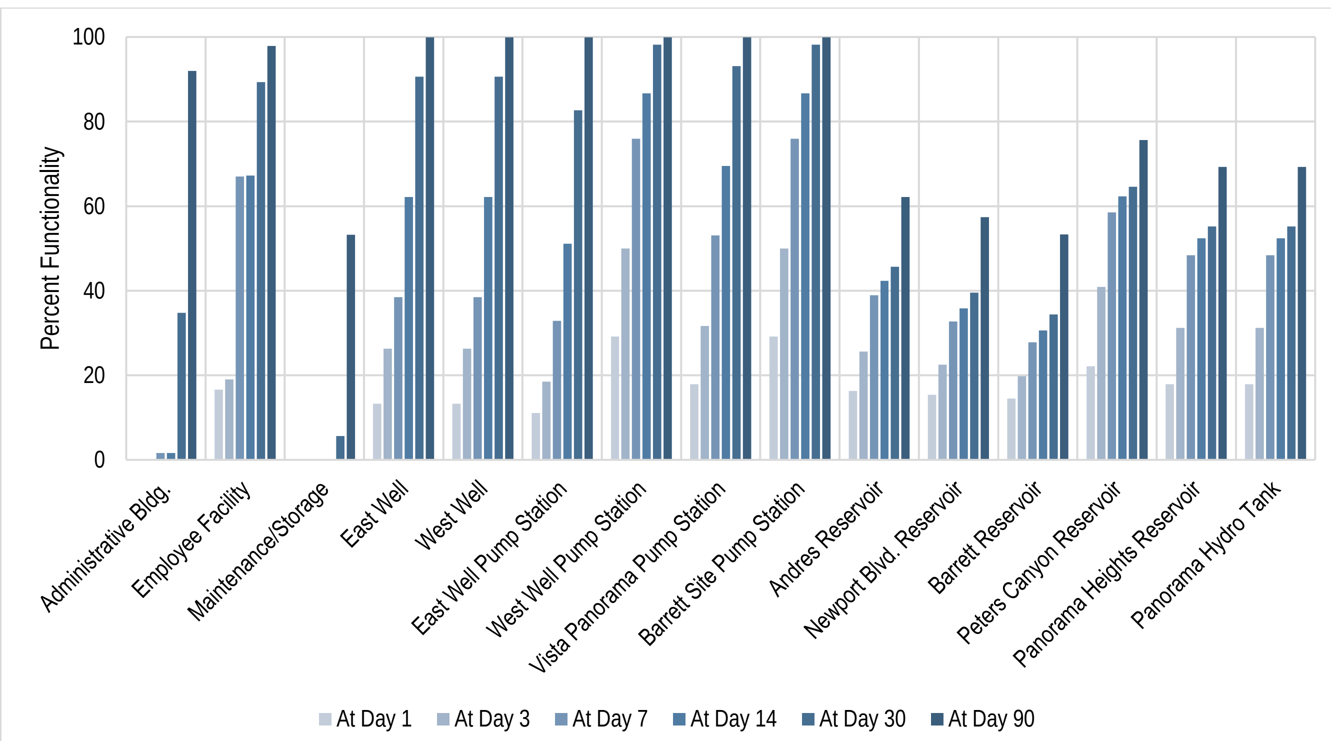


Figure 9-19. Critical Facility Functionality After Peralta Hills M6.6 Earthquake, by Number of Days Post-Event

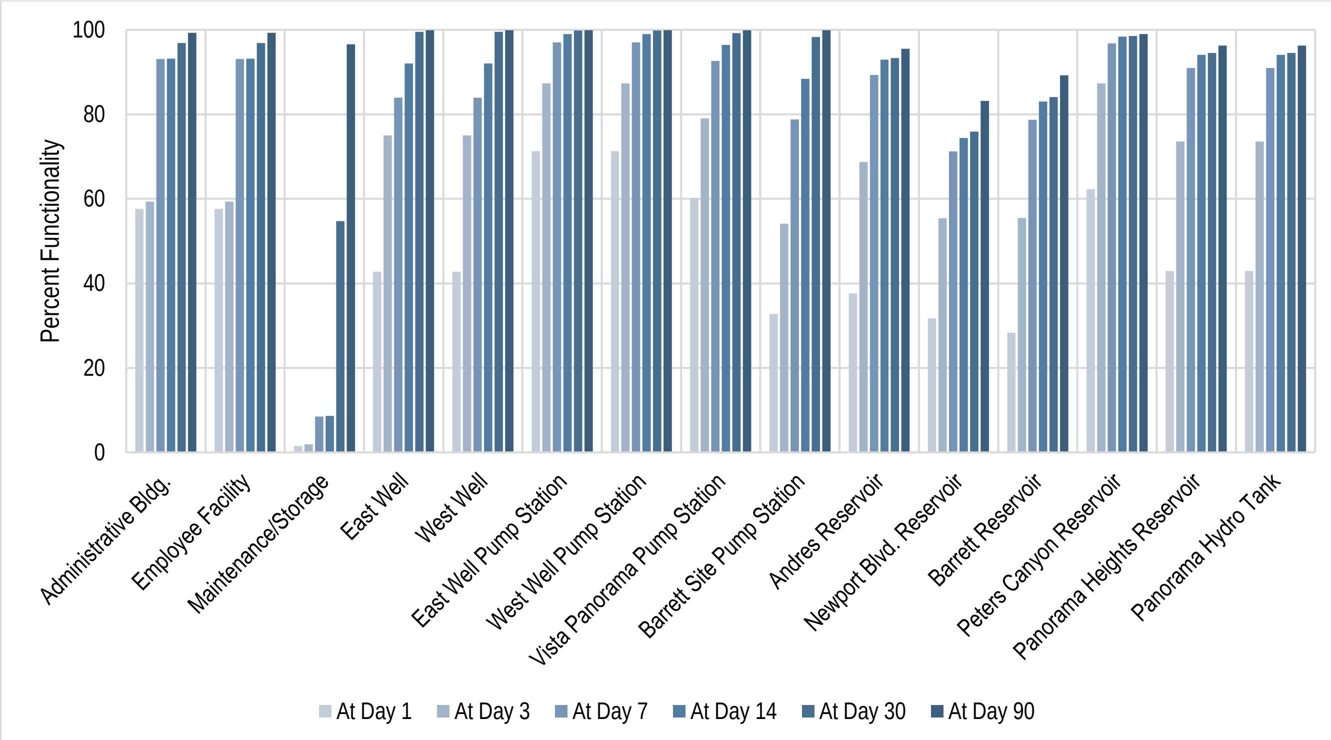


Figure 9-20. Critical Facility Functionality After Newport/Inglewood M7.2 Earthquake, by Number of Days Post-Event

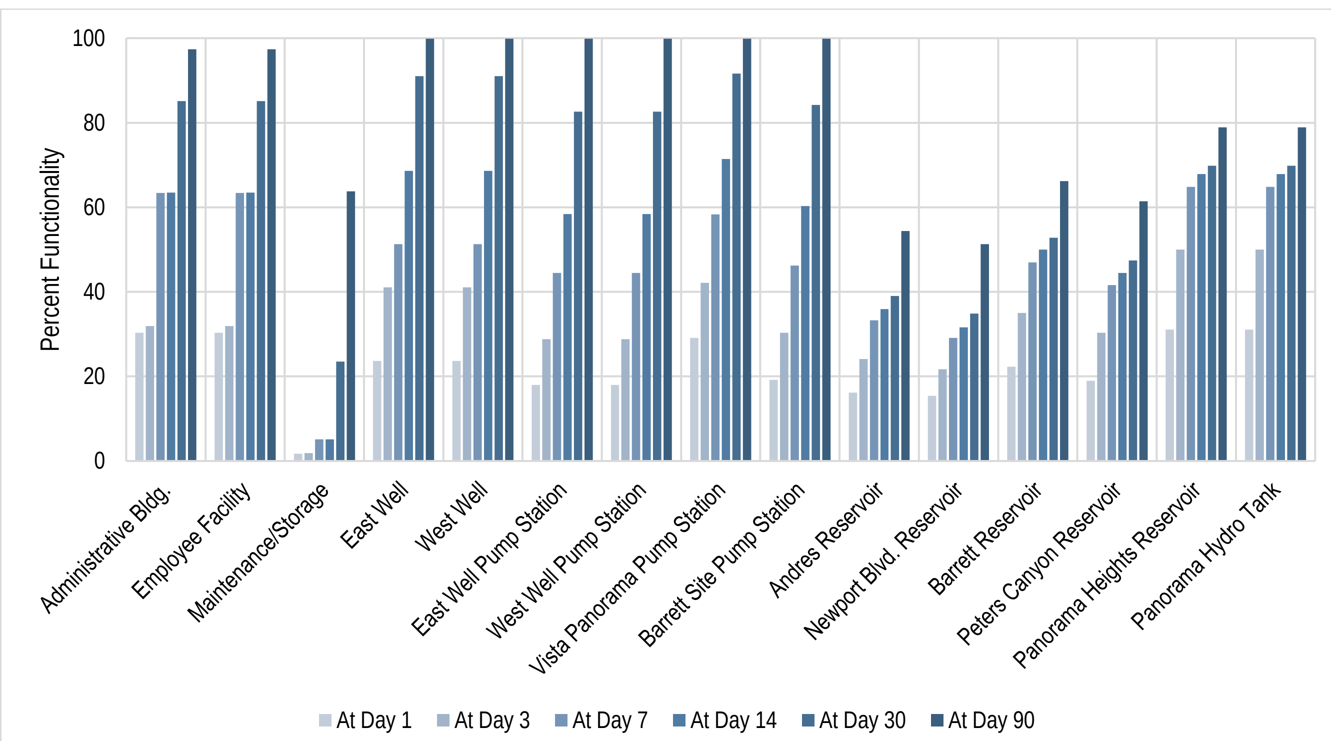


Figure 9-21. Critical Facility Functionality After 500-Year Probabilistic Earthquake, by Number of Days Post-Event

9.5 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 Orange, the City of Orange or the City of Tustin, 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.

9.6 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 impacts, 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.

9.7 ISSUES

Important issues associated with an earthquake include the following:

- The District has numerous critical assets with a high degree of vulnerability to earthquake.
- The average damage from the scenario earthquakes represents 30.4% of the replacement cost of all identified critical assets for the District.
- 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 using 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.
- There are a large number of earthen dams within the planning area. Dam failure warning and evacuation plans and procedures should be reviewed and updated to reflect the dams' risk potential associated with earthquake activity in the region.
- Earthquakes could trigger other natural hazard events such as dam failures and landslides, which could severely impact the planning area.

10. FLOOD

10.1 GENERAL BACKGROUND

10.1.1 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 (SFHA) 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.

10.1.2 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.

10.2 HAZARD PROFILE

Orange County's 510,000 acres are mainly mountainous terrain (on the northeast and southeast) and floodplain (in the central and western section). The County's rapid growth and transformation from an agricultural community to an urban community has changed flood control of large flows from mountains and hills to include control of additional runoff produced by development of the plains. Although there is a countywide system of flood control facilities, the majority of these are inadequate for conveying runoff from major storms, such as the 100-year flood.

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.

10.2.1 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 (WRCC, 2014).

The major flooding threat in Orange County has been the Santa Ana River. In 1938, the Santa Ana River flooded parts of Anaheim, Santa Ana, and Garden Grove, reportedly killing more than 50 people. Although the Prado Dam helped to substantially reduce the flood damage, the 1969 storm caused the largest dollar loss in Orange County history. Santa Ana River is owned by the U.S. Army Corps of Engineers and operated by U.S. Army Corps of Engineers Los Angeles District and Orange County Flood Control District.

Despite the Corps' extensive efforts at flood control protection, it appears that portions of the county, which would not be inundated by the river overflow during the 100-year event, could be subject to flooding from overflow of storm water drainage facilities that are presently inadequate for carrying the 100-year discharge. The East Garden Grove-Wintersburg Channel and Ocean View Channel system is one of the underlying channel systems of the Santa Ana River floodplain. This drainage system does not have the capacity to contain the 100-year flood because the channel banks and levees are overtopped at several locations.

In addition to the Santa Ana River, other areas subject to flooding during severe storms include the area adjacent to Atwood Channel, Brea Creek Channel, Carbon Canyon Channel, Capistrano Beach Storm Channel, El Modena Irvine Channel, Fullerton creek Channel, Hickey Canyon Storm Channel, Houston Storm Channel, Horno Creek Channel, Modjeska Canyon, Silverado Canyon, Niguel Storm Drain, Oso Creek Channel, San Juan Creek Channel, Santiago Creek Channel, and Trabuco Creek Channel.

In the central portion of the county, areas adjacent to Santiago Creek and Collins Channel may be inundated. Large portions of the San Diego Creek watershed in the City of Irvine and unincorporated area of the county are also subject to inundation. In the southern part of the county, the flooding is mostly confined to the canyon areas; however, these areas are also of concern since their development is expanding (OC Public Works, 2020).

10.2.2 Past Events

Orange County has experienced nine flooding events since 1969 for which federal disaster declarations were issued, as summarized in Table 10-1. 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 Orange County.

Table 10-1. History of Flood Events

Date	Declaration #	Type of event
1/18 – 1/23/2017	DR-4305	Severe winter storms, flooding, and mudslides
12/17/2010 – 1/4/2011	DR-1952	Severe winter storms, flooding, and debris and mud flows
1/5 – 3/20/1993	DR-979	Severe storm, winter storm, mud & landslides, flooding
2/10 – 2/18/1992	DR-935	Snow storm, 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
10/09/1978	DR-566	Landslides
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. Everywhere in Orange County saw 2 to 3 inches of rain in less than 6 hours. It caused roads to be flooded, homes to be threatened by mudslides, and traffic to become clogged on many freeways and surface streets (Mercury News, 2017).

December 2010 – January 2011 Winter Storms

A series of storms brought heavy rain, gusty winds and flash flooding to Southern California. Rainfall totals ranged from 4 to 8 inches over coastal areas. Water was chest high in places, which stranded many vehicles and flooded numerous businesses. Orange County storm damage was $33 million (Orange County Register, 2010).

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).

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 $5 million in Orange County. 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).

October 9, 1978 Severe Storms and Landslides

Damage caused directly by heavy rainfall was relatively light in Orange County compared to other areas of southern California. Most of the damage in the county resulted from failures of slopes along streets and highways. Few dwellings sustained serious damage resulting from the record precipitation: a total of three houses, two in Fullerton at the same locality and one in the Anaheim Hills area, sustained damage estimated at $20,000. Slopes of a relatively new tract on the north side of the West Coyote Hills in the City of La Habra suffered considerable damage from shallow debris slides. The Bluebird Canyon landslide in Laguna Beach on October 2, 1978, destroyed, damaged or endangered in excess of 50 houses, with a total estimated damage of $15 million, even though it covered only about 3.5 acres (NWS, 2017).

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).

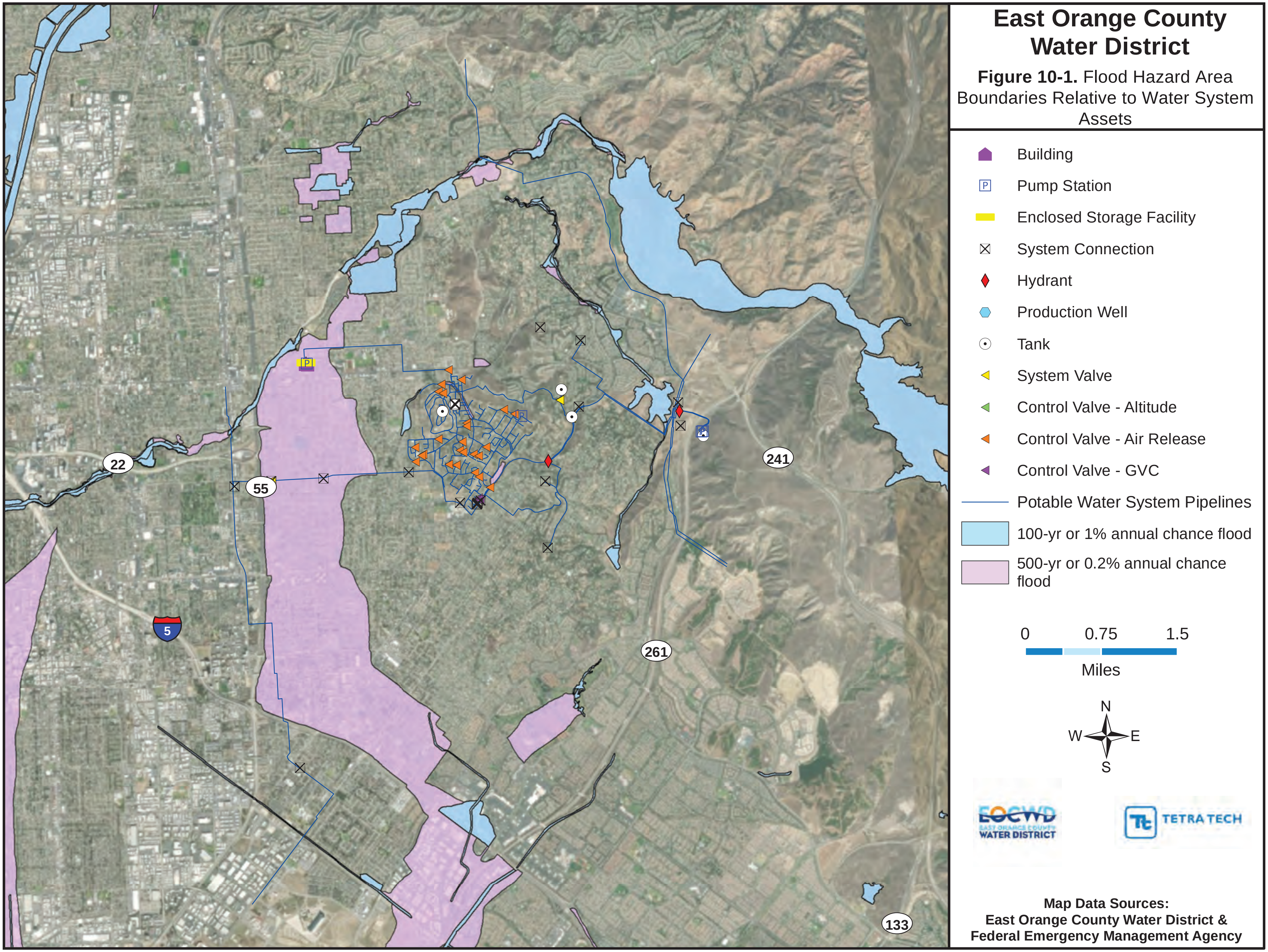
January 26, 1969 Severe Storms

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)

10.2.3 Location

Area Within the Mapped Floodplain

The March 21, 2019, Orange County Digital Flood Insurance Rate Maps (DFIRMs) are FEMA's official delineation of SFHAs for all of Orange County (see Figure 10-1 and Figure 10-2). Identified SFHAs include shallow flooding areas, floodways, alluvial fans, and coastal areas. These maps are the basis for the exposure and vulnerability analyses presented in this chapter. They represent the best data available at the time of this analysis, but they may not represent all identified sources of flood risk in Orange County. Extent and location mapping for flood hazards that fall outside of FEMA's *Guidelines and Specifications for Flood Insurance Studies* are not currently available for all flood hazard areas identified.

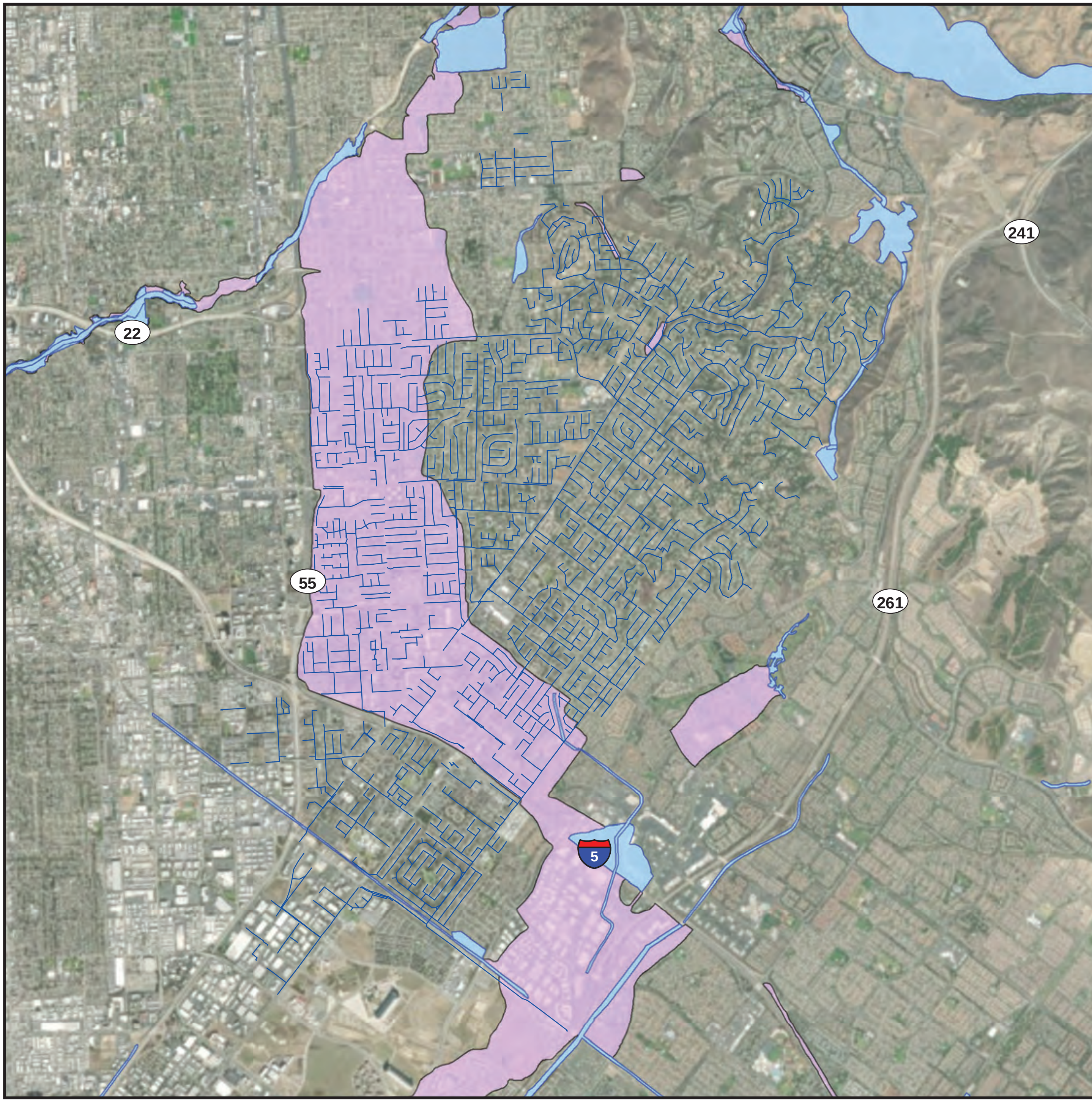


East Orange County Water District

Figure 10-1. Flood Hazard Area Boundaries Relative to Water System Assets

East Orange County Water District

Figure 10-2. Flood Hazard Area Boundaries Relative to Wastewater System Assets



Waste Water System Pipelines

100-yr or 1% annual chance flood

500-yr or 0.2% annual chance flood

0 0.5 1

Miles

N
W E
S

Map Data Sources:
East Orange County Water District &
Federal Emergency Management Agency

10.2.4 Frequency

Orange County has experienced nine flood events that triggered a federal disaster declaration since 1969, and average of one such flood event every 5.7 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.

10.2.5 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. Peak flows used by FEMA to map the floodplains in Orange County are listed in Table 10-2.

Table 10-2. Summary of Peak Discharges in the Planning Area

Source/Location	Drainage Area (square miles)	Discharge (cubic feet/second)			
		10-Year	50-Year	100-Year	500-Year
Barranca Channel					
At confluence San Diego Creek	2.3	340	740	1,000	1,900
At Barranca Road	1.2	210	450	630	1,150
At Red Hill Avenue	0.7	150	330	400	850
Como Storm Drain					
At confluence with Peters Canyon Wash	1.7	480	1,100	1,600	3,100
Downstream of Walnut Avenue Wash	0.7	250	560	800	1,600
El Modena Irvine Channel					
Downstream of confluence with Browning Avenue Channel	10.1	1,700	3,900	5,400	10,000
At Browning Avenue	8.9	1,500	3,500	4,700	9,600
Downstream of confluence of Redhill Channel	8.5	1,400	3,300	4,400	9,000
Downstream of confluence of North Tustin Channel	3.8	600	1,400	2,000	3,700
Downstream of Jordan Avenue (Retarding Basin)	1.5	400	500	500	2,200
Start of open channel downstream	1.3	340	670	870	1,900
Handy Creek					
At confluence with Santiago Creek	--	--	--	2,400	--
Upstream of Amapola Avenue	3.8	680	1,600	2,300	4,000
Downstream of Chapman Avenue	2.0	600	1,500	2,000	3,600
Lane Channel					
At confluence with San Diego Creek	4.0	540	1,200	1,500	3,000
At Red Hill Avenue	2.2	310	660	850	1,700
Peters Canyon Wash Channel					
At confluence with San Diego Creek	--	--	--	14,660	99
Downstream of El Modena-Irvine Channel	32.6	--	--	11,580	--
Approximately 1,400 feet downstream of Peters Canyon Reservoir	0.24	--	--	320	--
Approximately 1,300 feet upstream of Lower Peters Canyon Reservoir	0.77	--	--	840	--
At Lower Peters Canyon Reservoir	0.95	--	--	980	--

Source/Location	Drainage Area (square miles)	Discharge (cubic feet/second) 10-Year	50-Year	100-Year	500-Year
San Diego Creek					
At MacArthur Boulevard	123.8	4,300	9,700	18,500	27,500
Downstream of confluence with San Joaquin channel	105.8	4,200	9,500	17,500	27,000
Downstream of confluence of Peters Canyon Wash	86.5	3,900	8,800	16,000	25,000
At Laguna Freeway	29.8	4,300	9,600	12,700	20,700
At San Diego Freeway	16.1	3,000	6,600	8,700	15,500
Downstream of confluence of Veeh Creek Tributary	14.5	1,600	3,700	5,500	10,500
At Valencia Avenue	9.3	3,200	4,300	4,700	6,200
Santiago Creek					
At Santa Ana River	102	1,500	4,000	12,000	27,000
At Atchison Topeka and Santa Fe Railway	96	1,500	4,000	12,000	27,000
Santa Ana-Santa Fe Channel					
At ATSF Railway crossing	4.2	500	1,300	2,000	3,700
At ATSF Railway junction	3.9	490	1,300	1,900	3,500
At Redhill Avenue	3.3	420	1,100	1,600	3,000
At Newport Freeway	2.3	290	760	1,100	2,100
Upstream of confluence of Southwest Tustin Channel	1.3	170	430	650	1,200
At Grand Avenue	0.8	100	260	400	730

10.2.6 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 10-3), 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.

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 in advance of the potential for flash flooding to occur.

To provide quantitative information for flood warning and detection, Orange County began installing its ALERT (Automated Local Evaluation in Real Time) system in 1983. Operated by the Environmental Resources group at Orange County Public Works in cooperation with the National Weather Service, ALERT uses remote sensors located in rivers, channels and creeks to transmit environmental data to a central computer in real time. Sensors are installed along the Santa Ana River, San Juan Creek, Arroyo Trabuco Creek, Oso Creek, and Aliso Creek, as well as flood control channels and basins. The field sensors transmit hydrologic and other data (precipitation data, water levels, temperature, wind speed, etc.) to base station computers for display and analysis. Seven pump stations regulating stormwater discharge to flood control channels are also instrumented. Their monitoring system includes automated call-out of operations personnel in the event of an emergency.

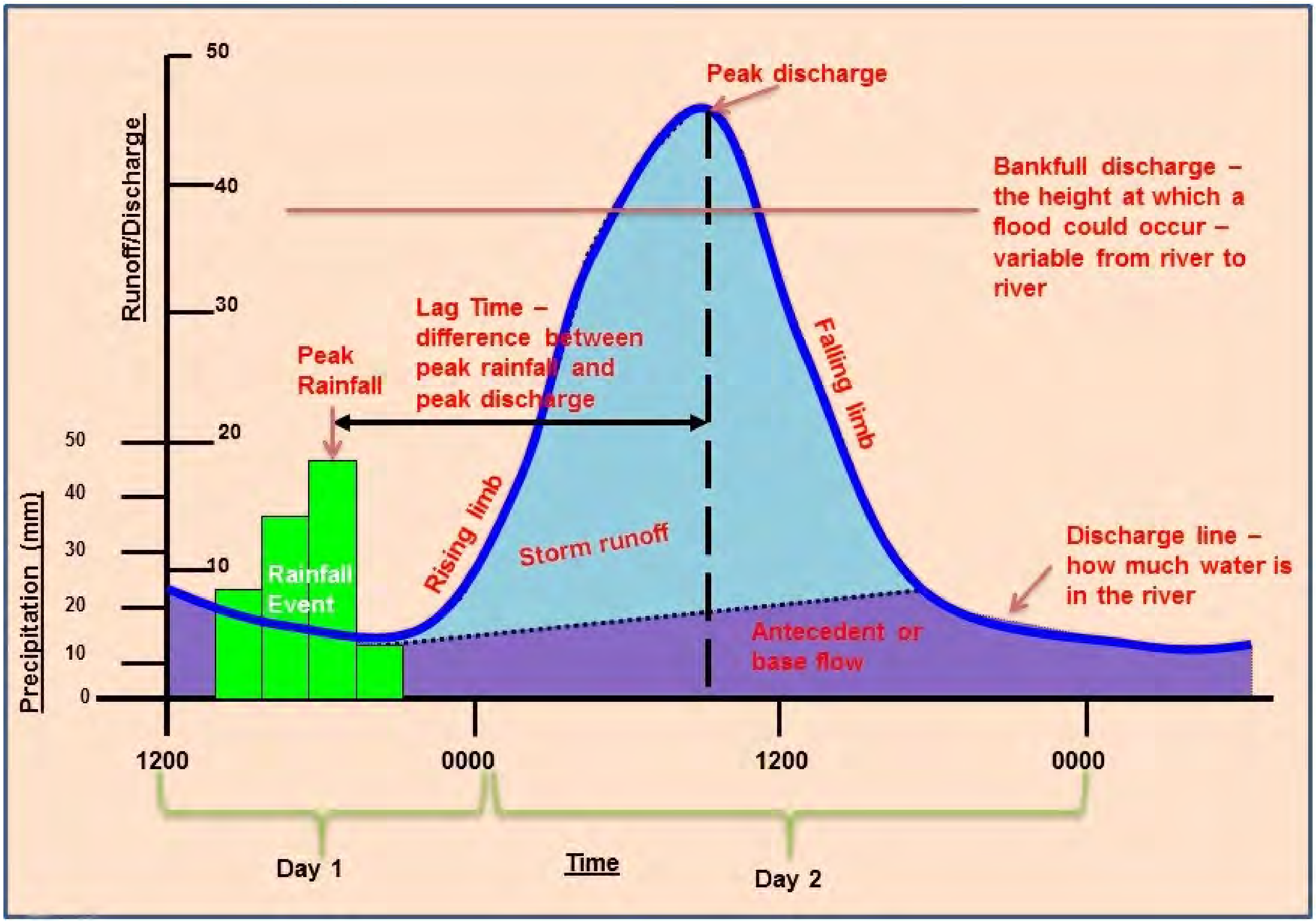


Figure 10-3. Example Hydrograph

The Orange County Public Works Department Operations Center is activated when heavy rainfall occurs or is predicted, or when storm runoff conditions indicate probable flood damage. The operations center monitors the situation on a 24-hour basis. Response may include patrols of flood control channels and deployment of equipment and personnel to reinforce levees when needed. Operations center activation and emergency response actions are based on the following emergency readiness stages:

- Stage I—Mild rainfall (watch stage)
- Stage II—Heavy rainfall or potential thereof. Operations center activated and surveillance of flood control facilities in effect.
- Stage III—Continued heavy rainfall or deterioration of facilities. County Public Works Director in charge. County’s personnel assume assigned emergency duties.
- Stage IV—Conditions are or are likely to be beyond County control. board of supervisors, or director of emergency services when the board is not in session, proclaims local emergency and assumes special powers. Mutual aid requested.
- Stage V—Damage beyond control of all local resources. State forces are required. Governor requested to proclaim state of emergency.
- Stage VI—Damage beyond control of local and state resources. Federal forces are required. President requested to declare major disaster.

10.2.7 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.

10.3 EXPOSURE

The risk assessment for flood evaluated District assets that lie within the 1-percent-annual-chance and 0.2-percent-annual-chance flood zones. It was assumed that underground pipelines are at limited risk from flooding, so only above-ground structures were identified. The analysis found that no District assets are exposed to the 1-percent-annual-chance flood. Table 10-3 summarizes the number of each type of structure found to be within the mapped 0.2-percent-annual-chance flood zone. Figure 10-4 shows these results as the percent of total planning area structures of each type.

Table 10-3. Number of District Structures Exposed to the 0.2 Percent Annual Chance Flood Zone

	Number of Structures in the 0.2 Percent Annual Chance Flood Zone
Building	2
Control Valve—Air Release	0
Control Valve—Altitude	0
Control Valve—GVC	0
Enclosed Storage Facility	1
Hydrant	8
Production Well	2
Pump Station	1
System Connection	2
System Valve	16
Tank	0
Total	32

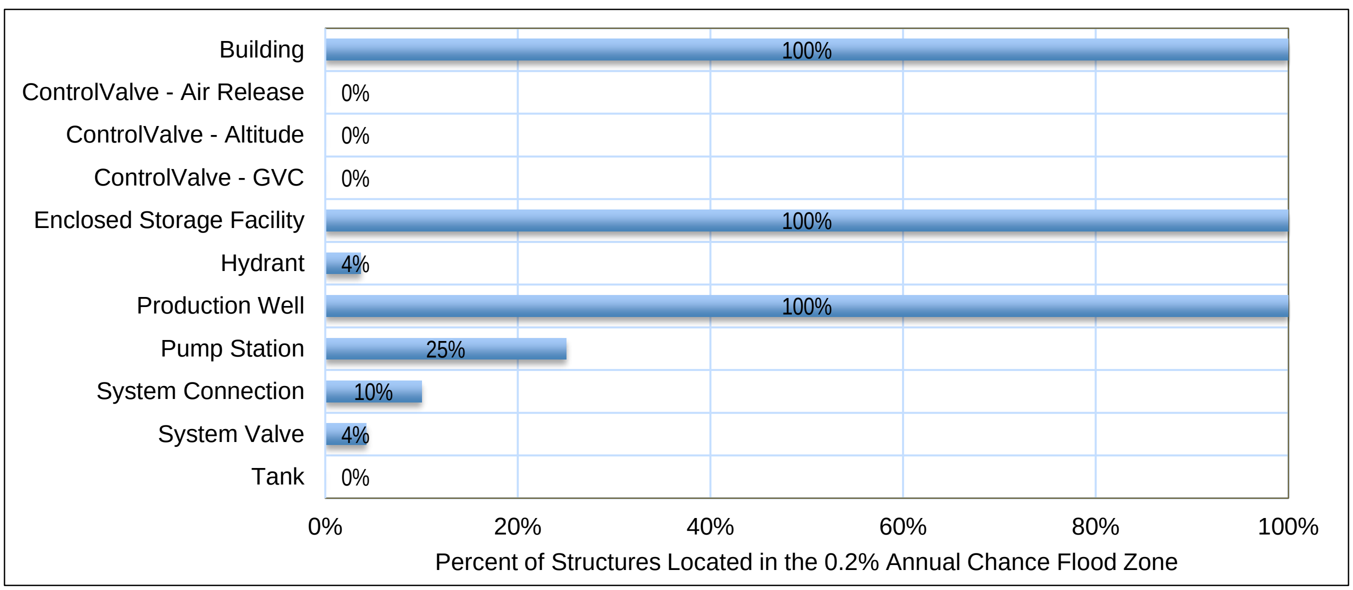


Figure 10-4. Percent of District Structures Exposed to the 0.2 Percent Annual Chance Flood

10.4 VULNERABILITY

The flood module of Hazus was used for a Level 2 assessment of vulnerability to the flood hazard. Hazus estimated no damage to critical District assets from the 1-percent-annual-chance or 0.2-percent-annual-chance flood. It is possible that these floods would cause damage to District assets that fall outside of the parameters recognized by the model.

10.5 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 Orange, the City of Orange or the City of Tustin, 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 Orange and Tustin 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.

10.6 SCENARIO

The major flooding causes in the District are short-duration, high-intensity storms. 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. 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. High in-channel flows could cause water courses to scour, possibly washing out roads and creating more isolation problems. 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. Additionally, as the grounds become saturated, groundwater flooding issues typical for the District would be significantly enhanced.

10.7 ISSUES

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

- The currently effective flood hazard mapping does not accurately reflect the true flood risk in the District service area. FEMA mapping does not recognize flooding associated with urban drainage issues.
- 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.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- There needs to be a coordinated hazard mitigation effort between jurisdictions affected by flood hazards across Orange County.
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.

- A lack of concern regarding flood risk by property owners can translate to the lack of political will to make changes.
- The potential impact of climate change on flood conditions needs to be better understood.
- Floodplain restoration/reconnection opportunities should be identified as a means to reduce flood risk.
- Post-flood disaster response and recovery actions need to be solidified.
- Floodplain management actions require interagency coordination.
- Open spaces (infiltration) have decreased substantially, with no plans to reverse this trend. More impervious surface leads to more runoff.

11. LANDSLIDE

11.1 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. 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.

11.1.1 Landslide Types

Landslides are commonly categorized by the type of initial ground failure. Common types of slides are shown on Figure 11-1. 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 com mon 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 in excess of 20 mph are not uncommon, and speeds in excess of 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.

Source: Washington Department of Ecology, 2026

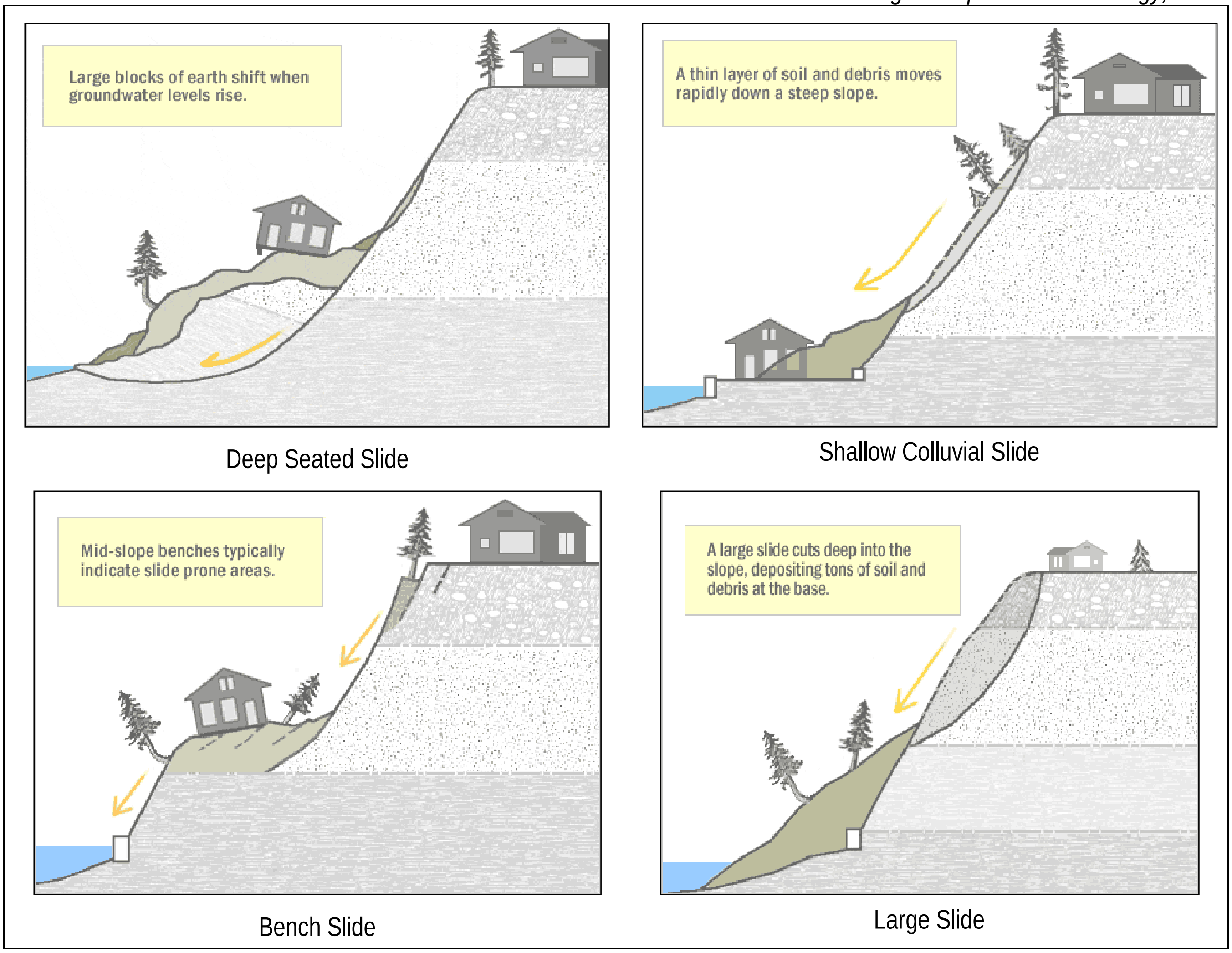


Figure 11-1. Common Landslide Types

11.1.2 Landslide 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).

11.1.3 Landslide 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

Watershed protection is a primary concern to Orange County. 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. To reduce fire hazards and protect slopes, Orange County Fire Authority presently mandates vegetation clearance and encourages property owners to plant appropriate vegetation (OCFA, 2020).

11.1.4 Landslide Management

While small landslides are often a result of human activity, the largest landslides are often naturally occurring phenomena with little or no human contribution. The sites of large landslides 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 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

11.2 HAZARD PROFILE

11.2.1 Past Events

Table 11-1 lists known landslide events that occurred in the vicinity of the planning area between 1978 and February 2017.

Table 11-1. Landslide Events in and near the District Planning Area

Event Date	Event Type	FEMA Number	Description
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	
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	
1/17/1994	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	Landslides in Orange County's San Clemente and Big Rock Mesa caused over $700 million in damage and litigation costs.
1/5 – 3/20/1993	Severe Winter Storm, Landslides, & Flooding	979	
2/10 – 2/18/1992	Rain/Snow/Wind Storms, Flooding, Mudslides	935	
10/1 – 11/20/1987	Earthquake and Aftershocks	799	
1/21 – 3/30/1983	Coastal Storms, Floods, Slides and Tornadoes	677	
2/15/1978	Coastal Storms, Mudslides and Flooding	547	Water and debris flowing down canyons led to 21 deaths and $50 million in damage.

Sources: FEMA 2020; California Department of Conservation, Division of Mines and Geology 1979, USGS 1988, and 1998; NOAA 2017

11.2.2 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 11-2 and Figure 11-3 show mapped landslide hazard areas.

11.2.3 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 NCEI storm events database, the planning area has been impacted by earthquakes, wildfires, and 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.

11.2.4 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.

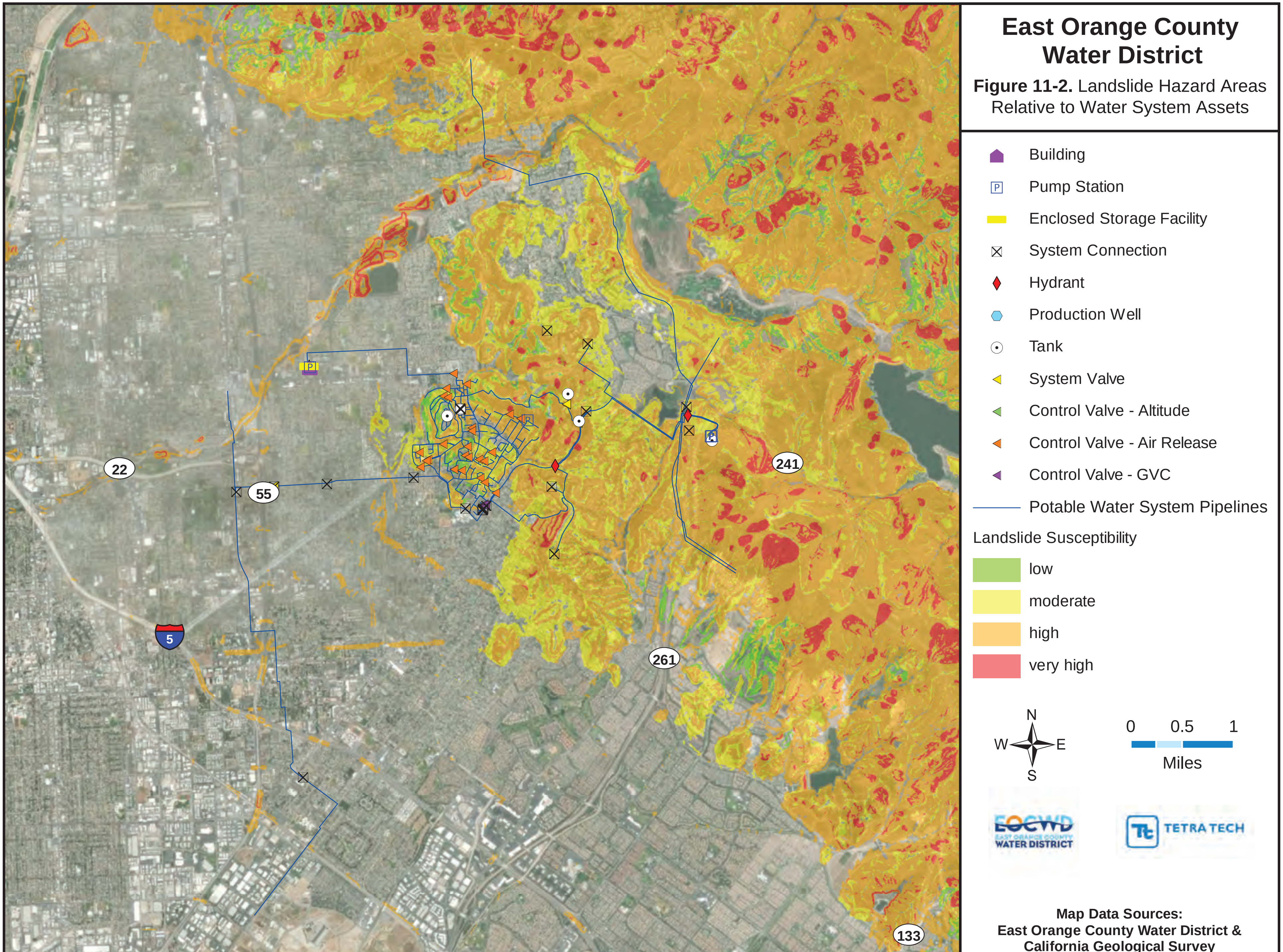
Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. Landslides and debris flows cause millions of dollars in cumulative damage to Southern California's homes, businesses, and infrastructure every year.

11.2.5 Warning Time

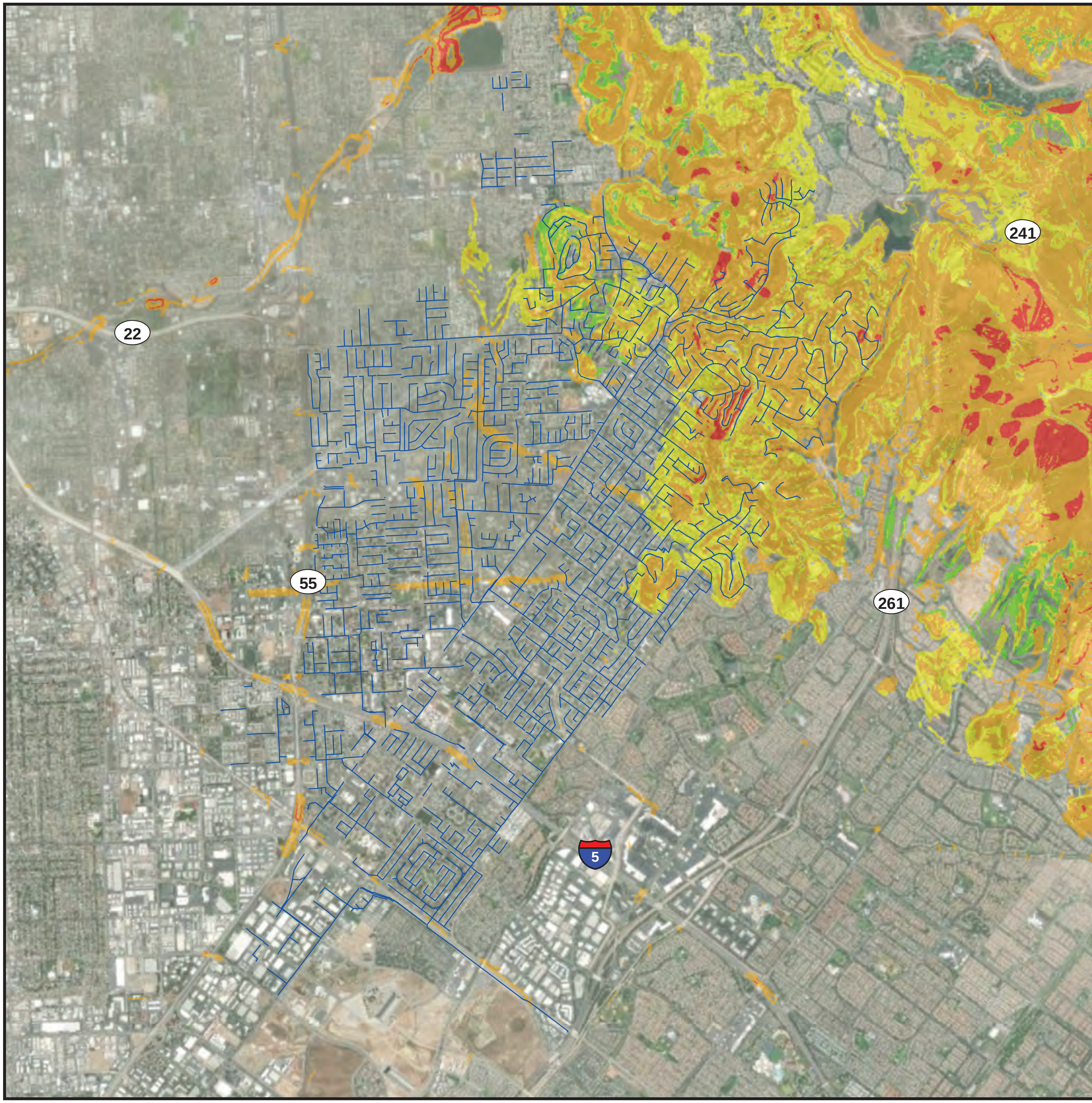
Landslides can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Landslides and debris flows can be initiated by severe storms, earthquakes, wildfires, or human modification of the land. They can move rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds.

East Orange County Water District

Figure 11-2. Landslide Hazard Areas Relative to Water System Assets



Map Data Sources:
East Orange County Water District &
California Geological Survey



East Orange County Water District

Figure 11-3. Landslide Hazard Areas Relative to Wastewater System Assets

Waste Water System Pipelines

Landslide Susceptibility

- low
- moderate
- high
- very high

0 0.5 1

Miles

N
W E
S

EOCWD EAST ORANGE COUNTY WATER DISTRICT

TETRA TECH

Map Data Sources:
East Orange County Water District &
California Geological Survey

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. Generally accepted warning signs for landslide activity include the following:

- 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 as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

11.3 SECONDARY IMPACTS

Landslides can cause secondary impacts such as blocking roads, which can isolate residents and businesses and delay commercial, public and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They also can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

11.4 EXPOSURE

The risk assessment for landslide determined District assets that lie within each landslide susceptibility zone. Table 11-2 and Table 11-3 summarize the length of pipeline and number structures, respectively, in each mapped landslide susceptibility zone. Figure 11-4 and Figure 11-5 show the results for pipelines and structures, respectively, as the percent of total planning area assets.

11.5 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.

Table 11-2. Length of District Pipeline Within Landslide Hazard Areas

	Length of Pipe in Landslide Hazard Areas (feet)			
	Low Susceptibility	Moderate Susceptibility	High Susceptibility	Very High Susceptibility
Potable Water Pipelines	12,964	71,533	73,543	1,035
Wastewater Pipelines	8,897	98,633	104,706	2,258
Total	21,861	170,166	178,249	3,293

Table 11-3. Number of District Structures Exposed to the Landslide Hazard

	Number of Exposed Structures in Landslide Susceptibility Zone[a]		
	Low Susceptibility	Moderate Susceptibility	High Susceptibility
Building	0	0	0
Control Valve—Air Release	3	9	3
Control Valve—Altitude	0	0	0
Control Valve—GVC	0	5	0
Enclosed Storage Facility	0	0	0
Hydrant	22	58	53
Production Well	0	0	0
Pump Station	0	2	1
System Connection	0	5	4
System Valve	29	106	80
Tank	0	2	2
Total	54	187	143

a. Very high susceptibility zone not shown because no District structures are within that zone.

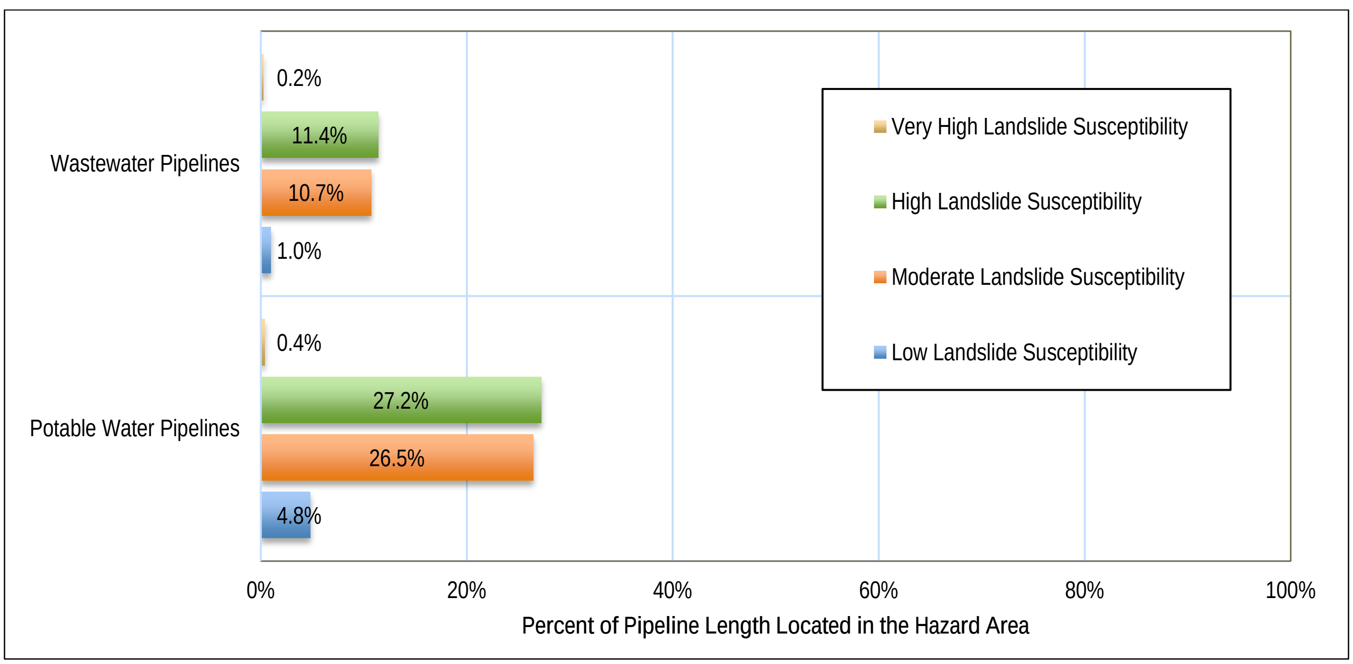


Figure 11-4. Percent of District Pipelines Exposed to the Landslide Hazard

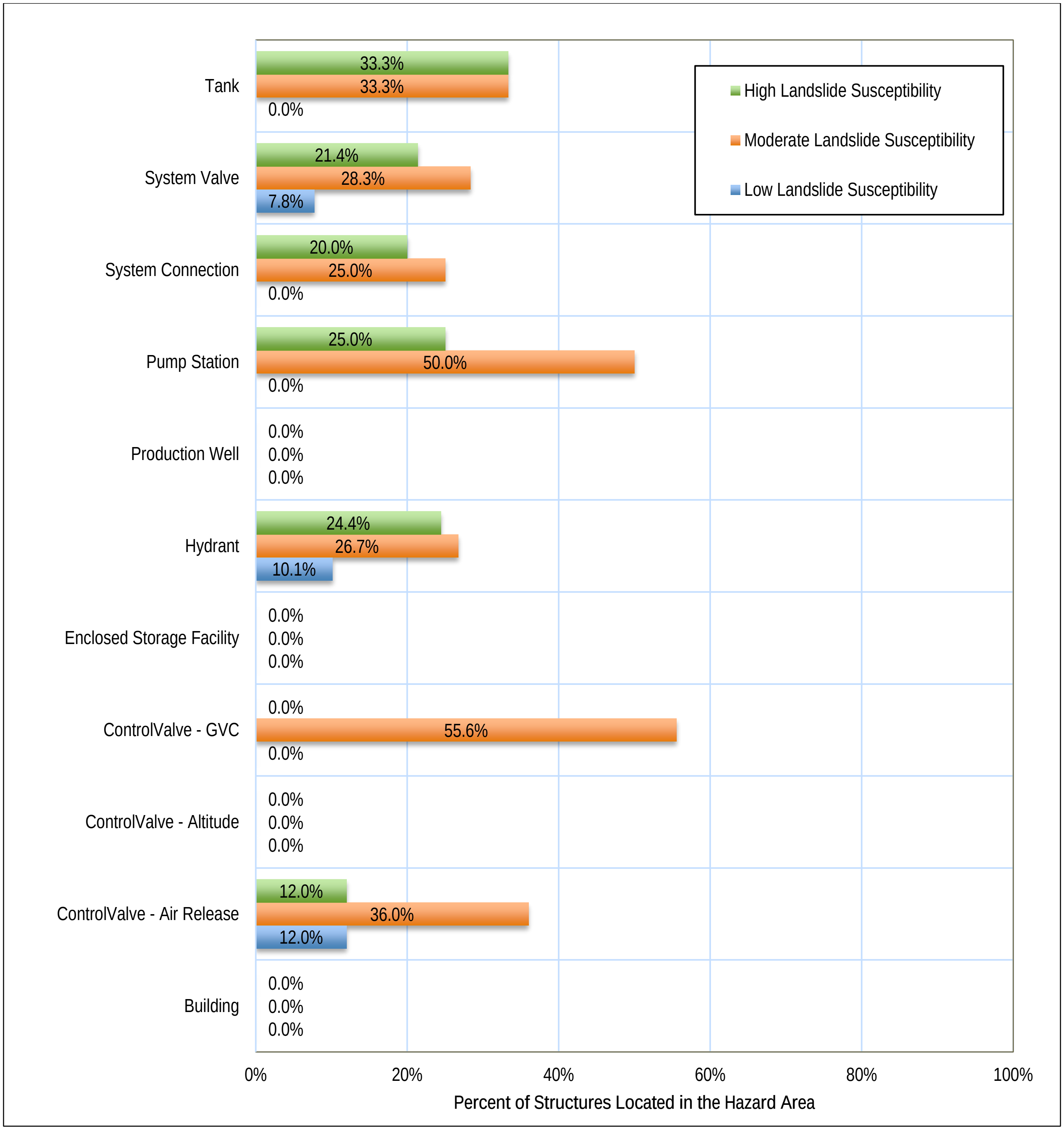


Figure 11-5. Percent of District Structures Exposed to the Landslide Hazard

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 ductile iron or PVC.

11.6 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 Orange, the City of Orange or the City of Tustin, 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.

11.7 SCENARIO

Major landslides in the planning area occur as a result of soil conditions that have been affected by severe storms, groundwater 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 and caused flooding. 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. 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 residents and businesses 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 access to residents.

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.

11.8 ISSUES

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

- The District has critical assets exposed to landslide hazards, most notably the Peters Canyon Reservoir. This reservoir, which serves a critical function in the District's ability to provide services, lies in an area of fill and could fail if waterlogged.
- 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.

12. SEVERE WEATHER

12.1 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 of these types of severe weather are described in the following sections.

12.1.1 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 12-1).

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 12-1. 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.

12.1.2 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 12-1 the Beaufort Wind Scale is an empirical measure that relates wind speed to observed conditions at sea or on land.

Table 12-1. 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

12.2 HAZARD PROFILE

12.2.1 Past Events

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

Extreme Heat

According to the Western Regional Climate Center, the planning area averages 20 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 (NCEI) lists three excessive heat events in the planning area:

- **July 2006**—In July 2006, California and Nevada were impacted by a heat wave that was unprecedented with respect to the magnitude and duration of high temperatures, especially high nighttime minimums; great areal extent, as it simultaneously impacted both northern and Southern California; and very high humidity levels (Los Angeles Times, 25 July 2006). The events are credited with 163 deaths in California.
- **August 30 – September 3, 2007**—The combination of above normal temperatures and relative humidity produced excessive heat across the planning area. Eight fatalities occurred related to the heat. Heat index values were between 105 and 112 ºF.
- **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.
- **October 25, 2017—**A strong upper level ridge settled over the region October 23 – 25, 2017, before weakening slowly over the following two days. High pressure over the Great Basin brought weak to moderate Santa Winds that contributed dry air and compressional warming. Afternoon high temperatures over the coast and valleys soared past the 100 ºF on three consecutive days, breaking numerous records. Overnight temperatures in some wind-prone spots failed to drop below 80 ºF.
- **August 6, 2018—**Orange County inland areas saw hot temperatures, with most areas experiencing temperatures over 95 ºF. The highest temperatures were observed on August 9, with Anaheim reaching 100 ºF and Santa Ana reaching 97 ºF. August 6 – 8 had temperatures slightly lower, but still remained above 95 ºF. Temperatures began to subside on August 10 but remained over 90 ºF through the weekend.
- **June 10-12, 2019—**A strong upper ridge over the Great Basin brought offshore flow and hot temperatures to Southern California June 9 – 12. Anaheim reached 100 ºF on June 10. Anaheim broke a record with a high of 91 ºF on June 11.
- **April 24-25, 2020**—High pressure built into Southern California April 22 – 30. High temperatures in the upper 90s to 100 ºF were observed in inland Orange County.

High Winds and Thunderstorms

Orange County has experienced both high wind and thunderstorm wind events. As an example of the impacts from high windstorms, a thunderstorm on January 19, 2010 caused about $350,000 worth of damage in Costa Mesa. The NCEI storm events database lists the following wind events from 1999 to 2019:

- 131 high wind events, with 18 categorized as damaging wind events.
- 24 thunderstorm events, with 19 categorized as damaging wind events.

12.2.2 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 events affect an entire region.

12.2.3 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 131 damaging wind events (over 60 mph) in 21 years, the planning area will continue to experience these on an annual basis.

The National Climatic Data Center storm events database lists 11 heat events in Orange County since 1997. 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.

12.2.4 Severity

The most common problems associated with severe storms 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 a 10-year record of weather fatalities across the nation from (2006-2015), excessive heat claimed more lives each year than floods, lightning, tornadoes, and hurricanes. In 2015, heat claimed 25 lives, though none of them were in California (NWS 2016b). 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 smoke stacks. 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 and 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.

12.2.5 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 12-2.

Table 12-2. 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

12.2.6 Secondary Hazards

A secondary impact of extreme heat is poor air quality when stagnant atmospheric conditions trap humid air and pollutants near the ground and closer to residents. High winds may cause loss of power if utility service is disrupted. Hazardous materials may be released if severe weather damages a structure that stores such materials or a vehicle transporting them.

12.3 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.

12.4 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 profiles 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 sever weather events. Therefore, not 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 PG&E 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.

12.5 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 Orange, the City of Orange or the City of Tustin, 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.

12.6 SCENARIO

Although extreme heat and high winds occur on an annual basis, secondary impacts can be significant for the densely populated Orange County planning area. 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 could tax the District's backup power capability beyond its capacity.

12.7 ISSUES

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

- The District's backup power capability should be enhanced
- Dead or dying trees as a result of drought conditions are more susceptible to falling during severe storm events.
- Severe weather events are likely to increase as a result of climate change impacts, including the potential for extreme heat.

13. WILDFIRE

13.1 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.

13.2 HAZARD PROFILE

13.2.1 Past Events

Incident information from the California Department of Forestry and Fire Protection (CAL FIRE) identifies over 17 wildfires in Orange County since 2005. Orange County has been included in six federal wildfire disaster declarations and another five federal fire management declaration events, for a total of 11 federal declaration since 1978. The following are recent major urban-wildland interface fires that have affected Orange County (as reported by CAL FIRE):

- **August 8, 2018, Holy Fire**—Burned 23,136 acres in Cleveland National Forest.
- **September 15 – October 9, 2017, Canyon Fires 1 and 2**—Series of fires in Coal Canyon (1st fire) and East Santa Ana Canyon Road (2nd fire) burned 11,879 acres.
- **November 15, 2008, Freeway Complex Fire**—Burned 30,305 acres between Corona, Chino Hills, Yorba Linda, Brea, and Anaheim.
- **October 21 – November 9, 2007, Santiago Fire—**Burned 28,400 acres within Santiago Canyon and Silverado Canyon
- **February 6 – 12, 2006, Sierra Fire**—Burned 10,584 acres across Orange County and Riverside County

13.2.2 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 land forms (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 13-1 and Figure 13-2

13.2.3 Frequency

Wildfire frequency can be assessed through review of the number of previous wildfire events and the area burned over a defined time 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. The total number of fires affecting the planning area from 1950 to 2016 is 358, an average of more than five per year.

13.2.4 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.

13.2.5 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.

If a fire does break out and spread rapidly, residents may need to evacuate 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 in recent years has further contributed to a significant improvement in warning time.

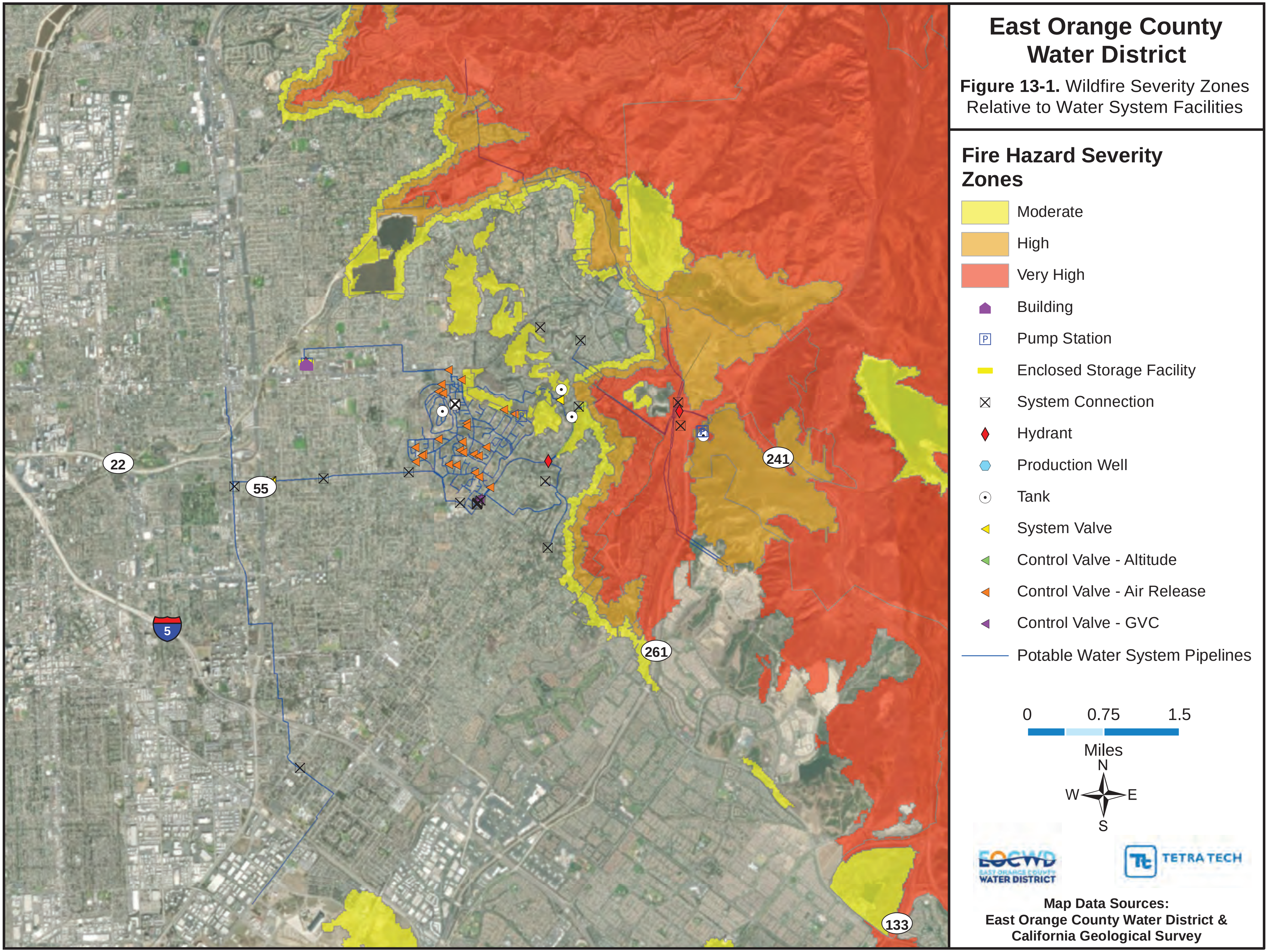
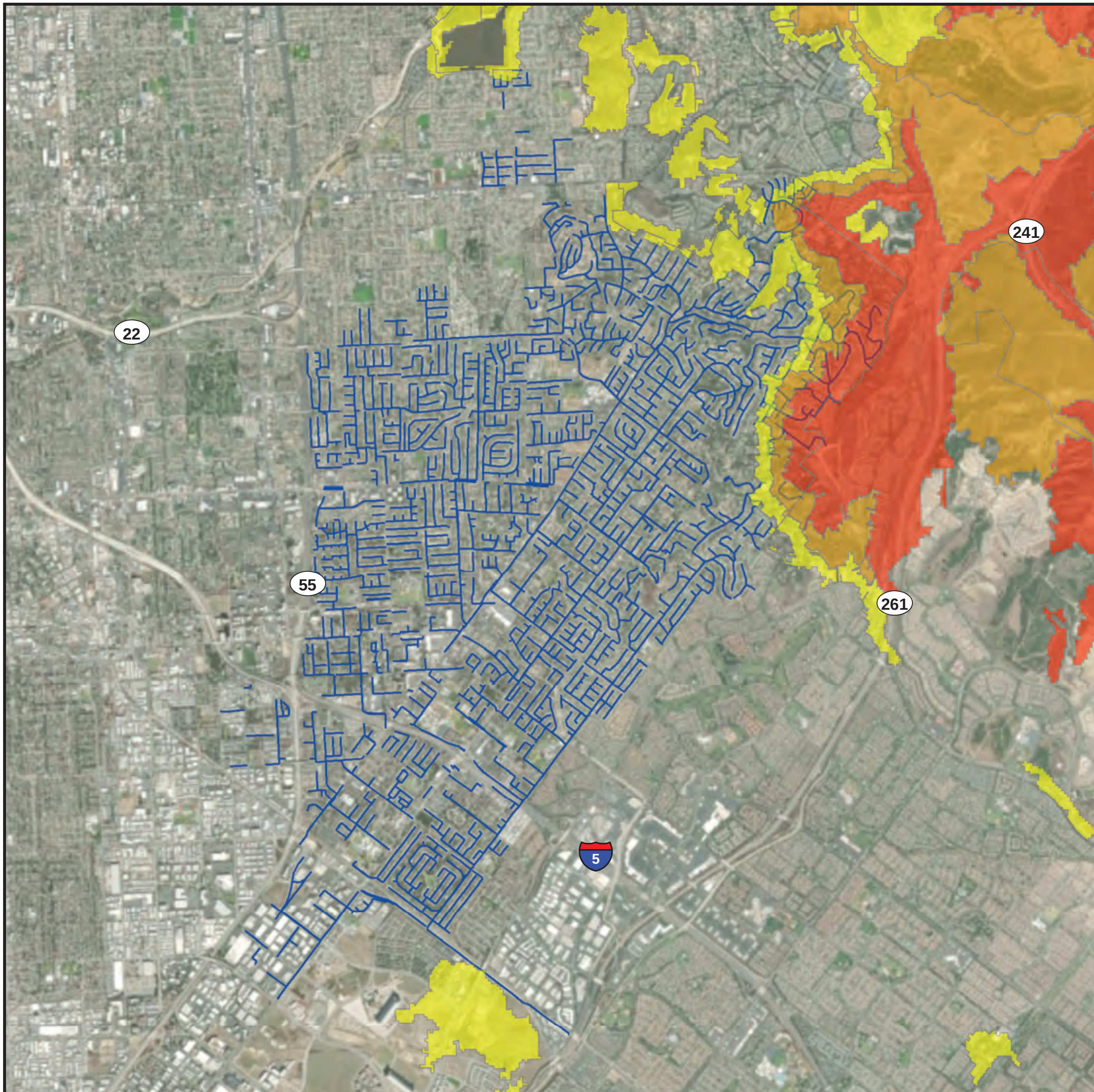


Figure 13-1. Wildfire Severity Zones Relative to Water System Facilities

East Orange County Water District

Figure 13-2. Wildfire Severity Zones Relative to Wastewater System Facilities



Fire Hazard Severity Zones

- Moderate
- High
- Very High
- Waste Water System Pipelines

0 0.5 1

Miles

N
W E
S

EOCWD
EAST ORANGE COUNTY
WATER DISTRICT

TETRA TECH

Map Data Sources:
East Orange County Water District &
California Geological Survey

13.3 SECONDARY IMPACTS

Wildfires can generate a range of secondary impacts, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires can have a significant impact on air quality, especially with prolonged periods of burning combined with climatic conditions. Wildfires cause the contamination of reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. 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.

13.4 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 13-1 summarizes the number of structures in each zone. Figure 13-3 shows the results as the percent of total planning area assets.

13.5 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. The Peters Canyon Reservoir which is located in the “very-high” severity zone, has a wood roof that would be highly susceptible to damage should a wildfire occur in that area. This reservoir is critical to the District’s ability to provide its services, and if the roof were to burn, the reservoir would have to be taken offline for repairs. This could result in significant loss of function for portions of the District.

13.6 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 Orange, the City of Orange or the City of Tustin, 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.

13.7 SCENARIO

A major wildfire in the planning area might begin with a wet spring, 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.

Table 13-1. Number of District Structures Exposed to the Wildfire Hazard

	Number of Exposed Structures in Wildfire Severity Zone[a]	
	Moderate Severity	Very High Severity
Building	0	0
Control Valve—Air Release	2	0
Control Valve—Altitude	0	0
Control Valve—GVC	0	0
Enclosed Storage Facility	0	0
Hydrant	5	1
Production Well	0	0
Pump Station	0	2
System Connection	0	2
System Valve	8	0
Tank	1	1
Total	16	6

a. High severity zone not shown because no District structures are within that zone.

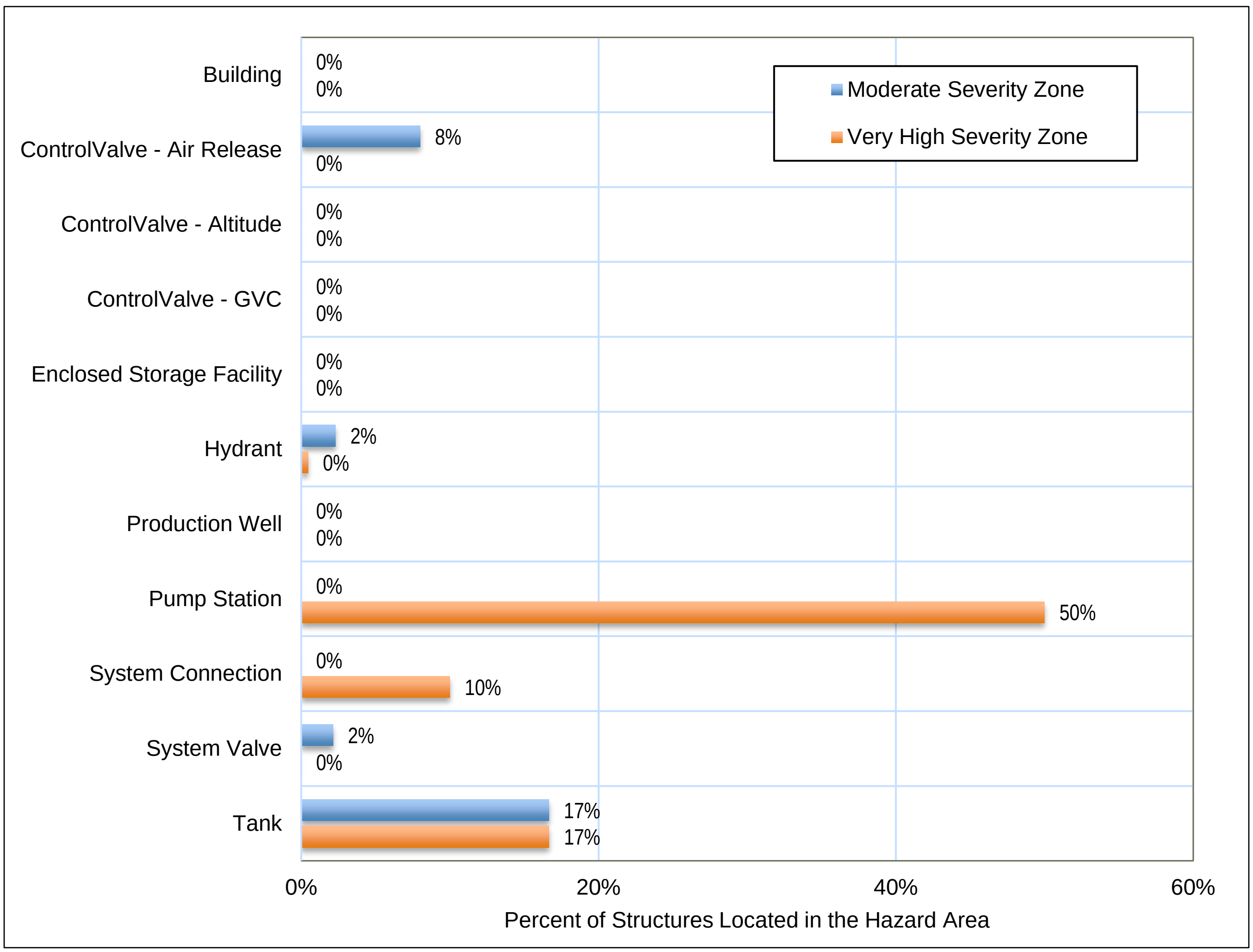


Figure 13-3. Percent of District Structures Exposed to the Wildfire Hazard

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. A wildfire in the area of Peters Canyon Reservoir that impacted the reservoir would be the worst-case scenario for the District

13.8 ISSUES

The major issues for wildfire are the following:

- The Peters Canyon Reservoir is vulnerable to wildfire because of its wood-construction roof.
- 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.
- Climate change could affect the wildfire hazard.
- Future growth into the foothills interface areas should continue to be managed.
- Vegetation management activities. This would include enhancement through expansion of the target areas as well as additional resources.

14. SPACE WEATHER

14.1 GENERAL BACKGROUND

All weather on Earth, from the surface of the planet into space, is influenced by the small changes the sun undergoes during its solar cycle. These variations are referred to as space weather. Sudden bursts of plasma and magnetic field structures from the sun's atmosphere—called coronal mass ejections—together with sudden bursts of radiation, or solar flares, all cause weather effects here on Earth. Extreme space weather can cause damage to critical infrastructure, especially the electric grid. It can produce electromagnetic fields that induce extreme currents in wires, disrupting power lines, and even causing wide-spread blackouts. In severe cases, it produces solar energetic particles, which can damage satellites used for commercial communications, global positioning, intelligence gathering, and weather forecasting.

NOAA's Space Weather Prediction Center has developed space weather scales ranging from minor to extreme effects as a way to communicate to the general public the current and future space weather conditions and their possible effects on people and systems. Descriptions of three general NOAA classifications of space weather—geomagnetic storms, solar radiation storms and radio blackouts—are included in Figure 14-1. NOAA Space Weather Prediction Center studies have determined that different types of space weather may occur separately.

The most important impact the sun has on Earth is related to its brightness or irradiance. The sun produces energy in the form of photons of light. The variability of the sun's output is wavelength dependent:

- Most of the energy from the sun is emitted in the visible wavelengths. The output from the sun in these wavelengths is nearly constant and changes by only 0.1 percent over the course of the 11-year solar cycle.
- At ultraviolet or UV wavelengths, solar irradiance is more variable, with changes up to 15 percent over the course of the 11-year solar cycle. This has a significant impact on the absorption of energy by ozone and in the stratosphere.
- At still shorter wavelengths, like extreme ultraviolet, solar irradiance changes by 30 to 300 percent over a period of minutes. These wavelengths are absorbed in the upper atmosphere, so they have minimal impact on the climate of Earth.
- At the other end of the light spectrum, at infrared wavelengths, solar irradiance is very stable and only changes by a percent or less over the solar cycle.

Other types of space weather can impact the atmosphere. Energetic particles penetrating into the atmosphere can change chemical constituents. These changes in minor species such as nitrous oxide can have long lasting consequences in the upper and middle atmosphere; however, it has not been determined if these have a major impact on the Earth's climate.

Space weather (geomagnetic storms, solar radiation storms, solar flare radio blackouts, solar radio bursts, and cosmic radiation) can impact aviation operations at airports. Effects include degradation or loss of HF radio transmission and satellite navigation signals; navigation system disruptions; and avionics errors. Airport dispatchers use space weather forecasts for flight planning at high latitudes, especially for polar routes.

NOAA Space Weather Scales

Category: Scale	Category: Descriptor	Effect (Duration of event will influence severity of effects)	Physical measure	Average Frequency (1 cycle = 11 years)
Geomagnetic Storms			Kp values* determined every 3 hours	Number of storm events when Kp level was met; (number of storm days)
G 5	Extreme	Power systems: widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage. Spacecraft operations: may experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. Other systems: pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).**	Kp=9	4 per cycle (4 days per cycle)
G 4	Severe	Power systems: possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid. Spacecraft operations: may experience surface charging and tracking problems, corrections may be needed for orientation problems. Other systems: induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).**	Kp=8	100 per cycle (60 days per cycle)
G 3	Strong	Power systems: voltage corrections may be required, false alarms triggered on some protection devices. Spacecraft operations: surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems. Other systems: intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).**	Kp=7	200 per cycle (130 days per cycle)
G 2	Moderate	Power systems: high-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage. Spacecraft operations: corrective actions to orientation may be required by ground control; possible changes in drag affect orbit predictions. Other systems: HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).**	Kp=6	600 per cycle (360 days per cycle)
G 1	Minor	Power systems: weak power grid fluctuations can occur. Spacecraft operations: minor impact on satellite operations possible. Other systems: migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine).**	Kp=5	1700 per cycle (900 days per cycle)

* Based on this measure, but other physical measures are also considered.
** For specific locations around the globe, use geomagnetic latitude to determine likely sightings (see www.swpc.noaa.gov/Aurora)

Scale	Descriptor	Effect	Flux level of ≥ 10 MeV particles (ions)*	Number of events when flux level was met**
Solar Radiation Storms				
S 5	Extreme	Biological: unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity); passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk. *** Satellite operations: satellites may be rendered useless, memory impacts can cause loss of control, may cause serious noise in image data, star-trackers may be unable to locate sources; permanent damage to solar panels possible. Other systems: complete blackout of HF (high frequency) communications possible through the polar regions, and position errors make navigation operations extremely difficult.	10^5	Fewer than 1 per cycle
S 4	Severe	Biological: unavoidable radiation hazard to astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: may experience memory device problems and noise on imaging systems; star-tracker problems may cause orientation problems, and solar panel efficiency can be degraded. Other systems: blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.	10^4	3 per cycle
S 3	Strong	Biological: radiation hazard avoidance recommended for astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely. Other systems: degraded HF radio propagation through the polar regions and navigation position errors likely.	10^3	10 per cycle
S 2	Moderate	Biological: passengers and crew in high-flying aircraft at high latitudes may be exposed to elevated radiation risk.*** Satellite operations: infrequent single-event upsets possible. Other systems: effects on HF propagation through the polar regions, and navigation at polar cap locations possibly affected.	10^2	25 per cycle
S1	Minor	Biological: none. Satellite operations: none. Other systems: minor impacts on HF radio in the polar regions.	10	50 per cycle

* Flux levels are 5 minute averages. Flux in particles·s^{-1}·$ster^{-1}$·cm^{-2} Based on this measure, but other physical measures are also considered.
** These events can last more than one day.
*** High energy particle (>100 MeV) are a better indicator of radiation risk to passenger and crews. Pregnant women are particularly susceptible.

Scale	Descriptor	Effect	GOES X-ray peak brightness by class and by flux*	Number of events when flux level was met; (number of storm days)
Radio Blackouts				
R 5	Extreme	HF Radio: Complete HF (high frequency**) radio blackout on the entire sunlit side of the Earth lasting for a number of hours. This results in no HF radio contact with mariners and en route aviators in this sector. Navigation: Low-frequency navigation signals used by maritime and general aviation systems experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours on the sunlit side of Earth, which may spread into the night side.	X20 ($2x10^{-3}$)	Fewer than 1 per cycle
R 4	Severe	HF Radio: HF radio communication blackout on most of the sunlit side of Earth for one to two hours. HF radio contact lost during this time. Navigation: Outages of low-frequency navigation signals cause increased error in positioning for one to two hours. Minor disruptions of satellite navigation possible on the sunlit side of Earth.	X10 (10^{-3})	8 per cycle (8 days per cycle)
R 3	Strong	HF Radio: Wide area blackout of HF radio communication, loss of radio contact for about an hour on sunlit side of Earth. Navigation: Low-frequency navigation signals degraded for about an hour.	X1 (10^{-4})	175 per cycle (140 days per cycle)
R 2	Moderate	HF Radio: Limited blackout of HF radio communication on sunlit side of the Earth, loss of radio contact for tens of minutes. Navigation: Degradation of low-frequency navigation signals for tens of minutes.	M5 ($5x10^{-5}$)	350 per cycle (300 days per cycle)
R 1	Minor	HF Radio: Weak or minor degradation of HF radio communication on sunlit side of the Earth, occasional loss of radio contact. Navigation: Low-frequency navigation signals degraded for brief intervals.	M1 (10^{-5})	2000 per cycle (950 days per cycle)

* Flux, measured in the 0.1-0.8 nm range, in W·m^{-2}. Based on this measure, but other physical measures are also considered.
** Other frequencies may also be affected by these conditions.

URL: *www.swpc.noaa.gov/NOAAscales* April 7, 2011

Figure 14-1. NOAA Space Weather Scales

14.2 HAZARD PROFILE

14.2.1 Past Events

Table 14-1 is a sample of recent space weather events affecting North America, as recorded by the NOAA Space Weather Prediction Center. NOAA Space Weather Prediction Center issues warnings in advance for these storm events that occur continuously and vary in strength and severity for the Earth.

Table 14-1. Past Space Weather Events

Date of Event	Event Type	Description
March 27-29,2017	Geomagnetic Storms	Moderate geomagnetic storm condition occurred because of a coronal hole effect impacting the Earth's magnetosphere. In turn this effects power grids, radios, and Aurora visible as low as New York to Wisconsin to Washington State.
October 13-15, 2016	Geomagnetic Storms	Moderate geomagnetic storm condition occurred because of a coronal hole effect impacting the Earth's magnetosphere. In turn this effects power grids, radios, and Aurora visible as low as New York to Wisconsin to Washington State.
September 28-30, 2016	Geomagnetic Storms	Moderate geomagnetic storm condition occurred as effects from a large coronal hole high speed stream. In turn this effects power grids, radios, and Aurora more intense in the northern latitudes.
May 9, 2016	Geomagnetic Storms	Strong geomagnetic storm condition with solar winds were observed.
September 12-14, 2014	Geomagnetic storms	Moderate geomagnetic storms occurred as result of the coronal mass ejection associated with solar flares. For several days, it impacted HF radio communications. Aurora watchers in the northern U.S. could see activity.
December 2006	Geomagnetic storms and solar flares	This event disabled Global Positioning System (GPS) signal acquisition over the United States.
October 2003	Solar Flares	A series of solar flares impacted satellite-based systems and communications. A one-hour long power outage occurred in Sweden as a result of the solar activity. Aurorae were observed as far south as Texas and the Mediterranean countries of Europe.
March 13, 1989	Space weather storm	A space weather storm disrupted the hydroelectric power grid in Quebec, Canada. This system-wide outage lasted for nine hours and left six million people without power.

14.2.2 Location

Different types of space weather can affect different technologies in Orange County. Solar flares can produce strong x-rays that degrade or block high-frequency radio waves used for radio communication during events known as radio blackout storms. Solar energetic particles can penetrate satellite electronics and cause electrical failure. These energetic particles also block radio communications at high latitudes during solar radiation storms. Coronal mass ejections can cause geomagnetic storms on Earth and induce extra currents in the ground that can degrade power grid operations and modify the signal from radio navigation systems (GPS), causing accuracy to be degraded.

14.2.3 Frequency

Space weather events occur daily, but do not always affect residents in Orange County. They are all monitored and reported by NOAA's Space Weather Prediction Center.

14.2.4 Severity

The severity of space weather can be far-reaching, as virtually all infrastructure and services depend on the electric power grid. Ground currents induced during geomagnetic storms can melt copper windings of transformers, which are the primary components of power distribution systems. Power lines traversing the planning area can pick up the currents and spread the problem over the entire area.

14.2.5 Warning Time

Space weather prediction services in the United States are provided primarily by NOAA's Space Weather Prediction Center and the U.S. Air Force's Weather Agency, which work closely together to address the needs of civilian and military user communities. The Space Weather Prediction Center draws on a variety of data sources, both space and ground-based, to provide forecasts, watches, warnings, alerts, and summaries as well as operational space weather products to civilian and commercial users.

14.2.6 Secondary Impacts

The most likely local secondary impact of space weather is disruption of the electric power grid. Space weather can have an impact on advanced technologies, which has a direct impact on daily life.

14.3 EXPOSURE AND VULNERABILITY

All District assets that are operated by electricity and/or a computer system are exposed to a space weather event. It is unlikely that the impacts of space weather would have a negative impact on structures, but a magnetic or blackout event caused by space weather would affect infrastructure systems.

14.4 FUTURE TRENDS IN DEVELOPMENT

Electrical and computer systems are vulnerable to space weather, and general improvements to the District's services in the future are likely to include such technologies. When implementing these improvements, the District should research and incorporate any best practices associated with minimizing these technology's vulnerability to space weather.

14.5 SCENARIO

A regional black-out power outage for several hours caused by a space weather event would cripple the entire region. All critical facilities and infrastructure would be on generator back-up power if available.

14.6 ISSUES

The major issues for space weather are the following:

- Encourage local businesses to adopt information technology and telecommunications recovery plans.
- Maintain any and all resident advisory groups and periodically e-mail emergency preparedness information including hazard preparedness instructions and reminders.

15. CLIMATE CHANGE CONSIDERATIONS

15.1 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 15-1).

Source: NASA, 2020

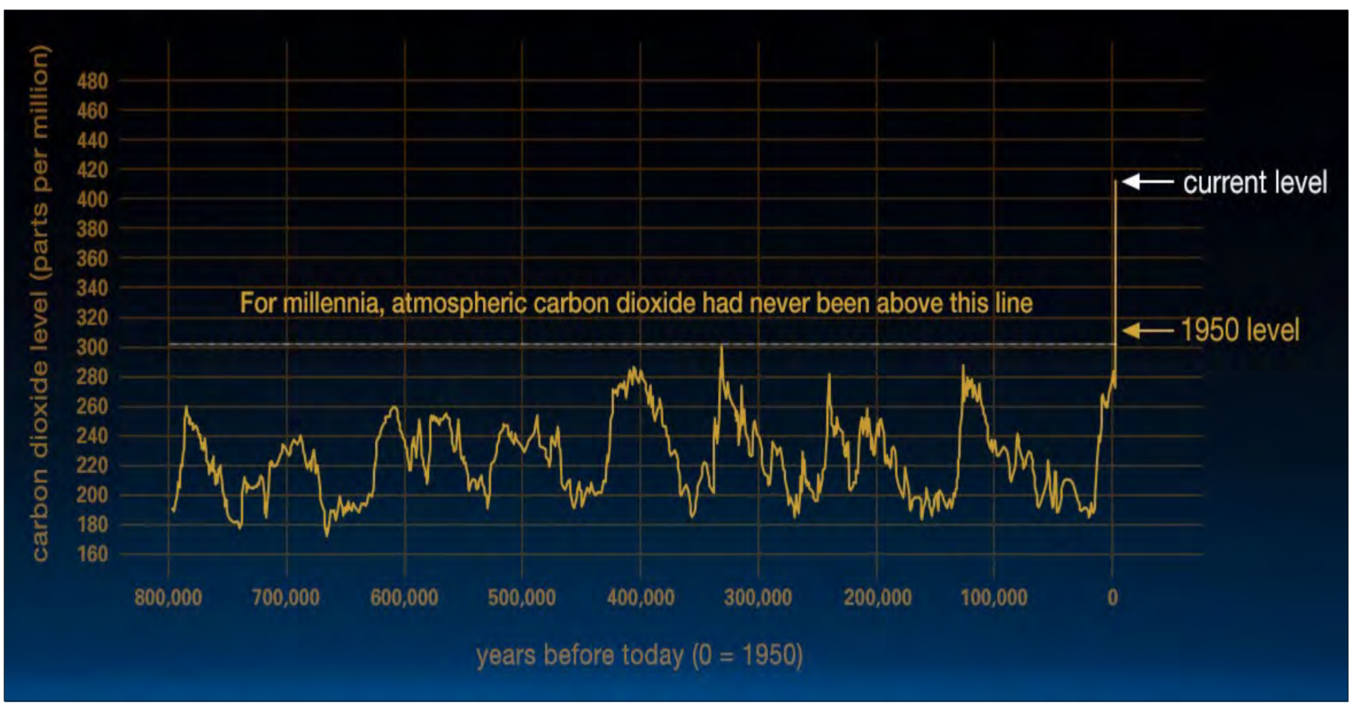


Figure 15-1. Global Carbon Dioxide Concentrations Over Time

15.2 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.

15.3 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.

15.4 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, which includes Orange County (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 primary and secondary impacts likely to affect the planning area are summarized in Table 15-1.

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, which includes Orange County.

Table 15-1. Summary of Primary and Secondary Impacts Likely to Affect Orange County

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

15.4.1 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 15-2). 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.

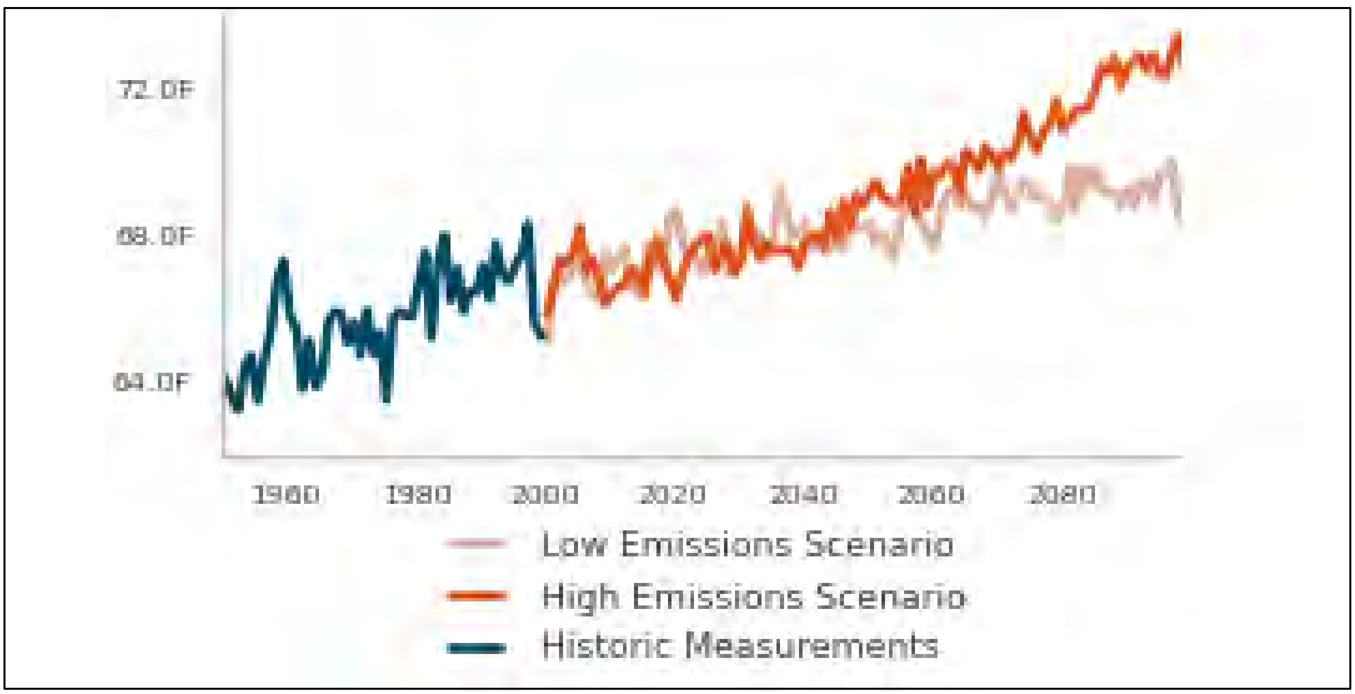


Figure 15-2. Observed and Projected Average Temperatures for the Los Angeles Region

15.4.2 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 15-3).

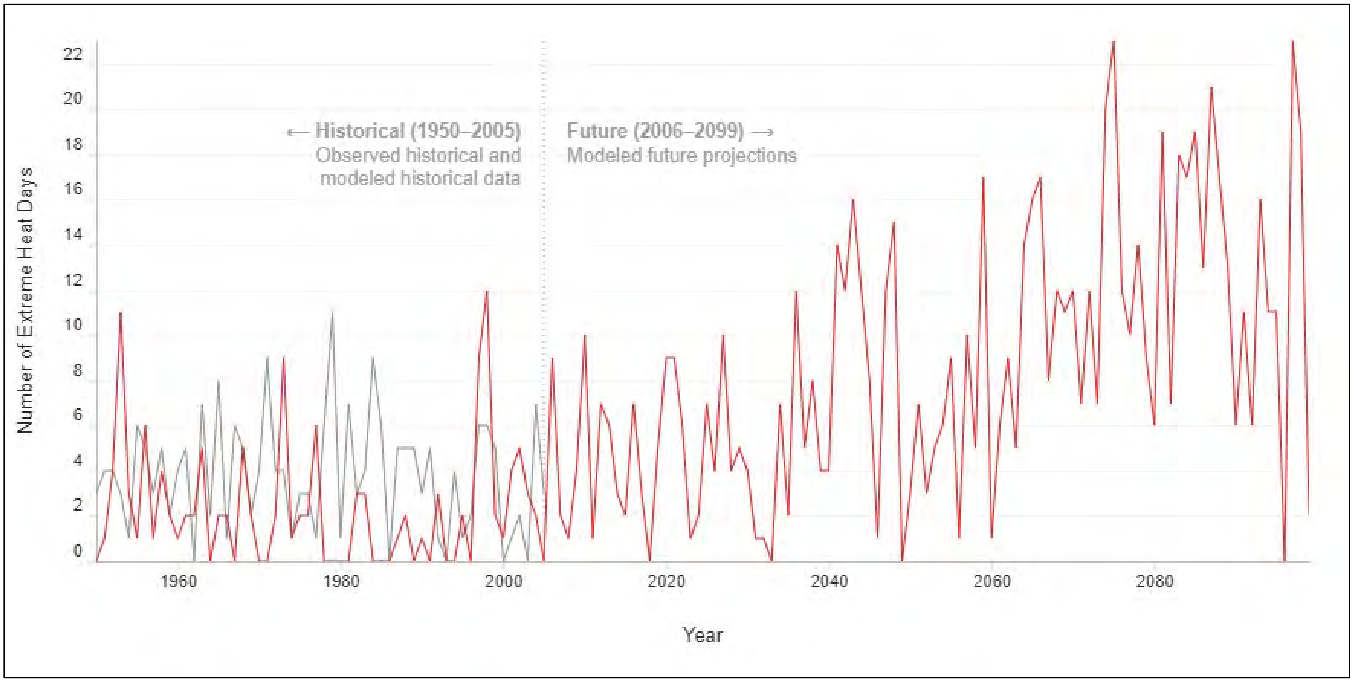


Figure 15-3. Projected Number of Extreme Heat Days by Year for the Los Angeles Region

15.4.3 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).

15.4.4 Snow Pack

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

15.4.5 Wildfire

Wildfire risk is expected to change in the coming decades (see Figure 15-4). 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.

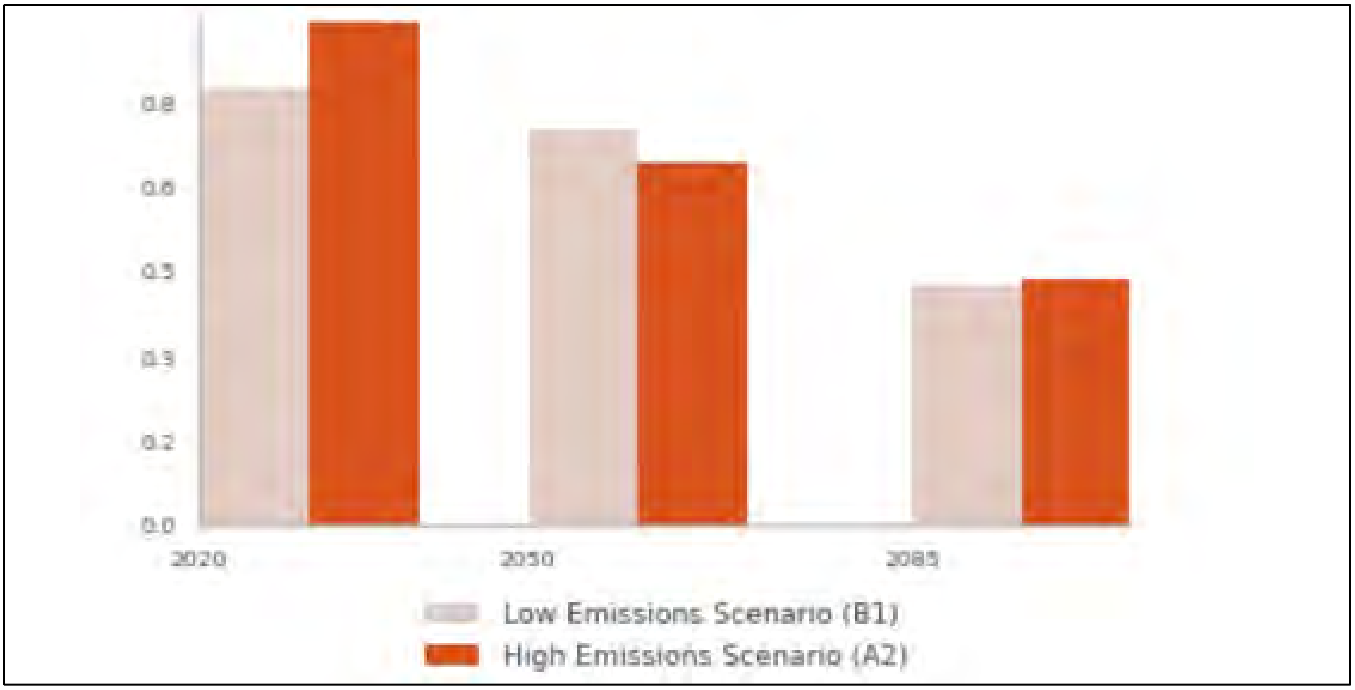


Figure 15-4. Projected Changes in Fire Risk for Los Angeles Region, Relative to 2010 Levels

15.5 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.

15.6 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.

15.6.1 Dam Failure

Impacts on the Hazard

Small changes in rainfall, runoff, and snowpack conditions may have significant impacts for water resource systems, including dams. Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Population and Property

Population and property exposure and vulnerability to the dam failure hazard are unlikely to change as a result of climate change.

Critical Facilities

The exposure and vulnerability of critical facilities are unlikely to change as result of climate change. Dam owners and operators may need to alter maintenance and operations to account for changes in the hydrograph and increased sedimentation.

Environment

The exposure and vulnerability of the environment to dam failure are unlikely to change as a result of climate change. Ecosystem services may be used to mitigate some of the factors that may increase the risk of design failures, such as increasing the natural water storage capacity in watersheds above dams.

15.6.2 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.

By addressing stresses on water supplies and by building a flexible, robust program, Canyon County will be able to more adeptly respond to changing conditions and to survive dry years.

Population

Population exposure and vulnerability to drought are unlikely to increase as a result of climate change. While greater numbers of people may need to engage in behavior change, such as water saving efforts, significant life or health impacts are unlikely.

Property

Property exposure and vulnerability may increase as a result of increased drought resulting from climate change, although this would most likely occur in non-structural property such as crops and landscaping. It is unlikely that structure exposure and vulnerability would increase as a direct result of drought, although secondary impacts of drought, such as wildfire, may increase and threaten structures.

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.

Environment

The vulnerability of the environment may increase as a result of increased drought resulting from climate change. The ecosystems and biodiversity in the planning area are already under stress from development and water diversion activities. Prolonged or more frequent drought resulting from climate change may further stress the ecosystems in the region. Figure 15-5 illustrates the vast variations in rainfall for the area for the past 20 years.

15.6.3 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.

Population, Property, Critical Facilities and the Environment

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

Source: Orange County Public Works

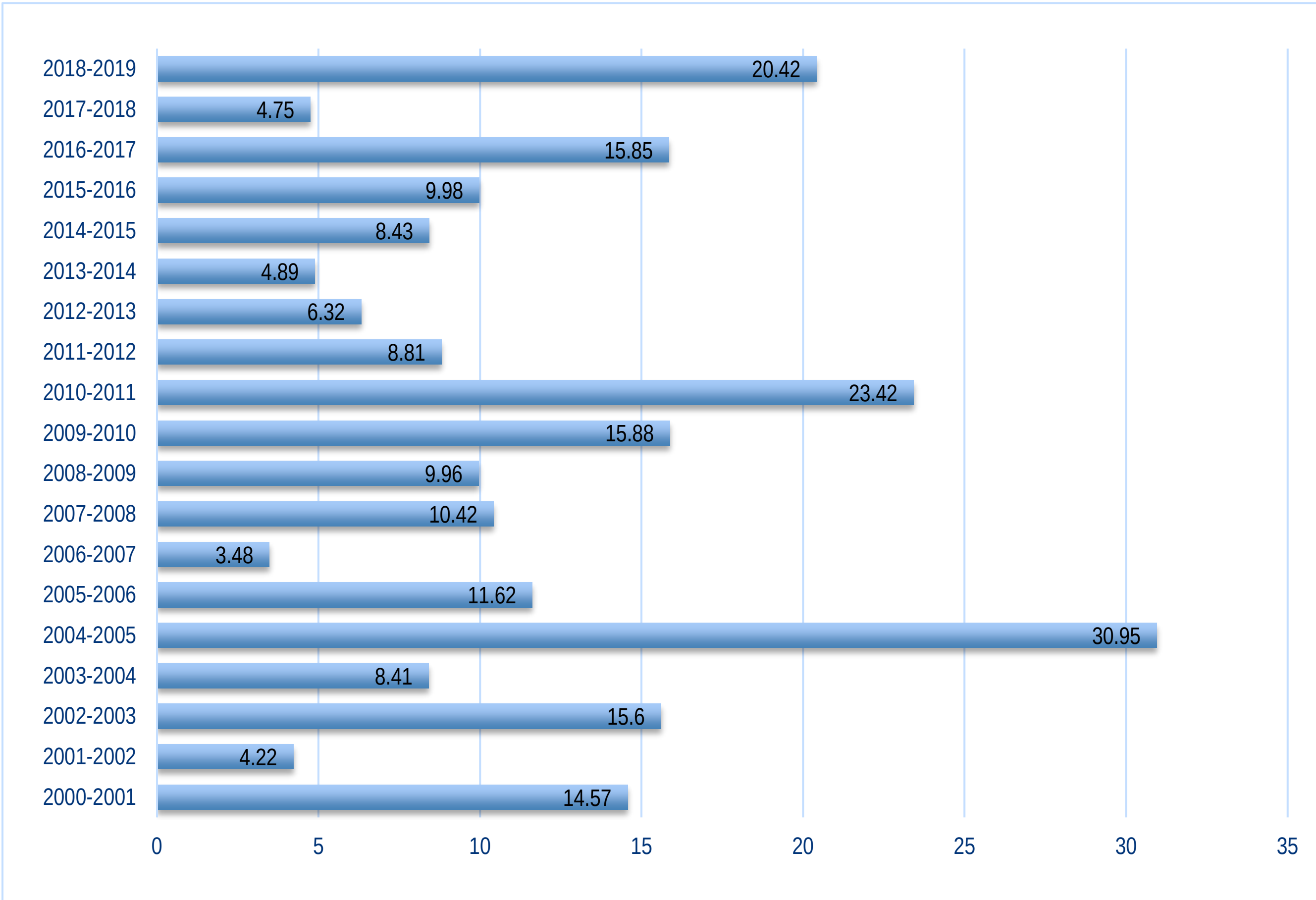


Figure 15-5. Annual Rainfall at Tustin-Irvine Ranch

15.6.4 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 (100-year flood) may strike more often, 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.

Population and Property

Population and property exposure and vulnerability may increase as a result of climate change impacts on the flood hazard. Runoff patterns may change resulting in flooding in areas where it has not previously occurred.

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.

Environment

The exposure and vulnerability of the environment may increase as a result of climate change impacts on the flood hazard. Changes in the timing and frequency of flood events may have broader ecosystem impacts that alter the ability of already stressed species to survive.

15.6.5 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.

Exposure, Sensitivity and Vulnerability

Population and Property

Population and property exposure and vulnerability would be unlikely to increase as a result of climate change impacts on the landslide hazard. Landslide events may occur more frequently, but the extent and location should be contained within mapped hazard areas or recently burned areas.

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.

Environment

Exposure and vulnerability of the environment would be unlikely to increase as a result of climate change, but more frequent slides in river systems may impact water quality and have negative impacts on stressed species.

Economy

Changes to the landslide hazard resulting from climate change are unlikely to result in impacts on the local economy.

15.6.6 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 15-6). Historical data shows that the probability for severe weather events increases in a warmer climate.

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.

Source: Munich RE, 2020

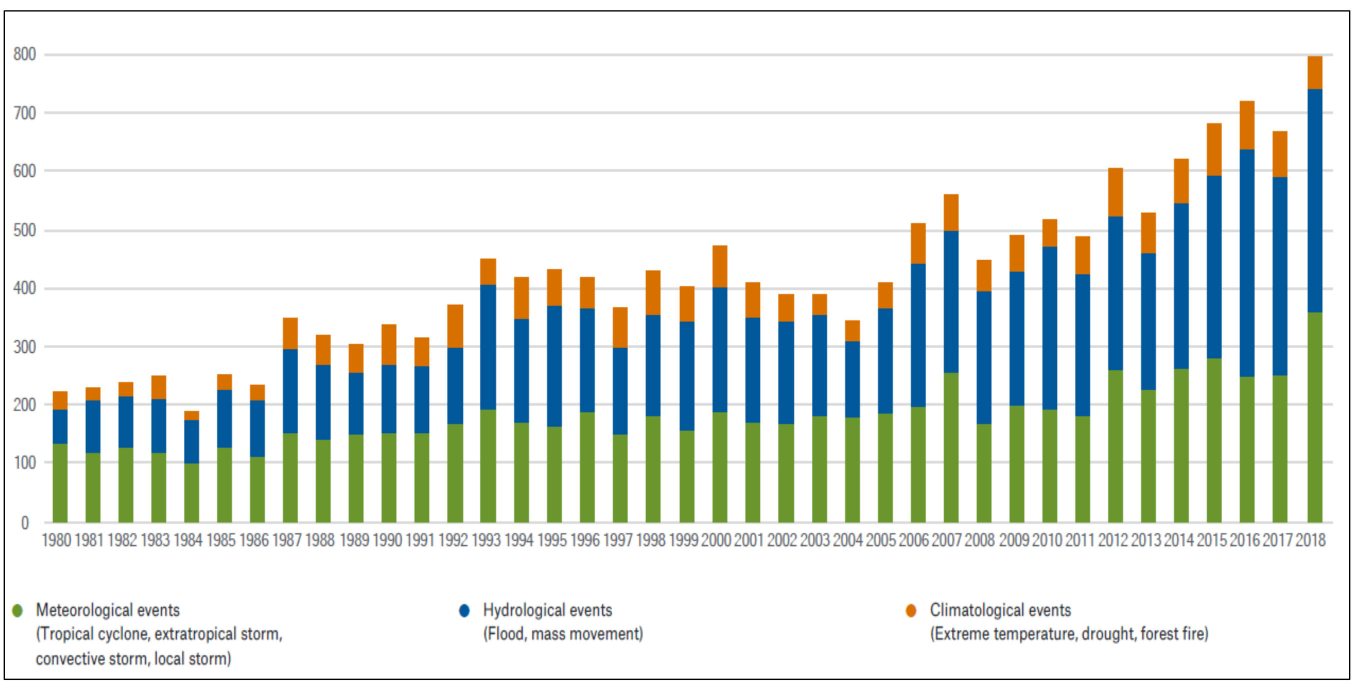


Figure 15-6. Worldwide Natural Catastrophe Events, 1980 – 2018

Population and Property

Population and property exposure and vulnerability would be unlikely to increase as a direct result of climate change impacts on the severe weather hazard. Severe weather events may occur more frequently, but exposure and vulnerability will remain the same. Secondary impacts, such as the extent of localized flooding, may increase, thus impacting greater numbers of people and structures.

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 owners and operators may experience more frequent disruptions. For example, more frequent and intense storms may cause more frequent disruptions in power service.

Environment

Exposure and vulnerability of the environment would be unlikely to increase; however, more frequent storms and heat events and more intense rainfall may place additional stressors on already stressed systems.

15.6.7 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.

Population, Property and Critical Facilities

Larger, more severe, and 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.

Environment

It is possible that the exposure and vulnerability of the environment will be impacted by impacts on wildfire risk from climate change, as natural fire regimes may change, resulting in more frequent or higher intensity burns. These impacts may alter the composition of the ecosystems in the planning area.

16. 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 8 through 16. Using that data, the 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 18 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 development of its action 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.

16.1 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 and changing climate conditions. For example, if your 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 your jurisdiction has experienced no damage from landslides in the last 100 years, your 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 16-1 summarizes the probability assessment for each hazard of concern for this plan.

Table 16-1. Probability of Hazards

Hazard Event	Probability (high, medium, low)	Probability Factor
Dam Failure	Medium	2
Drought	High	3
Earthquake	High	3
Flood	High	3
Landslide	Medium	2
Severe Weather	High	3
Space Weather	Low	1
Wildfire	High	3

16.2 IMPACT

The impact of each hazard is divided into three categories: impacts on people, impacts on property, and impacts on the economy. 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 operations is assessed based on estimates of how long it will take your jurisdiction 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 16-2, Table 16-3 and Table 16-4 summarize the impacts for each hazard.

Table 16-2. Impact on People from Hazards

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (3)
Dam Failure	High	0	3 x 3 = 9
Drought	None	0	0 x 3 = 0
Earthquake	High	3	3 x 3 = 9
Flood	Low	1	1 x 3 = 3
Landslide	Medium	2	2 x 3 = 6
Severe Weather	Medium	2	2 x 3 = 6
Space Weather	None	0	0 x 3 = 0
Wildfire	Low	1	1 x 3 = 3

Table 16-3. Impact on Property from Hazards

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (2)
Dam Failure	Medium	2	2 x 2 = 4
Drought	None	0	0 x 2 = 0
Earthquake	High	3	3 x 2 = 6
Flood	Low	1	1 x 2 = 2
Landslide	High	3	3 x 2 = 6
Severe Weather	Low	1	1 x 2 = 2
Space Weather	Low	1	1 x 2 = 2
Wildfire	Low	1	1 x 2 = 2

Table 16-4. Impact on Continuity of Operations from Hazards

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (1)
Dam Failure	Medium	2	2 x 1 = 2
Drought	Medium	2	2 x 1 = 2
Earthquake	Low	1	1 x 1 = 1
Flood	Low	1	1 x 1 = 1
Landslide	Low	1	1 x 1 = 1
Severe Weather	Low	1	1 x 1 = 1
Space Weather	Low	1	1 x 1 = 1
Wildfire	Low	1	1 x 1 = 1

16.3 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 16-5.

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. Table 16-6 shows the hazard risk ranking.

Table 16-5. Hazard Risk Rating

Hazard Event	Probability Factor	Sum of Weighted Impact Factors	Total (Probability x Impact)
Dam Failure	2	(9+4+2) = 15	2x15=30
Drought	3	(0+0+2) = 2	3x2=6
Earthquake	3	(9+6+1) = 16	3x16=48
Flood	3	(3+2+1) = 6	3x6=18
Landslide	2	(6+6+1) = 13	2x13=26
Severe Weather	3	(6+2+1) = 9	3x9=27
Space Weather	1	(0+2+1) = 3	1x3=3
Wildfire	3	(3+2+1) = 6	3x6 =18

Table 16-6. Hazard Risk Ranking

Hazard Ranking	Hazard Event	Category
1	Earthquake	High
2	Dam Failure	High
3	Severe Weather	Medium
4	Landslide	Medium
5	Flood	Medium
5	Wildfire	Medium
6	Drought	Low
7	Space Weather	low

17. OTHER HAZARDS OF INTEREST

The hazards of concern assessed in this plan are those that present significant risks in the East Orange County Water District 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.

17.1 CYBER-ATTACK

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.

17.1.1 Background

Types of Cyber-Attack

Cyber-threats differ by motive, attack type and perpetrator profile. Motives range from the pursuit of financial gain to political or social aims. Cyber-threats are difficult to identify and comprehend. Types of threats 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. The spectrum of cyber-risks is limitless, with threats having a wide-range of effects on the individual, community, organizational, and national threat (FEMA 2013).

This risk assessment includes cyber-attacks and cyber-terrorism under the inclusive hazard of cyber-threats. The terms often are used interchangeably, though they are not the same. While all cyber-terrorism is a form of cyber-attack, not all cyber-attacks are cyber-terrorism.

Public and private computer systems are likely to experience a variety of cyber-attacks, from blanket malware infection to targeted attacks on system capabilities. Cyber-attacks specifically 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 17-1 describes the most common cyber-attack mechanisms faced by organizations today.

Table 17-1. 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.

17.1.2 Profile

Past Events

In Orange County, the Cyber Crimes Detail is comprised of one Sergeant, two Investigators, and one Office Specialist. The Cyber Crimes Detail is responsible for investigating past, ongoing, or threatened intrusion, disruption, or other events that impair, or are likely to impair, the confidentiality, integrity, or availability of electronic information, information systems, services, or networks. Investigators work to identify, track, and prosecute individuals who commit such acts as: network intrusions, wire transfer interception, fraudulent tax refund campaigns, unlawful computer access, business e-mail compromise (BEC), ransomware, malware, directed denial of service (DDoS) attacks, theft of digital currency, and phishing campaigns with a financial loss. Personnel assigned to the Cyber Crimes Detail are also involved in federal task forces which are focused on high-tech crimes. Cases where a computer is not the target of the crime (i.e. cyber bullying or Craigslist scams) are handled by General Investigations.

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.

Secondary Impacts

Computer breaches associated with data and communications losses can have significant economic impact.

17.1.3 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 and all of Orange County 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 County has taken a proactive position in its cyber-security efforts with the establishment of the Cyber Crimes Detail unit and is expected to remain vigilant in its efforts to prevent attacks from occurring or disrupting business operations. This vigilance applies to the District as well, which 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 (AWIA) 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 AWIA assessment as appropriate.

17.2 HAZARDOUS MATERIALS

17.2.1 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 the CCR, Title 19.

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

- 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.

17.2.2 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.

17.2.3 Oversight

The Environmental Health Division was designated as the Certified Unified Program Agency (CUPA) for the County of Orange by the State Secretary for Environmental Protection on January 1, 1997. The CUPA is the local administrative agency that coordinates the regulation of hazardous materials and hazardous wastes in Orange County through the following six programs:

- Hazardous Materials Disclosure
- Business Emergency Plan
- Hazardous Waste
- Underground Storage Tank
- Aboveground Petroleum Storage Tank
- California Accidental Release Prevention

County and city fire agencies within Orange County have joined in partnership with the CUPA as Participating Agencies (PAs). In most Orange County cities, the environmental health division administers all programs, with the exception of La Habra, Fullerton, Costa Mesa, Huntington Beach, Newport Beach, Orange and Fountain Valley, where the local fire agencies are responsible for hazardous materials and business emergency plan programs. The fire agencies in the cities of Orange and Fullerton also administer the underground storage tank program.

The CUPA provides its regulated businesses several convenient benefits such as a single point of contact for permitting, billing and inspections; uniformity and consistency in enforcement of regulations; and a single fee system incorporating all of the applicable fees from the six CUPA programs.

17.3 TERRORISM

Acts of terrorism are intentional, criminal, malicious acts with the following characteristics:

- They involve the use of illegal force.
- They are intended to intimidate or coerce.
- They are committed in support of political or social objectives.

Table 17-2 provides a hazard profile summary for terrorism-related events.

Table 17-2. Event Profiles for Terrorism

Hazard	Application Mode[a]	Hazard Duration[b]	Static/Dynamic Characteristics[c]	Mitigating and Exacerbating Conditions[d]
Conventional Bomb	Detonation of explosive device on or near target; delivery via person, vehicle, or projectile.	Instantaneous; additional secondary devices, or diversionary activities may be used, lengthening the duration of the hazard until the attack site is determined to be clear.	Extent of damage is determined by type and quantity of explosive. Effects generally static other than cascading consequences, incremental structural failure, etc.	Blast force is inversely proportional to the cube of the distance from the blast; thus, each additional increment of distance provides progressively more protection. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting energy and debris. Exacerbating conditions include ease of access to target; lack of barriers and shielding; poor construction; and ease of concealment of device.
Chemical Agent	Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/ containers; or munitions.	Chemical agents may pose viable threats for hours to weeks depending on the agent and the conditions in which it exists.	Contamination can be carried out of the initial target area by persons, vehicles, water, and wind. Chemicals may be corrosive or otherwise damaging over time if not remediated.	Air temperature can affect evaporation of aerosols. Ground temperature affects evaporation of liquids. Humidity can enlarge aerosol particles, reducing inhalation hazard. Precipitation can dilute and disperse agents but can spread contamination. Wind can disperse vapors but also cause target area to be dynamic. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Shielding in the form of sheltering in place can protect people and property from harmful effects.
Arson/ Incendiary Attack	Initiation of fire or explosion on or near target via direct contact or remotely via projectile.	Generally minutes to hours.	Extent of damage is determined by type and quantity of device, accelerant, and materials present at or near target. Effects generally static other than cascading consequences, incremental structural failure, etc.	Mitigation factors include built-in fire detection and protection systems and fire-resistive construction techniques. Inadequate security can allow easy access to target, easy concealment of an incendiary device, and undetected initiation of a fire. Non-compliance with fire and building codes, as well as failure to maintain existing fire protection systems, can substantially increase the effectiveness of a fire weapon.
Armed Attack	Tactical assault or sniping from remote location, or random attack based on fear, emotion, or mental instability.	Generally minutes to days.	Varies based on the perpetrators' intent and capabilities.	Inadequate security can allow easy access to target, easy concealment of weapons, and undetected initiation of an attack.
Biological Agent	Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point or line sources such as munitions, covert deposits, and moving sprayers.	Biological agents may pose viable threats for hours to years depending on the agent and the conditions in which it exists.	Depending on the agent used and the effectiveness with which it is deployed, contamination can be spread via wind and water. Infection can spread via human or animal vectors.	Altitude of release above ground can affect dispersion; sunlight is destructive to many bacteria and viruses; light to moderate wind will disperse agents but higher winds can break up aerosol clouds; the micro-meteorological effects of buildings and terrain can influence aerosolization and travel of agents.
Cyber-terrorism	Electronic attack using one computer system against another.	Minutes to days.	Generally no direct effects on built environment.	Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks.

Hazard	Application Mode[a]	Hazard Duration[b]	Static/Dynamic Characteristics[c]	Mitigating and Exacerbating Conditions[d]
Agro-terrorism	Direct, generally covert contamination of food supplies or introduction of pests and/or disease agents to crops and livestock.	Days to months.	Varies by type of incident. Food contamination events may be limited to specific distribution sites, whereas pests and diseases may spread widely. Generally no effects on built environment.	Inadequate security can facilitate adulteration of food and introduction of pests and disease agents to crops and livestock.
Radiological Agent	Radioactive contaminants can be dispersed using sprayers/ aerosol generators, or by point or line sources such as munitions.	Contaminants may remain hazardous for seconds to years depending on material used.	Initial effects will be localized to site of attack; depending on meteorological conditions, subsequent behavior of radioactive contaminants may be dynamic.	Duration of exposure, distance from source of radiation, and the amount of shielding between source and target determine exposure to radiation.
Nuclear Bomb	Detonation of nuclear device underground, at the surface, in the air, or at high altitude.	Light/heat flash and blast/shock wave last for seconds; nuclear radiation and fallout hazards can persist for years. Electromagnetic pulse from a high-altitude detonation lasts for seconds and affects only unprotected electronic systems.	Initial light, heat, and blast effects of a subsurface, ground, or air burst are static and determined by the device's characteristics and employment; fallout of radioactive contaminants may be dynamic, depending on meteorological conditions.	Harmful effects of radiation can be reduced by minimizing the time of exposure. Light, heat, and blast energy decrease logarithmically as a function of distance from seat of blast. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting radiation and radioactive contaminants.
Intentional Hazardous Material Release (fixed facility or transportation)	Solid, liquid, and/or gaseous contaminants may be released from fixed or mobile containers	Hours to days.	Chemicals may be corrosive or otherwise damaging over time. Explosion and/or fire may be subsequent. Contamination may be carried out of the incident area by persons, vehicles, water, and wind.	As with chemical weapons, weather conditions directly affect how the hazard develops. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Shielding in the form of sheltering in place can protect people and property from harmful effects. Non-compliance with fire and building codes, as well as failure to maintain existing fire protection and containment features, can substantially increase the damage from a hazardous materials release.

Source: FEMA 386-7

a. Application Mode—The human acts necessary to cause the event to occur.
b. Hazard Duration—The length of time the hazard is present. For example, a chemical warfare agent such as mustard gas, if un-remediated, can persist for hours or weeks under the right conditions.
c. Dynamic or Static Characteristics—An event's tendency to expand, contract, or remain confined in time, magnitude, and space. For example, a cloud of chlorine gas leaking from a storage tank can change location by drifting with the wind and can diminish in danger by dissipating over time.
d. Mitigation and Exacerbating Conditions:
   Mitigation Conditions—Characteristics of the target and its physical environment that can reduce the effects of a hazard. For example, earthen berms can provide protection from bombs; exposure to sunlight can render some biological agents ineffective; and effective perimeter lighting and surveillance can minimize the likelihood of someone approaching a target unseen.
   Exacerbating conditions—Characteristics that can enhance or magnify the effects of a hazard. For example, depressions or low areas in terrain can trap heavy vapors, and a proliferation of street furniture (trash receptacles, newspaper vending machines, mail boxes, etc.) can provide hiding places for explosive devices.

The Federal Bureau of Investigation (FBI) categorizes two types of terrorism in the United States:

- Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. The bombing of the Alfred P. Murrah federal building in Oklahoma City is an example of domestic terrorism. The FBI is the primary response agency for domestic terrorism. The FBI coordinates domestic preparedness programs and activities of the United States to limit acts posed by terrorists, including the use of weapons of mass destruction.
- International terrorism involves groups or individuals whose terrorist activities are foreign-based or directed by countries or groups outside the United States, or whose activities transcend national boundaries. Examples include the 1993 bombing of the World Trade Center and the attacks of September 11, 2001 at the World Trade Center and the Pentagon.

Most terrorist events in the United States have been bombing attacks, involving detonated or undetonated explosive devices, tear gas, pipe bombs, or firebombs. The effects of terrorism can vary from loss of life and injuries to property damage and disruptions in services such as electricity, water supplies, transportation, or communications. The event may have an immediate effect or a delayed effect. Terrorists often choose targets that offer limited danger to themselves and areas with relatively easy public access. Foreign terrorists look for visible targets where they can avoid detection before and after an attack such as international airports, large cities, major special events, and high-profile landmarks.

Three factors distinguish terrorism hazards from other types of hazards:

- In the case of chemical, biological, and radioactive agents, their presence may not be immediately obvious, making it difficult to determine when and where they may have been released, who has been exposed, and what danger is present for first responders and emergency medical technicians.
- There is limited scientific understanding of how these agents affect the population at large.
- Terrorism evokes strong emotional reactions, ranging from anxiety to fear to anger to despair to depression.

While education, heightened awareness, and early warning of unusual circumstances may deter crime and terrorism, intentional acts that harm people and property are possible at any time. Public safety entities react to the threat, locating, isolating and neutralizing further damage, and investigating potential scenes and suspects to bring criminals to justice. Those involved with terrorism response, including public health and public information staff, are trained to deal swiftly with the public's emotional reaction. The area of the event must be clearly identified in all emergency alert messages to prevent those not affected by the incident from overwhelming local emergency rooms and response resources, which would reduce service to those actually affected. The public must be informed clearly and frequently about what government agencies are doing to mitigate the impacts of the event. The public will also be given clear directions on how to protect the health of individuals and families.

In dealing with terrorism, the unpredictability of human beings must be considered. People with a desire to perform criminal acts may seek out targets of opportunity that may not fall into established lists of critical areas or facilities. First responders train not only to respond to organized terrorism events, but also to respond to random acts by individuals who, for a variety of reasons ranging from fear to emotional trauma to mental instability, may choose to harm others and destroy property.

The AWIA assessment that the District is currently performing includes a significant terrorism assessment and recommendations element. The District will integrate elements of this Hazard Mitigation Plan with the AWIA assessment as appropriate.

17.4 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.

NOTE REGARDING COVID-19

As this planning process was being completed, the East Orange County Water District, the State of California and the remainder of the world was just beginning to deal with the impacts from the COVID-19 global pandemic. COVID-19 is the name of the disease caused by the virus whose name is SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2)

The impacts from this event will be long term and change the way society as a whole views, prepares for and responds to pandemics. At the time of this report; the District had not been significantly impacted by 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 event and the development policies to respond were in their infancy as of this writing and were not fully vetted enough to inform this plan update. It is anticipated that future updates to this plan will have well informed, expanded dialogue on this subject matter.

17.4.1 Identified Hazards

The California Department of Public Health has identified the conditions described in the sections below as human diseases that could contribute to a serious epidemic in the state.

Animal Transmitted

These are diseases that are transmitted by domestic or non-domestic animals. Diseases of this type identified by the California Department of Public Health include the following:

- Brucellosis (undulant fever)
- Campylobacteriosis
- Cat scratch disease
- Cryptosporidiosis
- Escherichia coli (E. coli)
- Giardiasis
- Middle Eastern Respiratory Syndrome (MERS)
- Plague
- Psittacosis (ornithosis, parrot fever)
- Q Fever
- Rabies
- Ringworm
- Salmonellosis
- Toxoplasmosis
- Tularemia

Bioterrorism Related

Bioterrorism agents are divided into three categories based on their ease of spread and the severity of illness they cause. Category A agents are most dangerous, and Category C agents are current emerging threats:

- Category A pathogens—Organisms or biological agents that pose the highest risk to national security and public health because they:

    - Can be easily spread or transmitted from person to person
    - Result in high death rates and have the potential for major public health impact
    - Might cause public panic and social disruption
    - Require special action for public health preparedness.

- Category B pathogens—The second highest priority organisms/biological agents. They:

    - Are moderately easy to disseminate
    - Result in moderate morbidity rates and low mortality rates
    - Require specific enhancements for diagnostic capacity and enhanced disease surveillance.

- Category C pathogens—The third highest priority, including emerging pathogens that could be engineered for mass dissemination in the future because of:

    - Availability
    - Ease of production and dissemination
    - Potential for high morbidity and mortality rates and major health impact.

Bloodborne

Viruses, bacteria and parasites that can be carried in blood and cause disease are known as bloodborne pathogens. Transmission of these diseases may be from direct blood contact, needle sticks, intravenous drug use, high risk sexual behavior or by insects or other vectors. Bloodborne diseases include the following:

- Ebola
- Hepatitis C
- Malaria

Community-Acquired Infections

Community-acquired infections are infections that are contracted outside of a hospital or are diagnosed within 48 hours of admission without any previous health care encounter. Types of community acquired infections include the following:

- Adenovirus
- Bed Bugs
- Body Lice
- Campylobacteriosis
- Conjunctivitis (pink eye)
- Common cold viruses
- Enterovirus, non-polio
- Hand, foot, and mouth disease
- Head lice
- Impetigo
- Influenza (flu)
- Invasive Group A Streptococcus (necrotizing fasciitis)
- Legionnaires' Disease/Pontiac Fever
- Methicillin-Resistant Staphylococcus Aureus
- Norovirus
- Pinworm disease
- Respiratory syncytial virus

- Ringworm
- Scabies
- Smallpox
- Staphylococcus aureus
- Strep throat/scarlet fever
- Streptococcus, Group B
- Tularemia
- Viral meningitis

Foodborne

Many diseases can be contracted by eating contaminated food or beverages. Most of these are spread when food becomes contaminated with fecal matter containing bacteria, viruses, or parasites. This contamination can happen at a farm, manufacturing plant, restaurant, or home. Foodborne diseases usually result in gastrointestinal illness, which can include symptoms such as diarrhea, vomiting, nausea, stomachache, and fever. People who are ill with a foodborne disease can give the infection to others, so proper hygiene and hand washing practices are essential to limit the spread of disease, and people experiencing gastrointestinal symptoms should not prepare or handle food for others. Foodborne diseases include the following:

- Amebiasis
- Angiostrongyliasis (rat lungworm)
- Anisakiasis
- Botulism
- Brucellosis (undulant fever)
- Campylobacteriosis
- Cholera
- Ciguatera fish poisoning
- Cryptosporidiosis
- Cyclosporiasis (cyclospora infection)
- Escherichia coli (E. coli)
- Giardiasis
- Listeriosis
- Norovirus
- Salmonellosis
- Scombroid
- Shigellosis
- Tularemia
- Typhoid Fever
- Vibriosis
- Yersinia enterocolitica (Yersiniosis), non-pestis

Influenza

Influenza is an infectious viral disease of birds and mammals commonly transmitted through airborne aerosols such as coughing or sneezing. Symptoms are chills, headache, fever, nausea, muscle pain and occasionally pneumonia. New flu strains caused pandemics in the late 19th and 20th centuries: Russian flu, 1918 Spanish flu, Asian flu, Hong Kong flu, and A/H1N1 or the swine flu. According to the CDC, avian influenza occurs naturally among wild aquatic birds worldwide and can infect domestic poultry and other bird and animal species. Avian flu viruses do not normally infect humans. The recent avian flu strains H5N1 and H7N9 have caused human deaths but have not escalated to pandemic proportions.

Respiratory Viruses

Respiratory viruses are responsible for influenza-like illness morbidity within the community. Respiratory viruses can also cause the common cold. Respiratory viruses include the following:

- Adenovirus
- Coronaviruses (including COVID-19, SARS and MERS CoV)
- Influenza (flu)
- Parainfluenza
- Parvovirus B19 (fifth disease)
- Respiratory syncytial virus
- Rhinovirus (common cold)
- Measles
- Pertussis (also known as whooping cough)

The virus that has caused the COVID-19 pandemic at the time this hazard mitigation plan is being prepared (SARS-CoV-2) also is a respiratory virus.

These viruses are usually mild in illness. People at high risk (those with certain underlying conditions, the elderly, the very young, and pregnant women) could develop severe illness that could result in hospitalization or death. The best way to protect oneself is by proper hand hygiene and avoiding contact with sick individuals. The best way for those who are infected to protect others is to cover their nose and mouth when sneezing and coughing, use good hand hygiene, and stay home from work or school.

Waterborne Diseases

Waterborne diseases are conditions caused by pathogenic micro-organisms that are transmitted in water. These diseases can be spread while bathing, washing, drinking water, or eating food exposed to contaminated water. Waterborne diseases include the following:

- Cholera
- Giardiasis
- Legionnaires’ Disease /Pontiac Fever
- Leptospirosis
- Typhoid Fever
- Vibriosis

Sexually Transmitted Disease

Sexually transmitted diseases include the following:

- Chlamydia
- Genital warts
- Gonorrhea
- Hepatitis A, B, and C
- Herpes
- Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS)
- Human papillomavirus
- Syphilis
- Zika

17.4.2 Location, Extent and Magnitude

Health hazards that affect the residents of Orange County and the District Service area may arise in a variety of situations, such as during a communicable disease outbreak, after a natural disaster, or as the result of a bioterrorism incident. All populations in Orange County are susceptible to bioterrorism or pandemic events. Populations who are young or elderly or have compromised immune systems are likely to be more vulnerable. The relative ease of world-wide travel in addition to the world’s expanding global food industry ensures that all countries are vulnerable to pandemic events at any time.

17.4.3 Planning Capability for Pandemic

The California Department of Public Health works to protect the public’s health in the Golden State and helps shape positive health outcomes for individuals, families and communities. The Department’s programs and services, implemented in collaboration with local health departments and state, federal and private partners, touch the lives of every Californian and visitor to the state 24 hours a day, 7 days a week.

The Orange County Health Care Agency is a regional service provider charged with protecting and promoting individual, family and community health in Orange County, California through the coordination of public and private sector resources. The Health Care Agency navigates a complex system of operations comprised of 180 different funding sources and more than 200 state and federal mandates that impact the way we provide and regulate a variety of programs and services to keep people well. Monitors and investigates the occurrence of disease, injury and related factors in the community and in collaboration with community partners develops and implements preventive strategies to maintain and improve the health of the public.

Part 3. Mitigation Plan

18. 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.

18.1 GOALS

Five goals were set for the District's first hazard mitigation plan which are listed below:

1. Protect life and property
2. Increase public awareness of risk
3. Protect natural resources
4. Facilitate partnerships and implementation coordination
5. Maintain continuity of essential services

18.2 OBJECTIVES

The Steering Committee members identified the following plan objectives:

1. Implement activities that assist in protecting lives by making infrastructure, critical facilities and other property more resistant to natural hazards
2. Address aging infrastructure issues to reduce/minimize future hazards and disasters
3. Protect water quality and supply
4. Raise awareness and communicate risk to District assets
5. Preserve, rehabilitate, and enhance natural systems to serve natural hazard mitigation functions
6. Leverage grant funding and low interest loan programs for hazard mitigation capital projects
7. Establish policy to ensure mitigation projects for critical facilities, services and infrastructure.

19. 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 except space weather are presented in Table 19-1 through Table 19-7. Such catalogs have not been generated for the space weather hazard, but the following objectives should be pursued toward mitigating that hazard (NSTC, 2015):

- Encourage development of hazard-mitigation plans that address the effects of space weather.
- Integrate information about space-weather hazards, as appropriate, into existing mechanisms for information sharing and into national preparedness mechanisms.
- Work with industry to achieve long-term reduction of vulnerability to space-weather events by implementing measures at locations most susceptible to space weather
- Adopt standards, business practices, and operational procedures that improve protection and resilience.
- Strengthen public-private collaborations that support action to reduce vulnerability to space weather.

Table 19-1. Alternatives to Mitigate the Dam Failure Hazard

Personal-Scale	Corporate-Scale	Government-Scale[a]
• Manipulate the hazard: ❖ None • Reduce exposure to the hazard: ❖ Relocate out of dam failure inundation areas. • Reduce vulnerability to the hazard: ❖ Elevate home to appropriate levels. • Increase the ability to respond to or be prepared for the hazard: ❖ Learn about risk reduction for the dam failure hazard. ❖ Learn the evacuation routes for a dam failure event. ❖ Educate yourself on early warning systems and the dissemination of warnings.	• Manipulate the hazard: ❖ Remove dams. ❖ Remove levees. ❖ Harden dams. • Reduce exposure to the hazard: ❖ Replace earthen dams with hardened structures. • Reduce vulnerability to the hazard: ❖ Flood-proof facilities within dam failure inundation areas. • Increase the ability to respond to or be prepared for the hazard: ❖ Educate employees on the probable impacts of a dam failure. ❖ Develop a continuity of operations plan.	• Manipulate the hazard: ❖ Remove dams. ❖ Remove levees. ❖ Harden dams. • Reduce exposure to the hazard: ❖ Replace earthen dams with hardened structures ❖ Relocate critical facilities out of dam failure inundation areas. ❖ Consider open space land use in designated dam failure inundation areas. • Reduce vulnerability to the hazard: ❖ Adopt higher floodplain standards in mapped dam failure inundation areas. ❖ Retrofit critical facilities within dam failure inundation areas. • Increase the ability to respond to or be prepared for the hazard: ❖ Map dam failure inundation areas. ❖ Enhance emergency operations plan to include a dam failure component. ❖ Institute monthly communications checks with dam operators. ❖ Inform the public on risk reduction techniques ❖ Adopt real-estate disclosure requirements for the re-sale of property located within dam failure inundation areas. ❖ Consider the probable impacts of climate in assessing the risk associated with the dam failure hazard. ❖ Establish early warning capability downstream of listed high hazard dams. ❖ Consider the residual risk associated with protection provided by dams 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.

Table 19-2. 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 19-3. 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 19-4. 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 techniques	• Manipulate the hazard: ❖ Clear storm drains and culverts ❖ Use low-impact development techniques	• 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 outside of hazard area ❖ Elevate utilities above base flood elevation ❖ Use low-impact development techniques	• Reduce exposure to the hazard: ❖ Locate critical facilities outside hazard area ❖ Use low-impact development techniques	• 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 identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. ❖ Adopt land 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: ❖ Raise structures above base flood elevation ❖ Elevate items within house above base flood elevation ❖ Build new homes above base flood elevation ❖ Flood-proof structures	• 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	• Reduce vulnerability to the hazard: ❖ Harden infrastructure, bridge replacement program ❖ Provide redundancy for critical functions and infrastructure ❖ Adopt regulatory standards such as freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; 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: ❖ Buy flood insurance ❖ Develop household plan, such as retrofit savings, communication with outside, 72-hour self-sufficiency during and after an event	• 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.	• 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 ❖ Consider participation in the Community Rating System ❖ 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 impacts of climate change 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 19-5. 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 19-6. 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 19-7. 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 fire fighting.	• 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.

20. MITIGATION ACTIONS

20.1 RECOMMENDED MITIGATION ACTIONS

The Steering Committee selected area-wide 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 20-1 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
- Ongoing= Continuing new or existing program with no completion date
- DOF = Depending upon funding

20.2 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)). The benefits of proposed actions were weighed against estimated costs as part of the action prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some actions may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each action was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these actions.

Cost ratings were defined as follows:

- **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 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 ratings were defined as follows:

- **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.

Using this approach, actions with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly.

Table 20-1. 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—.Construct New EOC/Administrative Building outside of Dam Inundation area, flood zone to appropriate seismic codes and standards.						
Hazards Mitigated: Dam Failure, Earthquake, Flood						
Existing	1,6,7	District	N/A	High ($6 Million)	District reserves, FEMA HMA Funding, DHS EOC Funding	Short Term, DOF
Action #2—Reconstruct Peters Canyon Reservoir to avoid future seismic landslide and wildfire risks						
Hazards Mitigated: Earthquake, Landslide, Wildfire						
Existing	1,2,3,6,7	District	N/A	High ($8 Million)	District reserves, FEMA HMA Funding,	Short Term, DOF
Action #3— Foothill Regional Environmentally Sustainable H2O (FRESH) project that involves the capture of stormwater runoff to attenuate stormwater impacts and pumping the captured stormwater to an impounded storage facility.						
Hazards Mitigated: Dam Failure, Drought, Flood						
New and Existing	3,5,7	District	Orange County	High ($80 Million)	District reserves, FEMA HMA Funding,	Long Term
Action #4—Acquire fixed place generators of sufficient size and capacity for the 3 district wells that currently do not have them, and convert Bartlet Reservoir, OC 70 Pump and the Administrative building for portable generator support to fixed place generator support.						
Hazards Mitigated: Dam Failure, Earthquake, Flood, Landslide, Severe Weather, Wildfire and Space Weather						
New and Existing	1,7	District		High ($2 Million)	District reserves, FEMA HMA Funding,	Short Term, DOF
Action #5—Upgrade the hardware and software of the District's SCADA system to provide increased security for District facilities						
Hazards Mitigated: Terrorism						
Existing	1,2,6,7	District	N/A	High ($1.5 Million)	District Reserves, DHS-EMPG Funding	Short Term, DOF
Action #6—Replace vulnerable Water Transmission Pipelines that interface liquefiable soils to mitigate future impacts from earthquake						
Hazards Mitigated: Earthquake						
Existing	1,2,6,7	District	N/A	High ($5 Million)	District reserves, FEMA HMA Funding,	Long Term
Action #7— District to maintain on its website a page dedicated to keeping the public apprised of hazard mitigation milestones achieved by this plan over its performance period, and provide the public a medium for which to stay engaged with the plan and its implementation.						
Hazards Mitigated Dam Failure, Drought, Earthquake, Flood, Landslide, Severe Weather, Space Weather, Wildfire						
New and Existing	1,4	District	N/A	Low	District funds	Ongoing
Action #8—Establish Security upgrades to facilities that would allow for the District remotely conduct a windshield survey and then make the appropriate adjustments such as closing valves to protect an existing water source in times of emergency.						
Hazards Mitigated: Terrorism, Dam Failure, Earthquake, Flood, Landslide, Severe Weather, wildfire						
Existing	2,7	District	N/A	High ($1 Million)	District Reserves, DHS-EMPG Funding	Short Term, DOF
Action #9—Replace existing well that are considered to be sub-standard as for code compliance due to their age to mitigate future impacts from earthquakes.						
Hazards Mitigated: Earthquake, Drought						
Existing	1,2,3,6,7	District	N/A	High ($2 Million)	District Reserves, FEMA HMA Funding, (State Proposition 1 Grant)	Short Term, DOF
Action #10—Vulnerable Sewer Line Replacement						
Hazards Mitigated: Earthquake						
Existing	1,2,3,6,7	District	N/A	High ($10 Million)	District reserves and debt financing, FEMA HMA Funding	Short Term. DOF
Action #11—Replace the seismically vulnerable Vista Panorama Reservoir.						
Hazards Mitigated:	Drought, Earthquake					
Existing	1,2,3,6,7	District		High (1.5 Million)	District reserves and debt financing, FEMA HMA Funding	Short term, DOF

Applies to New or Existing Assets	Objectives Met	Lead Agency	Support Agency	Estimated Cost	Sources of Funding	Timeline
Action #12—Replace exposed wastewater pipes that cross waterways and flood channels with ductile pipe to better withstand dam failure, flood and earthquake impacts.						
Hazards Mitigated	Dam failure, Earthquake, flood					
Existing	1,2,3,6,7	District		High ($400 Million)	District reserves and debt financing, FEMA HMA Funding	Long Term
Action #13—Wholesale Water System Transmission Main Rehabilitation needed to mitigate seismic vulnerability due to location within susceptible soils.						
Hazards Mitigated:	Earthquake					
Existing	1,2,3,6,7	District		High ($55 Million)	District reserves and debt financing, FEMA HMA Funding	Long Term
Action #14—Treatment Plant Rehabilitation needed to mitigate seismic vulnerability due to location within susceptible soils.						
Hazards Mitigated:	Earthquake, Dam Failure					
Existing	1,2,3,6,7	District		High ($25 Million)	District reserves and debt financing, FEMA HMA Funding	Long Term
Action #15— Coordinate and Collaborate with other Orange County Stakeholders with a stake in hazard mitigation and planning in increasing the regional resilience of the Orange County operation area that interfaces with district assets and interests.						
Hazards Mitigated:	Dam Failure, Drought, Earthquake, Flood, Landslide, Severe Weather, Space Weather, Wildfire					
New and Existing	1,3,4,7	District	Other OC Stakeholders	Low	District funds	Ongoing
Action #16— As the opportunities arise, the District will seek to integrate viable components of this hazard mitigation plan into other plans and programs that can support or enhance the District's ability to increase its resilience to the hazards assessed by this plan.						
Hazards Mitigated:	Dam Failure, Drought, Earthquake, Flood, Landslide, Severe Weather, Space Weather, Wildfire					
New and Existing	1,2,3,4,5,6,7	District	N/A	Low	District Funds	Ongoing

For many of the actions identified in this plan, financial assistance may be available through the HMGP or PDM programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For actions not seeking financial assistance from grant programs that require detailed analysis, "benefits" can be defined according to parameters that meet the goals and objectives of this plan.

20.3 ACTION PLAN PRIORITIZATION

Table 20-2 lists the priority of each area-wide action. A qualitative benefit-cost review was performed for each of these actions. The priorities are defined as follows:

- **Implementation Priority**
  - **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.

Table 20-2. 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[a]	Grant Pursuit Priority
1	3	High	High	Yes	Yes	No	Medium	High
2	5	High	High	Yes	Yes	No	Medium	High
3	3	High	High	Yes	Yes	No	Medium	High
4	2	High	High	Yes	Yes	No	Medium	High
5	4	High	High	Yes	Yes	No	Medium	High
6	4	High	High	Yes	Yes	No	Medium	Medium
7	2	Medium	Low	Yes	No	Yes	High	N/A
8	2	High	High	Yes	Yes	No	Medium	High
9	5	High	High	Yes	Yes	No	Medium	High
10	5	High	High	Yes	Yes	No	Medium	High
11	5	High	High	Yes	Yes	No	Medium	High
12	5	High	High	Yes	Yes	No	Medium	Medium
13	5	High	High	Yes	Yes	No	Medium	Medium
14	5	High	High	Yes	Yes	No	Medium	Medium
15	4	Medium	Low	Yes	No	Yes	High	N/A
16	7	Medium	Low	Yes	No	Yes	High	N/A

- **Grant Pursuit Priority**
  - **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.

20.4 CLASSIFICATION OF MITIGATION ACTIONS

Each recommended action was classified based on the hazard it addresses and the type of mitigation it involves. Table 20-3 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 residents and elected officials about hazards and ways to mitigate them. Includes outreach projects, real estate disclosure, hazard information centers, and school-age and adult education.

Table 20-3. 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								
Dam Failure	5,16	1	7	3	1,2,4	1, 2, 3, 14	1, 2, 3, 14	1, 2, 15,16
Earthquake	5,16	1	7		1, 2, 4	1, 2,6,9,10, 11,12, 13, 14	1, 2,9, 11,13, 14	1, 2 15,16
Medium-Risk Hazards								
Severe Weather	5,16	1	7		4			15,16
Landslide	5,16		7		4	2	2	15,16
Flood	5,16	1	7	3	1, 2, 4	1, 2, 3	1, 2, 3	1, 2, 15,16
Wildfire	5,16		7		4	2	2	15,16
Low-Risk Hazards								
Drought	5,16		7	3	4	3,9,11	3,9,11	15,16
Space Weather	5,16		7		4			15,16

- **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.

20.5 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.

21. PLAN ADOPTION AND MAINTENANCE

21.1 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. Figure 21-1 shows the District Board of Directors resolution adopting this plan.

21.2 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 21-1 summarizes the plan maintenance strategy. The sections below further describe each element.

21.2.1 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 General Manager will have individual responsibility for overseeing the plan monitoring and implementation strategy as summarized in Table 21-1.

Insert Adoption Resolution

Figure 21-1. District Resolution Adopting the Hazard Mitigation Plan

Table 21-1. 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.	Annually after the adoption and final approval of the plan by FEMA. Actual reporting period TBD	General Manager	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.	Annually after final plan approval by FEMA, or upon comprehensive update to General Plan or major disaster	General Manager	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 following a major disaster event that significantly impacts the district	General Manager	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. https://www.eocwd.com/hazardmitigationplan	Annually	General Manager	Contractor support for Public Outreach
Plan Integration	Integrate relevant information from hazard mitigation plan into other plans and programs where viable and opportunities arise	Ongoing	General Manager	N/A

21.2.2 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 during the reporting period

Uses of the progress report will be at the discretion of the General Manager. 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.

21.2.3 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.

21.2.4 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.

21.2.5 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
- AWIA plan
- Capital improvement programs
- District vulnerability assessment

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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East Orange County Water District Hazard Mitigation Plan

Appendix A. Public Involvement Materials

A. PUBLIC INVOLVEMENT MATERIALS

SUMMARY OF SURVEY RESULTS

About the Survey

The East Orange County Water District developed and disseminated a 13-question survey to assist with the incorporation of public outreach in its 2020 Hazard Mitigation Plan. The survey was available through a link on the District website. 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, completed by 117 District rate payers, sought to determine public awareness and perception on several hazard mitigation issues, including:

- Types of natural hazards experienced
- Personal disaster/emergency preparedness, focusing on water disruption
- District's ability to deal with a disaster/emergency scenario

The complete survey and survey results are included at the back of this section.

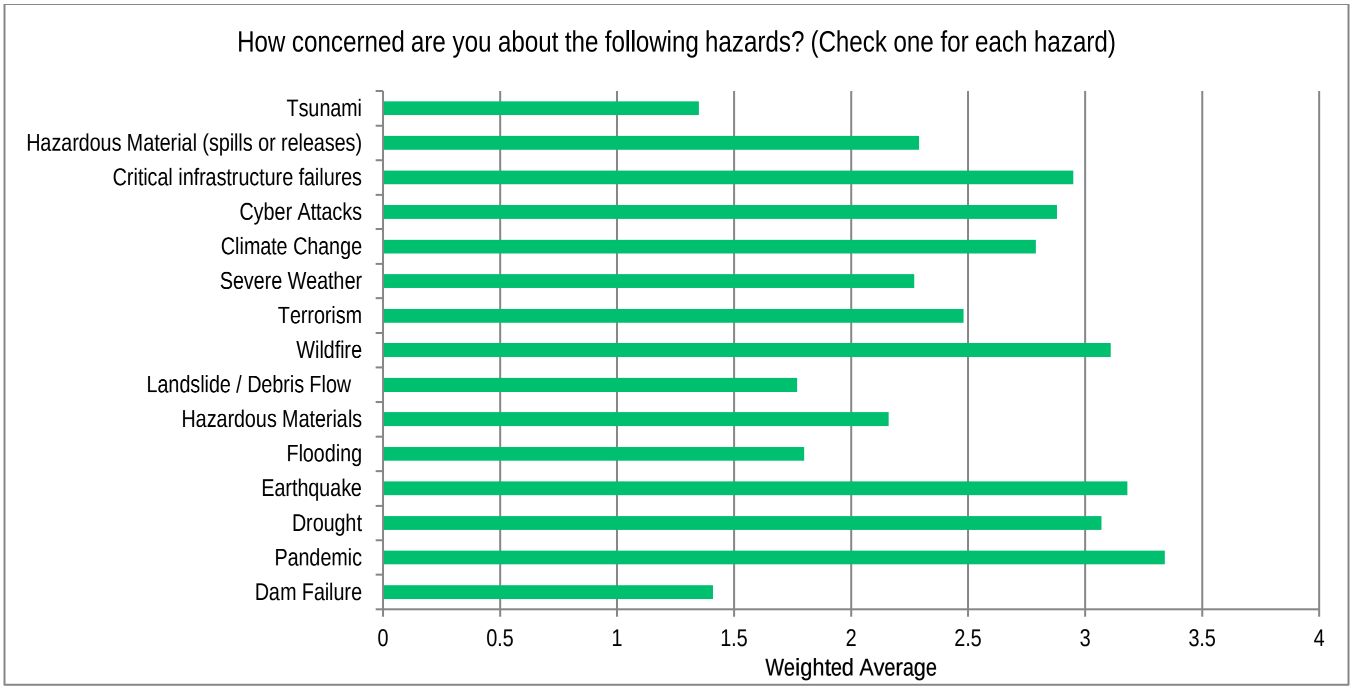
About the Survey Respondents

As noted above, 117 rate payers provided information via the survey to enhance the 2020 Hazard Mitigation Plan. All respondents were over the age of 18, with over half of the respondents (52.59 percent) being age 60 or older (Question 12). Question 11 asked rate payers where they lived and worked; the majority of respondents answered Orange and North Tustin as their residence and/or city of employment (47.41 percent and 25.86 percent respectively). The other cities represented (in descending order) were Other (11.21 percent, although some responded North Tustin in their comment), Cowan Heights (9.48 percent), and Tustin (6.03 percent). None of the responding rate payers live in Lemon Heights.

Rate payers were asked what natural hazards they had experienced or had been affected by within the past 3 years (Question 1). Respondents were asked to check all that applied, and pandemic and drought were the most common answers (76.72 percent and 46.55 percent respectively). Rate payers were also asked about man-made hazards that they had experienced in the same time frame (Question 2). The majority of respondents said they had not experienced any man-made hazard (73.04 percent), but the most common hazards listed after that were critical infrastructure failure (utility, transportation, electrical or communications system) and cyber attack (17.39 percent and 12.17 percent).

Rate payers were also asked about their level of concern regarding several natural and man-made disasters (Question 6). The top three hazards rate payers stated that they were "extremely concerned" about were (in descending order):

1. Wildfire (19.66 percent)
2. Climate Change (18.80 percent)
3. Pandemic (18.10 percent)



Hazard Preparedness and Education

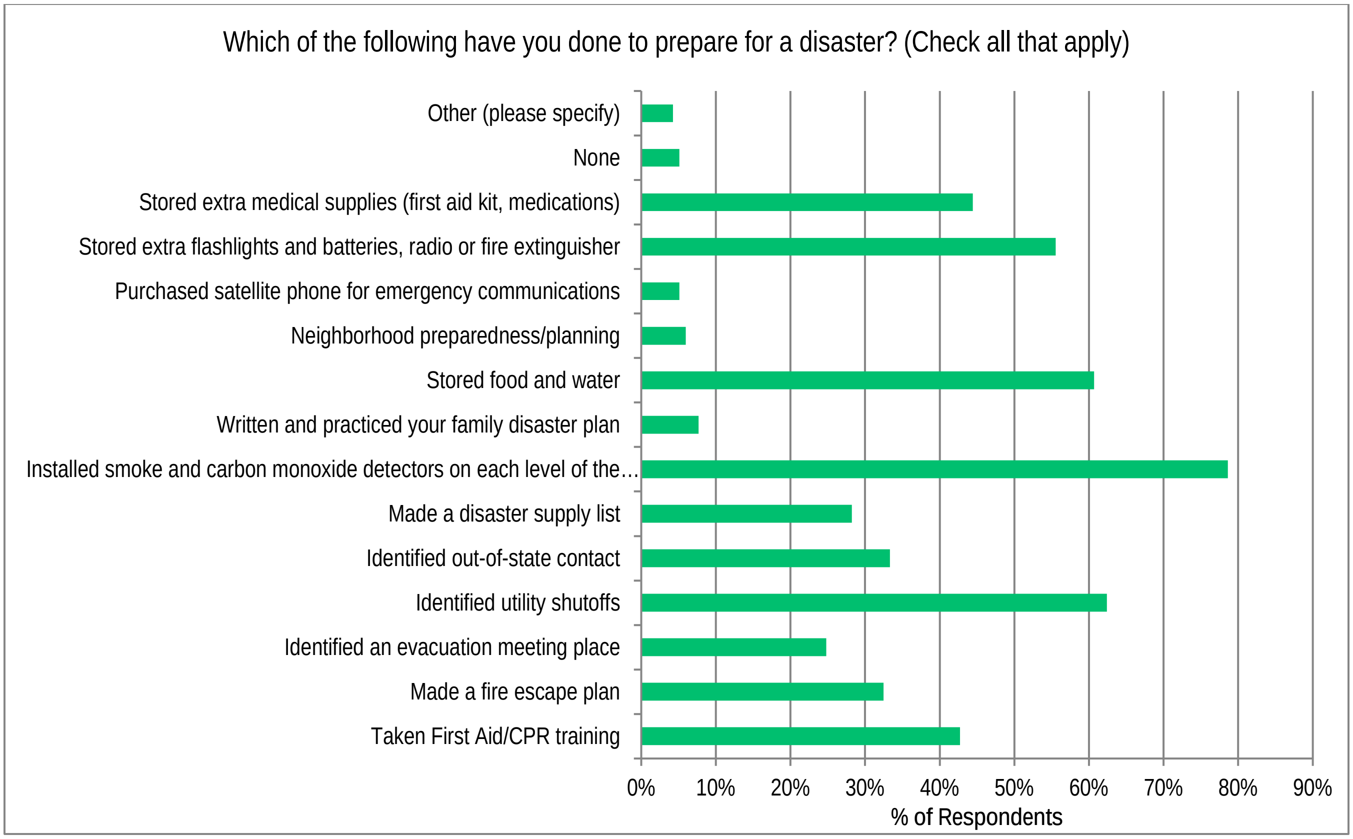
Several questions in the survey asked rate payers about their perceptions of District's and their own personal hazard preparedness. Question 8 asked respondents how prepared that they thought District is to provide water service following a disaster. While a sizeable percentage thought that the district was at least prepared, if not more than or very prepared (37.49 percent combined), nearly half of respondents thought District was only somewhat prepared to provide water service (49.11). Another 13.39 percent thought that the District was not prepared at all.

Rate payers were asked several questions regarding their own level of preparedness. Question 3 asked how ready they were to deal with a disaster or big emergency, particularly water disruption. A plurality of respondents stated they had an average level of preparedness (37.61 percent), followed by just a little (31.62 percent), not prepared at all (17.09 percent), above prepared (11.11 percent), and very prepared (2.56 percent). If water service was temporarily disrupted (Question 9), 41.03 percent of rate payers could continue for 1-3 days without drinking water; 32.48 percent could continue for 3-5 days; 14.53 percent said they could continue for 5-7 days; and 11.97 of rate payers could continue for more than 7 days without drinking water.

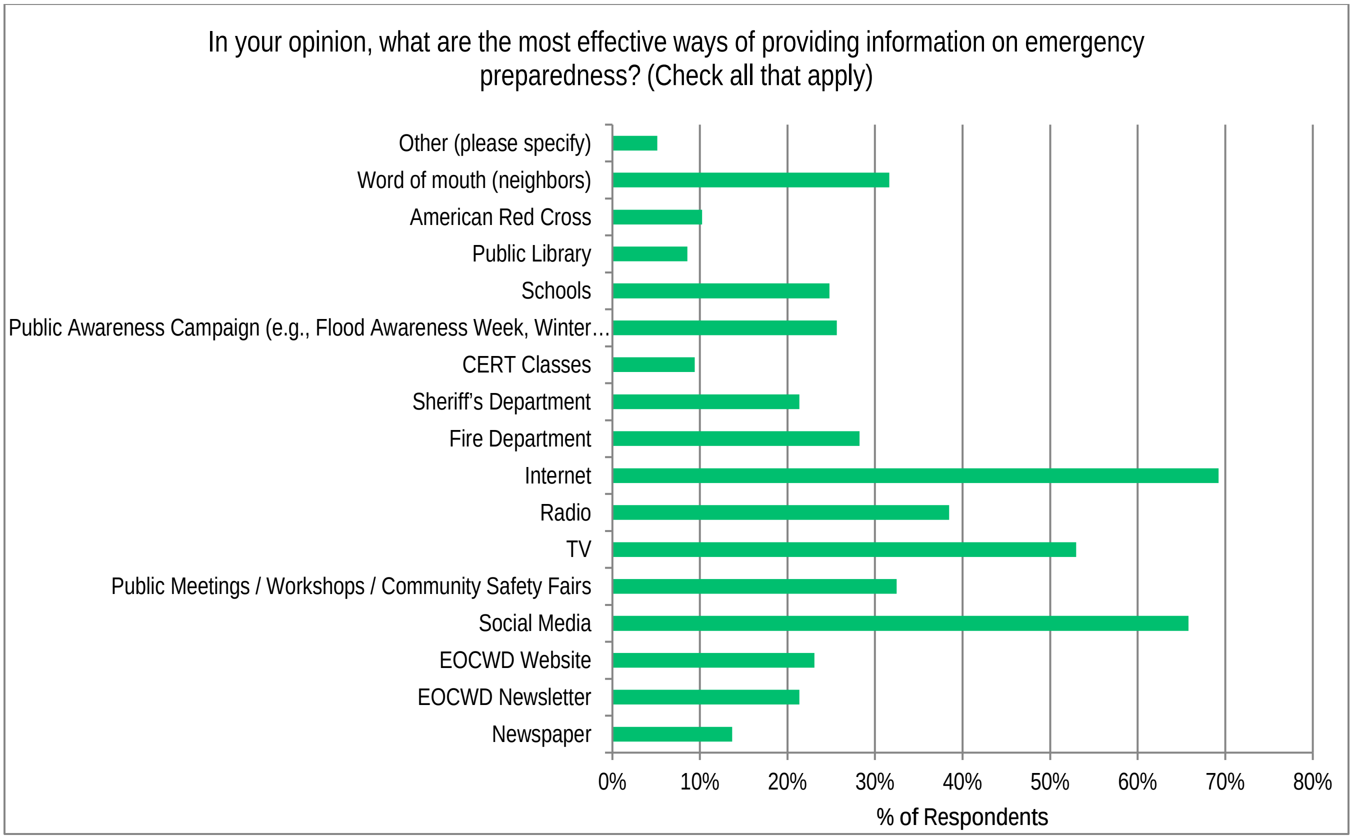
Most respondents have taken some action to prepare for a disaster (Question 5). When asked to check all that applied, the three most popular answers were:

1. Installed smoke and carbon monoxide detectors on each level of the house (78.63 percent)
2. Identified utility shutoffs (62.39 percent)
3. Stored food and water (60.68 percent)

When asked about resources that have helped them become more prepared for emergencies and disasters (Question 4), nearly half named the news or another media source (47.01 percent). Other popular answers were experience from past disasters (31.62 percent) and none (18.80 percent).



Rate payers were asked their opinion about the most effective ways of providing information on emergency preparedness (Question 7). Out of 17 methods listed, the most popular were the internet (69.24 percent), social media (65.81 percent), and TV (52.99 percent). Rate payers currently expect to be notified of an immediate threat in several ways (Question 10). The most popular three answers were television (58.12 percent), email (53.85 percent), and community warning system (52.14). The rest were telephone (51.28 percent), social media (48.72 percent), radio (46.15 percent), Nextdoor (23.93 percent), and other (8.55 percent; most common answer – text). Considering more than half of respondents skipped providing their email to receive updates from the District (Question 13) (53 answered, 64 skipped), the District may want to consider other means of informing their rate payers of the hazard mitigation actions and updates.


In your opinion, what are the most effective ways of providing information on emergency preparedness? (Check all that apply)
Other (please specify)
Word of mouth (neighbors)
American Red Cross
Public Library
Schools
Public Awareness Campaign (e.g., Flood Awareness Week, Winter…
CERT Classes
Sheriff's Department
Fire Department
Internet
Radio
TV
Public Meetings / Workshops / Community Safety Fairs
Social Media
EOCWD Website
EOCWD Newsletter
Newspaper
0%
10%
20%
30%
40%
50%
60%
70%
80%
% of Respondents

SURVEY QUESTIONS

Hazard Mitigation Plan

Community Survey

Dear Valued Resident:

We sincerely hope you are healthy and safe. Just prior to the outbreak of COVID-19, the East Orange County Water District (EOCWD) received a grant under the federal government's Disaster Mitigation Act of 2000 (Public Law 106-109).

This grant provides funding for EOCWD to plan and implement a hazard mitigation plan (HMP) to address natural disasters. The plan will be developed with significant public input and its development will be overseen by a public steering committee made up of your neighbors in East Orange and North Tustin.

We're hopeful that through this hazard mitigation planning process, our residents will not only suggest ways that EOCWD can protect the community's water and sewer infrastructure against disasters but also think about ways our residents and their families can be better prepared for the next natural disaster.

Your participation in this survey will help EOCWD continue to evolve and improve. We appreciate you taking the time to answer this survey candidly with your insights and opinions.

Thank you in advance for your feedback and 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.)
- ☐ Wildfire
- ☐ Dam Failure
- ☐ Other (please specify)

2. **What man-made hazard have you experienced or been affected by in the last 3 years?** *(Check all tha apply)*

- [ ] Critical Infrastructure Failure (utility, transportation, electrical or communications systems)
- [ ] Cyber Attack or Security Incident
- [ ] Hazardous Materials (spill or release)
- [ ] Terrorism
- [ ] None
- [ ] Other (please specify)

3. **How prepared are you to deal with a disaster or big emergency, particularly water disruption?** *(Select One)*

Not prepared at all	Just a little	Average	Above prepared	Very prepared
○	○	○	○	○

4. **What resources have helped you become more prepared for emergencies and disasters?** *(Check al that apply)*

- [ ] Community Emergency Response Training (CERT) or other disaster training program
- [ ] News or another media source
- [ ] Attended meetings with disaster preparedness information
- [ ] Emergency preparedness information from the government (*please write in name of government agency in comment box)
- [ ] Emergency preparedness information from your local utility (*please write in name of utility in comment box)
- [ ] Experience from past disasters
- [ ] Schools
- [ ] None
- [ ] Other (*please specify in comment box)

Comment Box

5. **Which of the following have you done to prepare for a disaster?** *(Check all that apply)*

- [ ] Taken First Aid/CPR training
- [ ] Made a fire escape plan
- [ ] Identified an evacuation meeting place
- [ ] Identified utility shutoffs
- [ ] Identified out-of-state contact
- [ ] Made a disaster supply list
- [ ] Installed smoke and carbon monoxide detectors on each level of the house
- [ ] Written and practiced your family disaster plan
- [ ] Stored food and water
- [ ] Neighborhood preparedness/planning
- [ ] Purchased satellite phone for emergency communications
- [ ] Stored extra flashlights and batteries, radio or fire extinguisher
- [ ] Stored extra medical supplies (first aid kit, medications)
- [ ] None
- [ ] Other (please specify)

6. **How concerned are you about the following hazards?** (Check one for each hazard)

	Not Concerned	Somewhat Concerned	Concerned	Very Concerned	Extremely Concerned
Dam Failure					
Pandemic					
Drought					
Earthquake					
Flooding					
Hazardous Materials					
Landslide / Debris Flow					
Wildfire					
Terrorism					
Severe Weather					
Climate Change					
Cyber Attacks					
Critical infrastructure failures					
Hazardous Material (spills or releases)					
Tsunami					

7. **In your opinion, what are the most effective ways of providing information on emergency preparedness?** *(Check all that apply)*

- [ ] Newspaper
- [ ] EOCWD Newsletter
- [ ] EOCWD Website
- [ ] Social Media
- [ ] Public Meetings / Workshops / Community Safety Fairs
- [ ] TV
- [ ] Radio
- [ ] Internet
- [ ] Fire Department
- [ ] Sheriff's Department
- [ ] CERT Classes
- [ ] Public Awareness Campaign (e.g., Flood Awareness Week, Winter Storm Preparedness Month)
- [ ] Schools
- [ ] Public Library
- [ ] American Red Cross
- [ ] Word of mouth (neighbors)
- [ ] Other (please specify)

8. **How prepared to do think EOCWD is to provide you with water service following a disaster?**

Not prepared at all	Somewhat prepared	Prepared	More than Prepared	Very Prepared

9. **If water service was temporarily disrupted, how long could you continue without any drinking water?** *(Select One)*

- 1-3 days
- 3-5 days
- 5-7 days
- More than 7 days

10. **How would you expect to be notified in case of an immediate threat caused by a local hazard?** *(Check all that apply)*

- ☐ Television
- ☐ Email
- ☐ Radio
- ☐ Social Media
- ☐ Telephone
- ☐ Nextdoor
- ☐ Community Warning System
- ☐ Other (please specify)

11. **I live or work in:** *(needed for demographic data)*

- Tustin
- North Tustin
- Cowan Heights
- Lemon Heights
- Orange
- Other (Please specify)

12. **What is your age range?** *(needed for demographic data)*

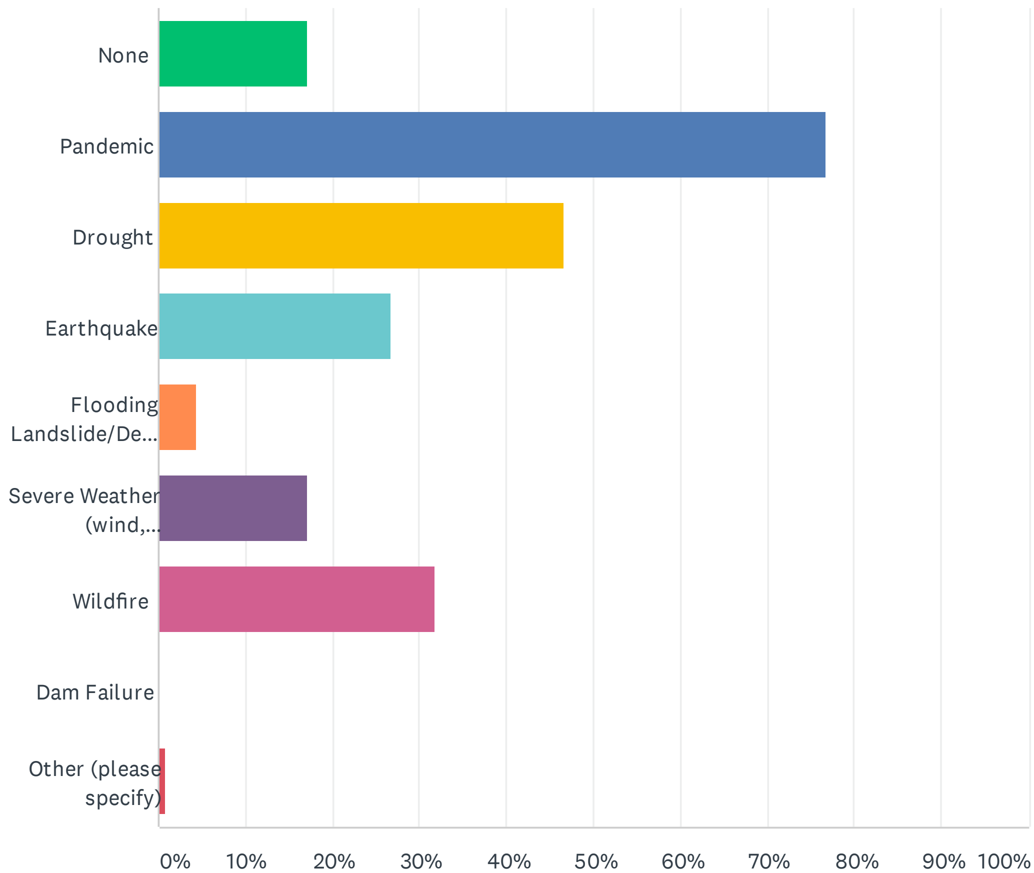
- 18-29
- 30-39
- 40-49
- 50-59
- 60 or older

13. **Would you like to receive general updates on EOCWD (including the results of this survey)?** If so, please type your email below.

Thank you for your input!

Q1 What natural hazard have you experienced or been affected by in the past 3 years? (Check all that apply)

Answered: 116   Skipped: 1

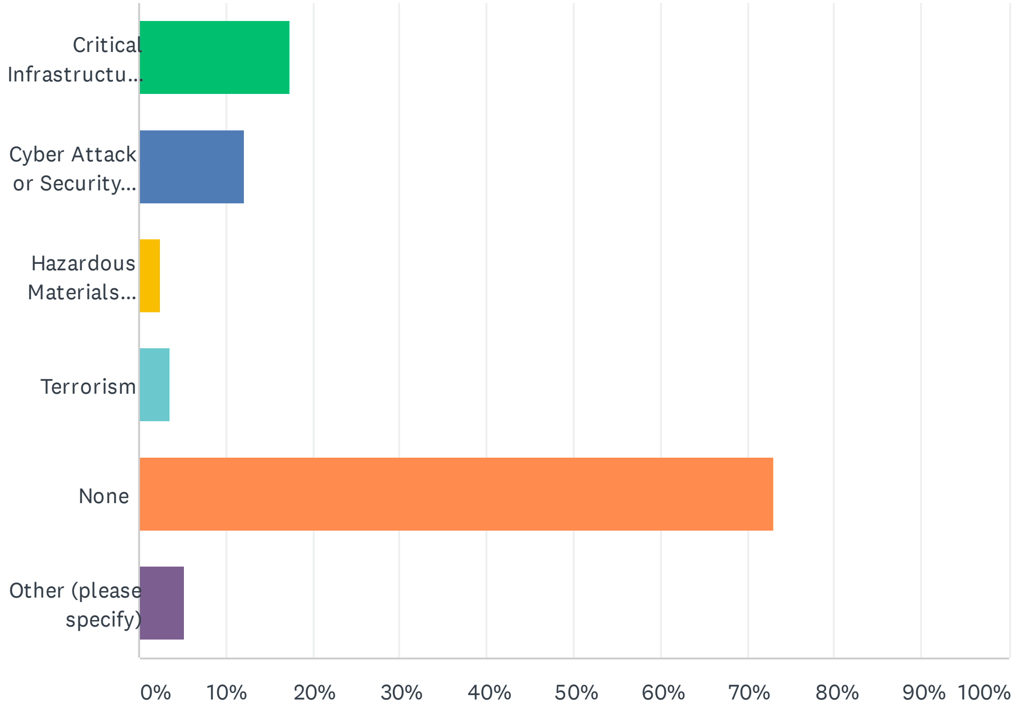


ANSWER CHOICES	RESPONSES	
None	17.24%	20
Pandemic	76.72%	89
Drought	46.55%	54
Earthquake	26.72%	31
Flooding Landslide/Debris Flow	4.31%	5
Severe Weather (wind, lightning, extreme cold or heat, winter storm, etc.)	17.24%	20
Wildfire	31.90%	37
Dam Failure	0.00%	0
Other (please specify)	0.86%	1
Total Respondents: 116		

#	OTHER (PLEASE SPECIFY)	DATE
1	Political	6/22/2020 12:17 PM

Q2 What man-made hazard have you experienced or been affected by in the last 3 years? (Check all that apply)

Answered: 115 Skipped: 2

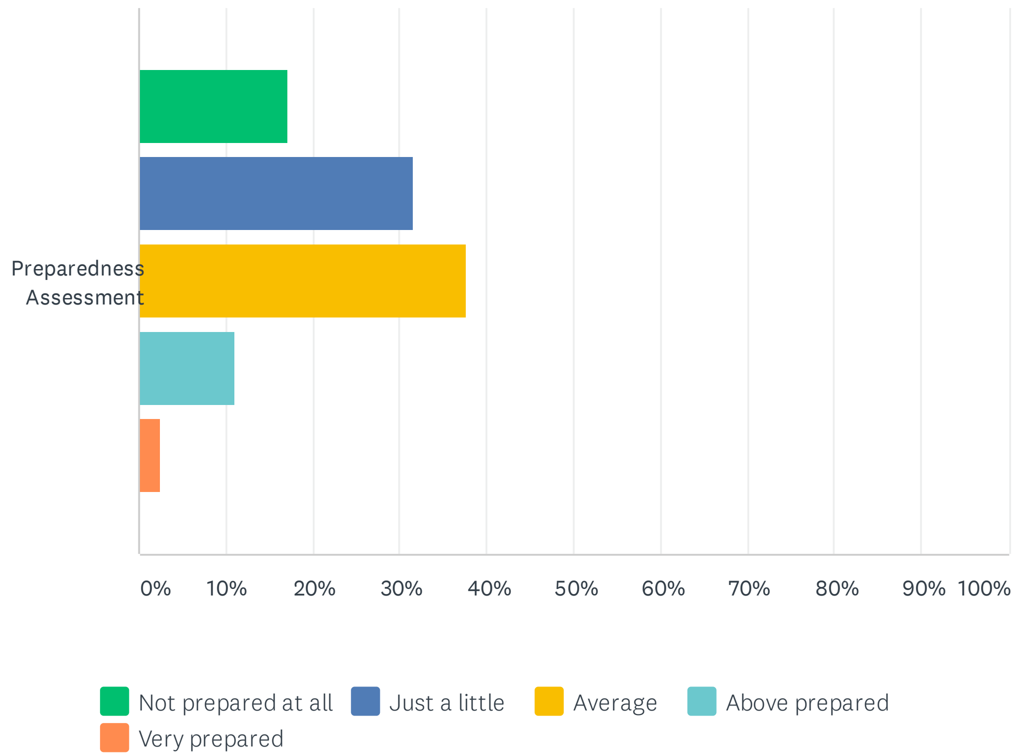


ANSWER CHOICES	RESPONSES	
Critical Infrastructure Failure (utility, transportation, electrical or communications systems)	17.39%	20
Cyber Attack or Security Incident	12.17%	14
Hazardous Materials (spill or release)	2.61%	3
Terrorism	3.48%	4
None	73.04%	84
Other (please specify)	5.22%	6
Total Respondents: 115		

#	OTHER (PLEASE SPECIFY)	DATE
1	Political	6/26/2020 9:09 AM
2	Political	6/25/2020 9:35 PM
3	covid-19	6/24/2020 9:32 PM
4	Political	6/22/2020 12:17 PM
5	Cost of living in SoCal	6/19/2020 9:20 AM
6	Pollution, climate change	5/23/2020 8:36 AM

Q3 How prepared are you to deal with a disaster or big emergency, particularly water disruption? (Select One)

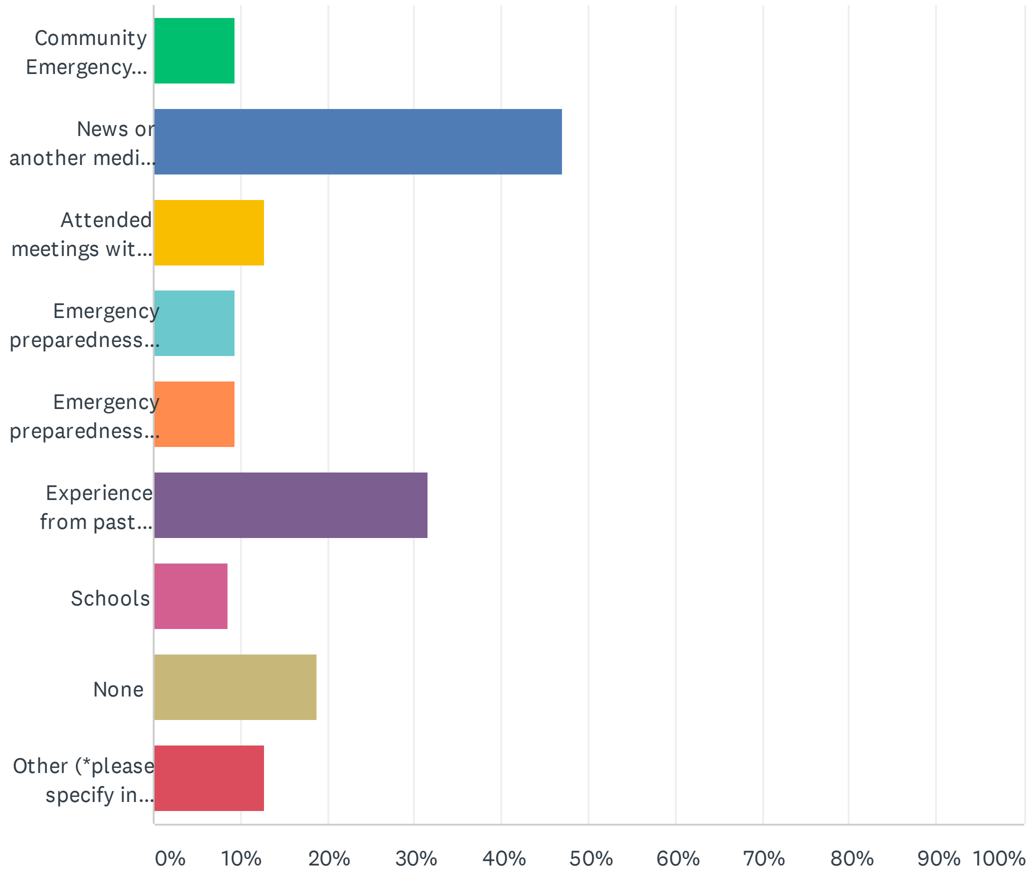
Answered: 117   Skipped: 0



	NOT PREPARED AT ALL	JUST A LITTLE	AVERAGE	ABOVE PREPARED	VERY PREPARED	TOTAL	WEIGHTED AVERAGE
Preparedness Assessment	17.09% 20	31.62% 37	37.61% 44	11.11% 13	2.56% 3	117	2.50

Q4 What resources have helped you become more prepared for emergencies and disasters? (Check all that apply)

Answered: 117 Skipped: 0

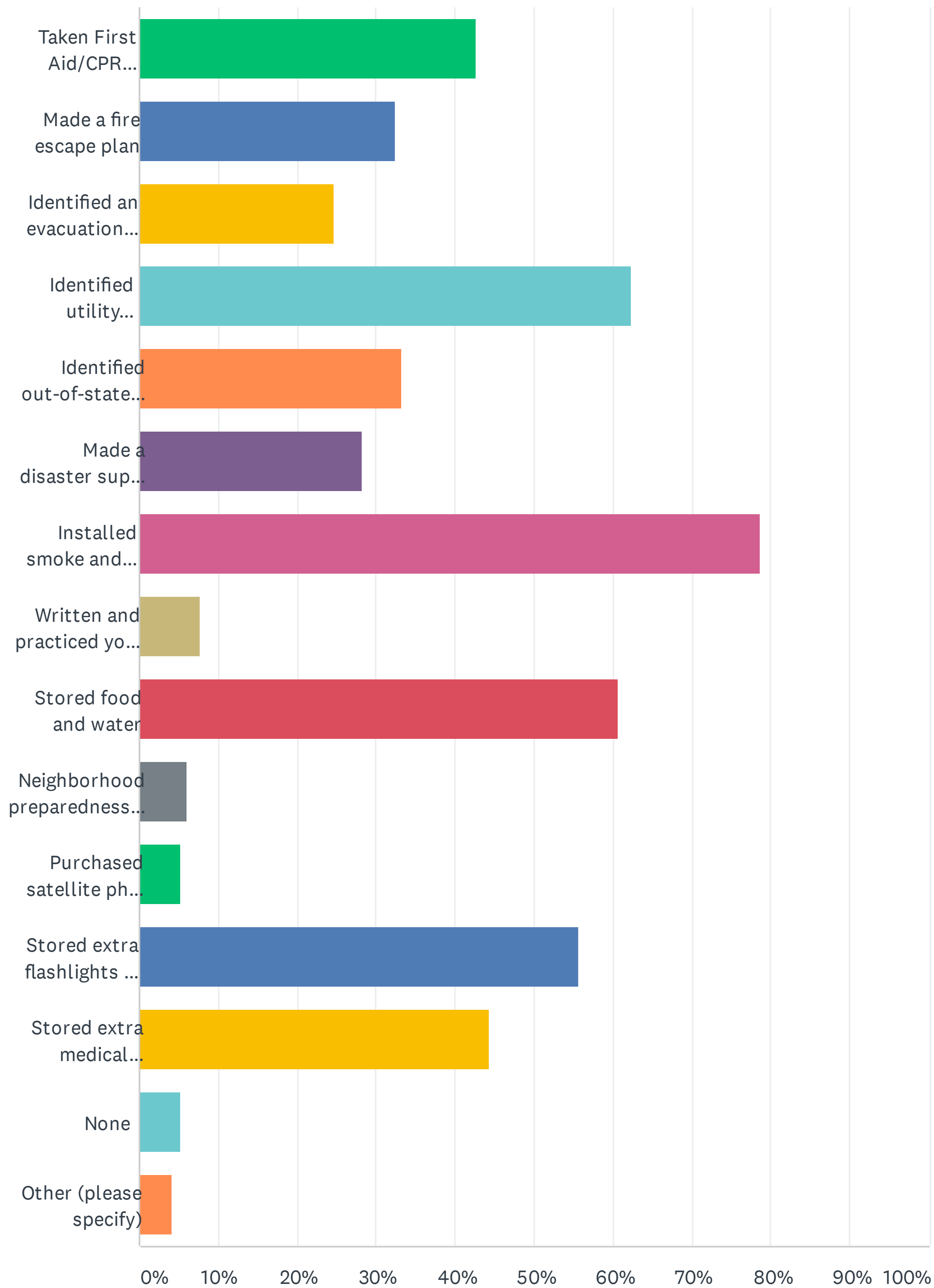


ANSWER CHOICES	RESPONSES	
Community Emergency Response Training (CERT) or other disaster training program	9.40%	11
News or another media source	47.01%	55
Attended meetings with disaster preparedness information	12.82%	15
Emergency preparedness information from the government (*please write in name of government agency in comment box)	9.40%	11
Emergency preparedness information from your local utility (*please write in name of utility in comment box)	9.40%	11
Experience from past disasters	31.62%	37
Schools	8.55%	10
None	18.80%	22
Other (*please specify in comment box)	12.82%	15
Total Respondents: 117		

#	COMMENT BOX	DATE
1	Prepper	6/27/2020 10:04 AM
2	Out of Service Area	6/26/2020 2:16 PM
3	Communications with friends and family	6/26/2020 11:46 AM
4	Out of Service Area	6/26/2020 9:10 AM
5	self research	6/26/2020 9:09 AM
6	electric gas co. public online information.	6/26/2020 7:40 AM
7	Common sense and hard work	6/25/2020 9:35 PM
8	As a facility management professional and educator, emergency preparedness and business continuity are core values of the profession.	6/25/2020 6:47 PM
9	Out of Service Area	6/25/2020 6:04 PM
10	Research	6/25/2020 5:43 PM
11	Out of Service Area	6/25/2020 5:22 PM
12	Neighborhood watch	6/23/2020 5:09 PM
13	CDC	6/23/2020 10:45 AM
14	I was employed by the U.S. Geological Survey for 37 years and had intimate knowledge of natural and man-made disasters.	6/22/2020 10:38 PM
15	Political	6/22/2020 12:17 PM
16	Boy Scouts	6/21/2020 1:30 PM
17	Out of Service Area	6/21/2020 9:30 AM
18	Civil Air Patrol	6/20/2020 11:15 PM
19	FEMA Training	6/19/2020 7:25 PM
20	Checklist booklet maybe irange cpunty	6/19/2020 3:15 PM
21	Lists and tips in newspaper and from Red Cross	6/19/2020 6:59 AM
22	Training at employer	5/25/2020 10:08 PM
23	Internet. Purchased survival kits	5/22/2020 6:33 AM
24	East Orange County water district	5/21/2020 8:49 PM
25	Water	5/21/2020 2:15 PM
26	Scouting family. “Be prepared.”	5/21/2020 11:10 AM

Q5 Which of the following have you done to prepare for a disaster? (Check all that apply)

Answered: 117 Skipped: 0

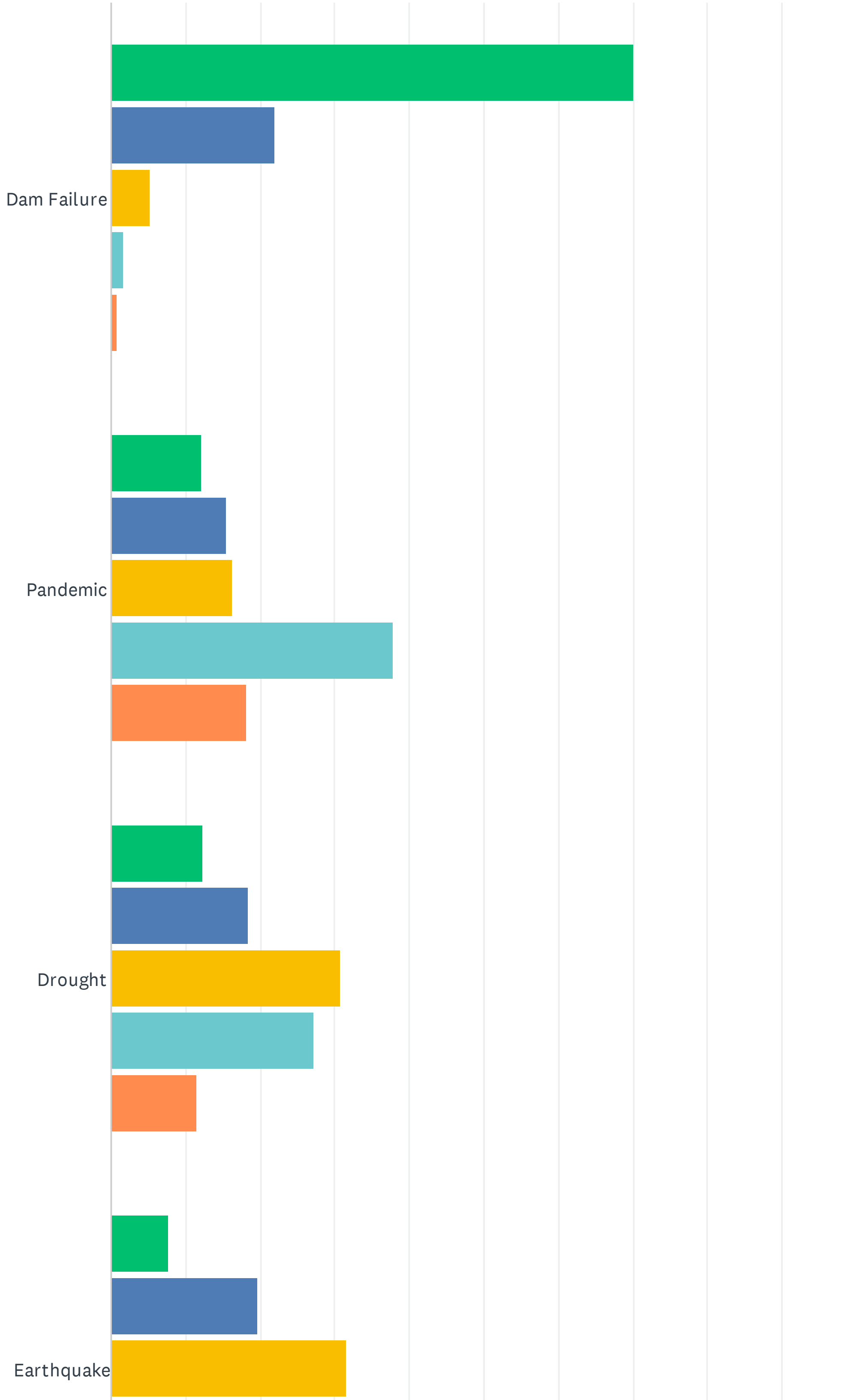


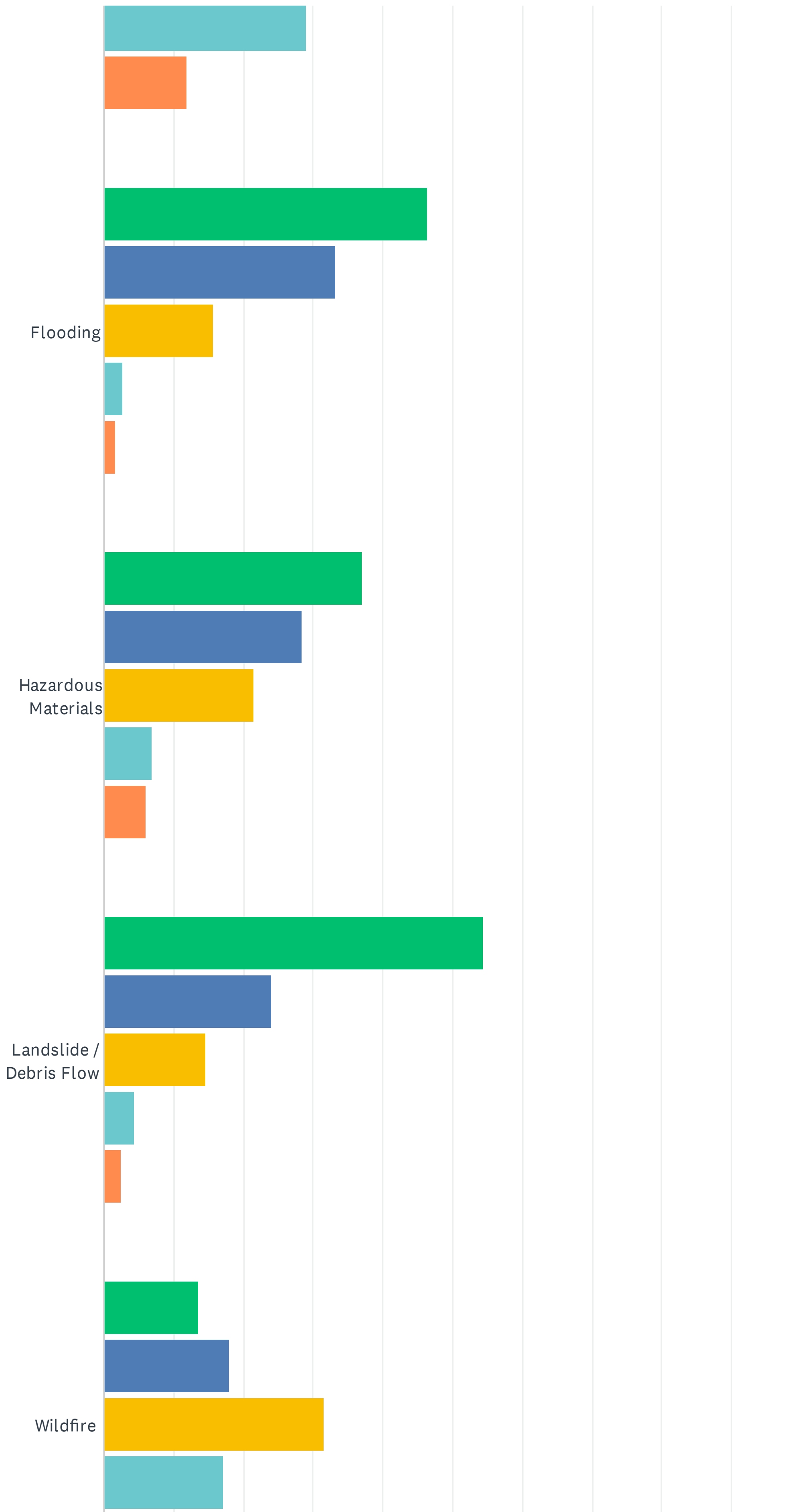
ANSWER CHOICES	RESPONSES	
Taken First Aid/CPR training	42.74%	50
Made a fire escape plan	32.48%	38
Identified an evacuation meeting place	24.79%	29
Identified utility shutoffs	62.39%	73
Identified out-of-state contact	33.33%	39
Made a disaster supply list	28.21%	33
Installed smoke and carbon monoxide detectors on each level of the house	78.63%	92
Written and practiced your family disaster plan	7.69%	9
Stored food and water	60.68%	71
Neighborhood preparedness/planning	5.98%	7
Purchased satellite phone for emergency communications	5.13%	6
Stored extra flashlights and batteries, radio or fire extinguisher	55.56%	65
Stored extra medical supplies (first aid kit, medications)	44.44%	52
None	5.13%	6
Other (please specify)	4.27%	5
Total Respondents: 117		

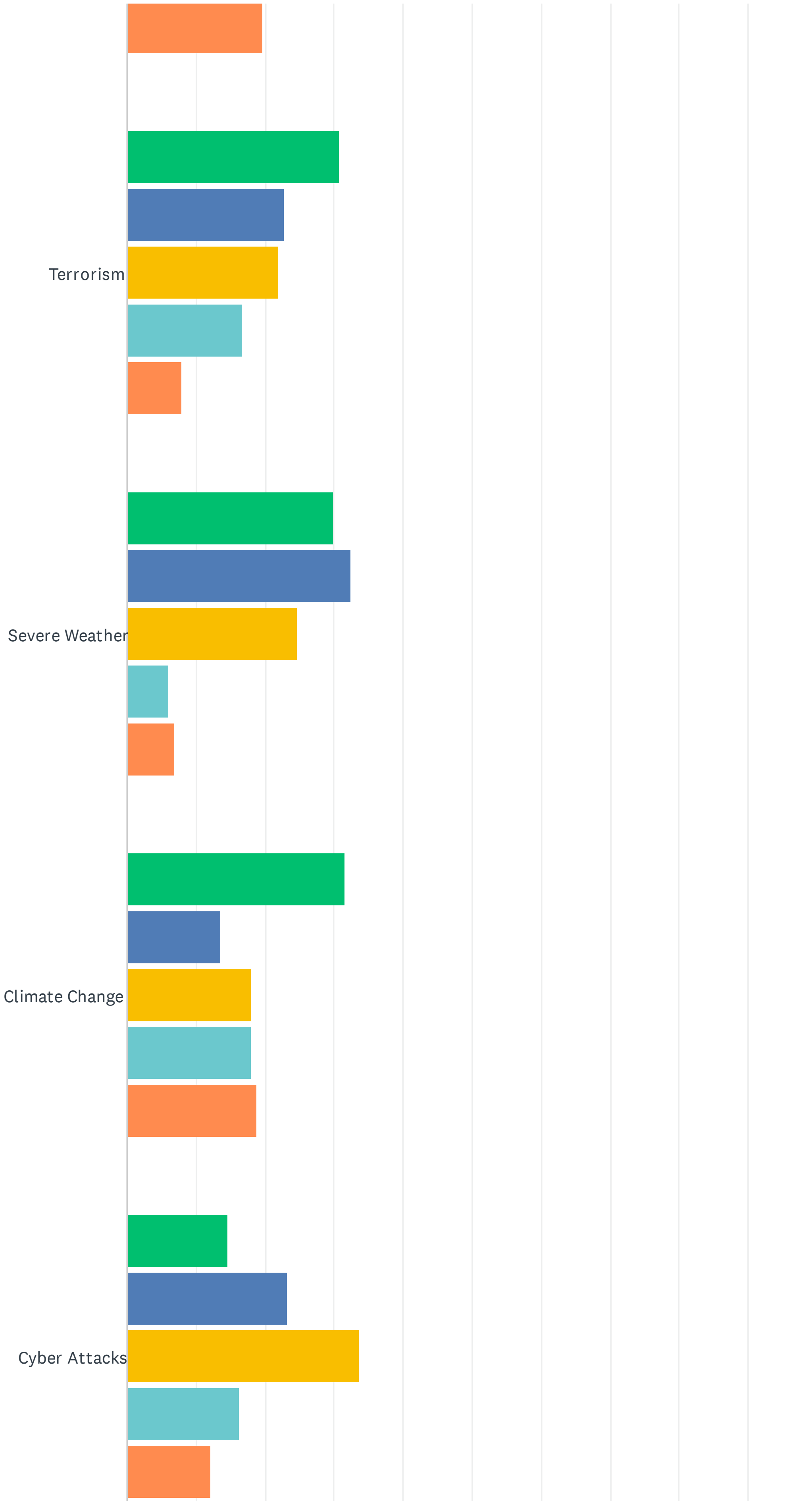
#	OTHER (PLEASE SPECIFY)	DATE
1	Bug out box, bags and survival gear.	6/27/2020 10:04 AM
2	All of the above	6/25/2020 9:35 PM
3	tactical equipment and aviation assets	6/22/2020 12:17 PM
4	Some extra pet food.	6/21/2020 9:30 AM
5	Food & water for pets & elders	5/25/2020 10:08 PM

Q6 How concerned are you about the following hazards? (Check one for each hazard)

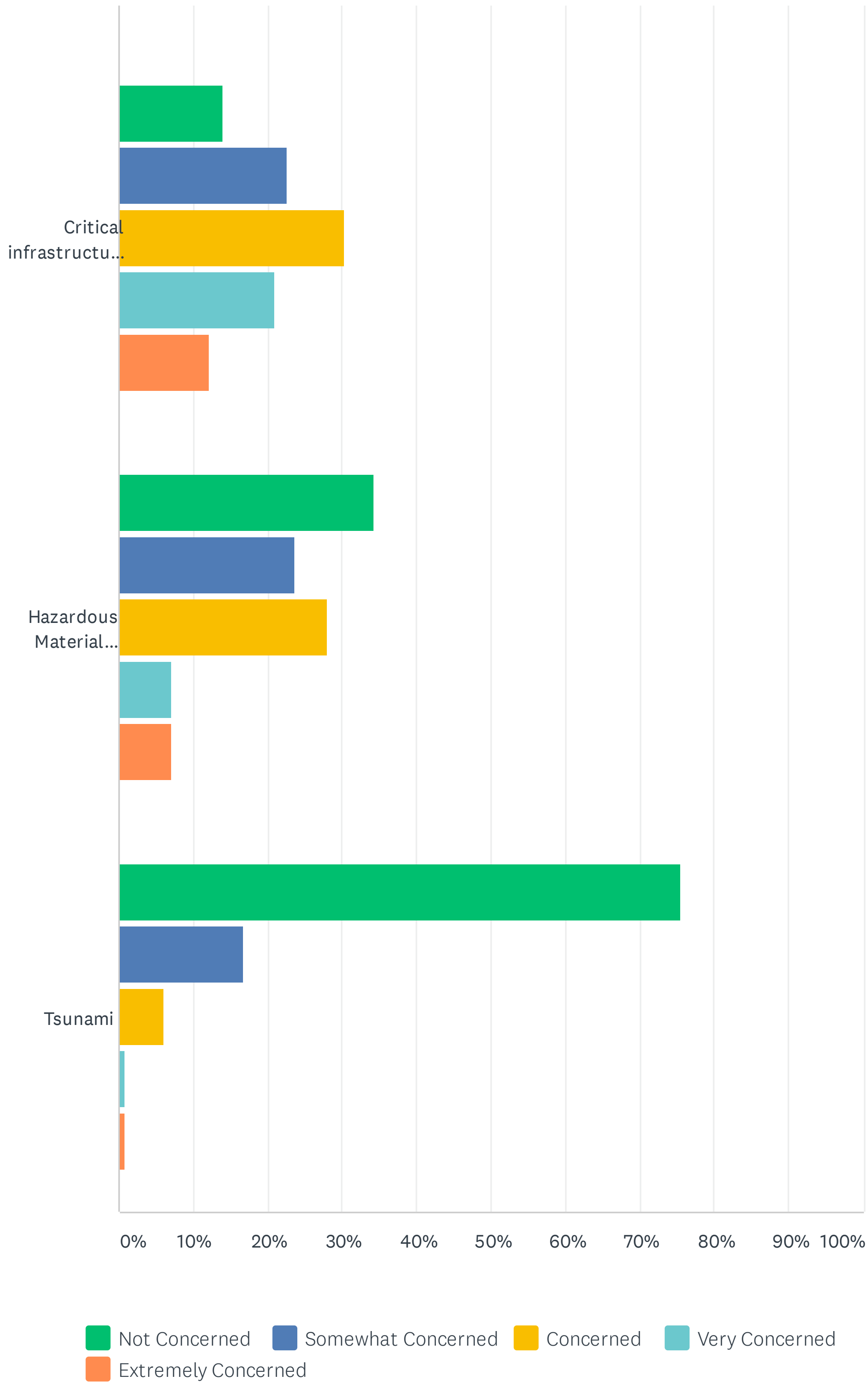
Answered: 117 Skipped: 0




Flooding
Hazardous Materials
Landslide / Debris Flow
Wildfire


Terrorism
Severe Weather
Climate Change
Cyber Attacks

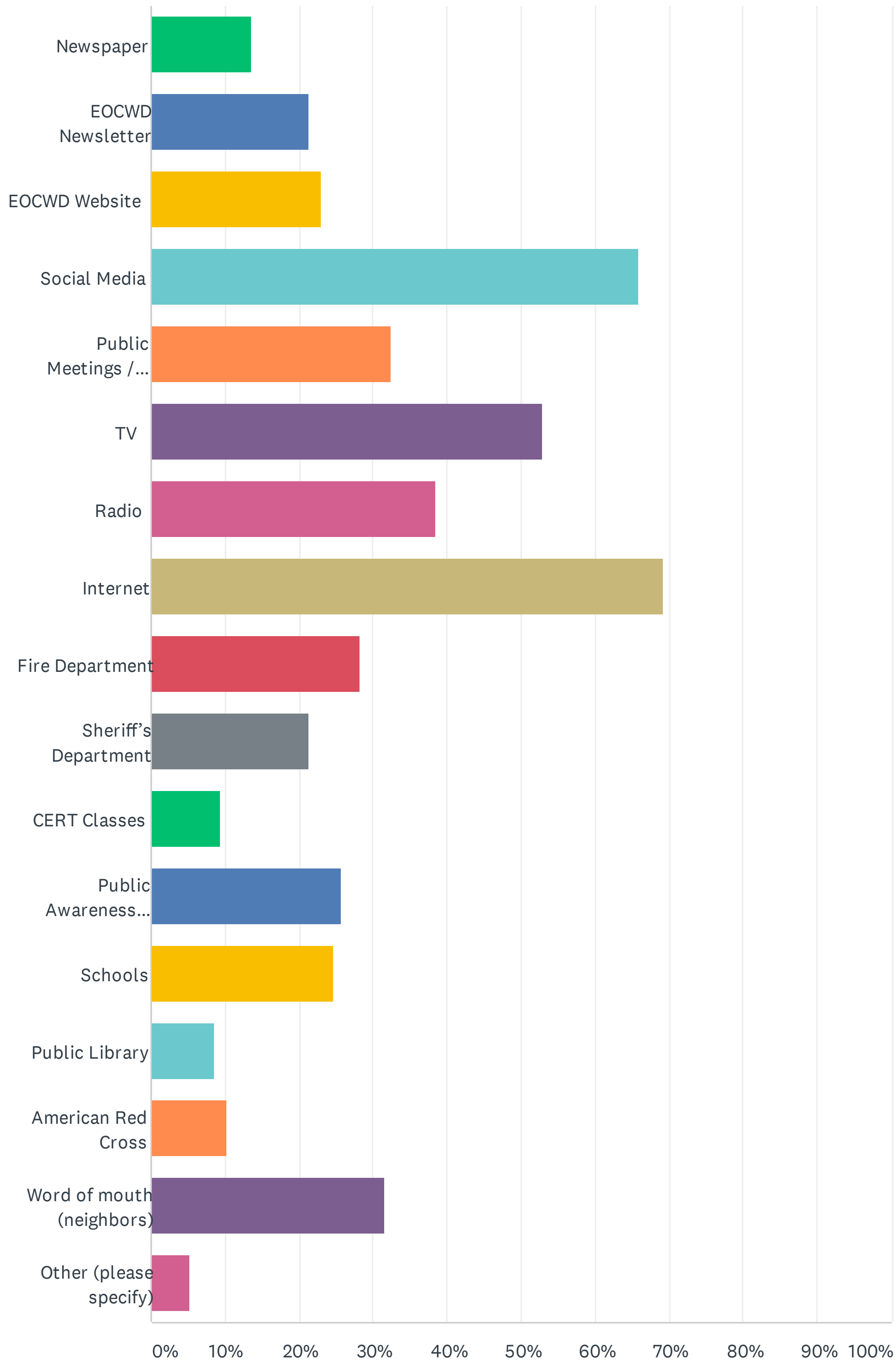
Hazard Mitigation Plan



	NOT CONCERNED	SOMEWHAT CONCERNED	CONCERNED	VERY CONCERNED	EXTREMELY CONCERNED	TOTAL	WEIGHTED AVERAGE
Dam Failure	70.18% 80	21.93% 25	5.26% 6	1.75% 2	0.88% 1	114	1.41
Pandemic	12.07% 14	15.52% 18	16.38% 19	37.93% 44	18.10% 21	116	3.34
Drought	12.28% 14	18.42% 21	30.70% 35	27.19% 31	11.40% 13	114	3.07
Earthquake	7.69% 9	19.66% 23	31.62% 37	29.06% 34	11.97% 14	117	3.18
Flooding	46.49% 53	33.33% 38	15.79% 18	2.63% 3	1.75% 2	114	1.80
Hazardous Materials	37.07% 43	28.45% 33	21.55% 25	6.90% 8	6.03% 7	116	2.16
Landslide / Debris Flow	54.31% 63	24.14% 28	14.66% 17	4.31% 5	2.59% 3	116	1.77
Wildfire	13.68% 16	17.95% 21	31.62% 37	17.09% 20	19.66% 23	117	3.11
Terrorism	30.70% 35	22.81% 26	21.93% 25	16.67% 19	7.89% 9	114	2.48
Severe Weather	29.91% 35	32.48% 38	24.79% 29	5.98% 7	6.84% 8	117	2.27
Climate Change	31.62% 37	13.68% 16	17.95% 21	17.95% 21	18.80% 22	117	2.79
Cyber Attacks	14.66% 17	23.28% 27	33.62% 39	16.38% 19	12.07% 14	116	2.88
Critical infrastructure failures	13.91% 16	22.61% 26	30.43% 35	20.87% 24	12.17% 14	115	2.95
Hazardous Material (spills or releases)	34.21% 39	23.68% 27	28.07% 32	7.02% 8	7.02% 8	114	2.29
Tsunami	75.44% 86	16.67% 19	6.14% 7	0.88% 1	0.88% 1	114	1.35

Q7 In your opinion, what are the most effective ways of providing information on emergency preparedness? (Check all that apply)

Answered: 117 Skipped: 0

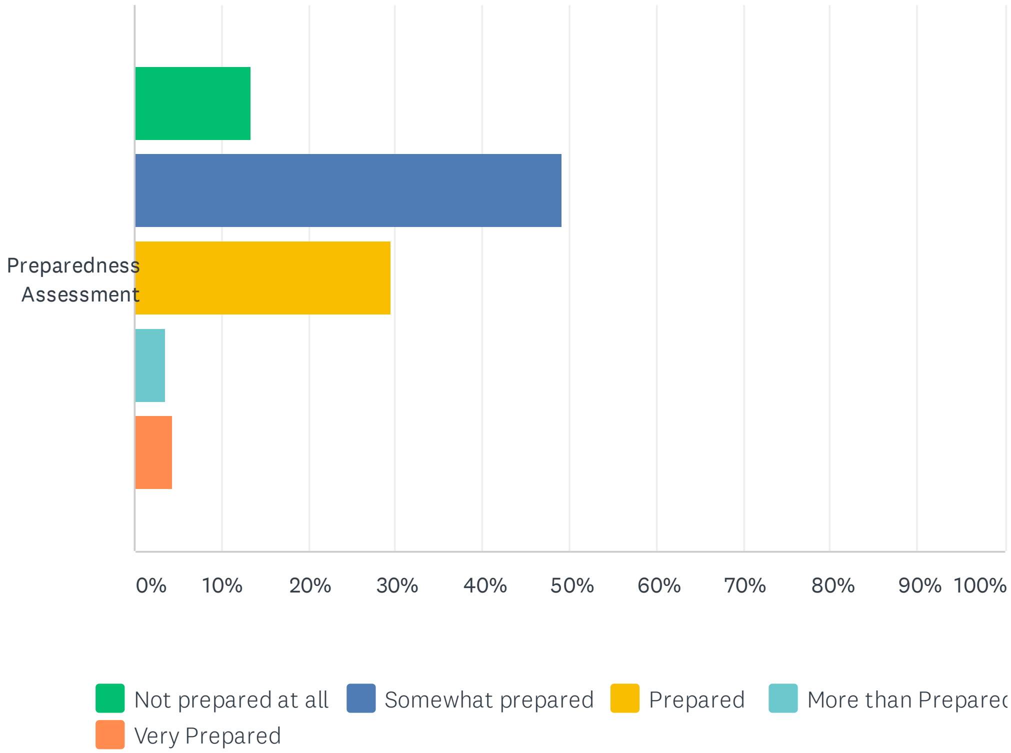

Newspaper
EOCWD Newsletter
EOCWD Website
Social Media
Public Meetings /...
TV
Radio
Internet
Fire Department
Sheriff's Department
CERT Classes
Public Awareness...
Schools
Public Library
American Red Cross
Word of mouth (neighbors)
Other (please specify)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

ANSWER CHOICES	RESPONSES	
Newspaper	13.68%	16
EOCWD Newsletter	21.37%	25
EOCWD Website	23.08%	27
Social Media	65.81%	77
Public Meetings / Workshops / Community Safety Fairs	32.48%	38
TV	52.99%	62
Radio	38.46%	45
Internet	69.23%	81
Fire Department	28.21%	33
Sheriff’s Department	21.37%	25
CERT Classes	9.40%	11
Public Awareness Campaign (e.g., Flood Awareness Week, Winter Storm PreparednessMonth)	25.64%	30
Schools	24.79%	29
Public Library	8.55%	10
American Red Cross	10.26%	12
Word of mouth (neighbors)	31.62%	37
Other (please specify)	5.13%	6
Total Respondents: 117		

#	OTHER (PLEASE SPECIFY)	DATE
1	Nextdoor neighborhood app	6/26/2020 7:02 AM
2	Common sense	6/25/2020 9:35 PM
3	Neighborhood watch	6/23/2020 5:09 PM
4	Nextdoor?	6/23/2020 2:19 PM
5	Political	6/22/2020 12:17 PM
6	Mailer/flyer with lists or quick, clear info	6/19/2020 6:59 AM

Q8 How prepared to do think EOCWD is to provide you with water service following a disaster?

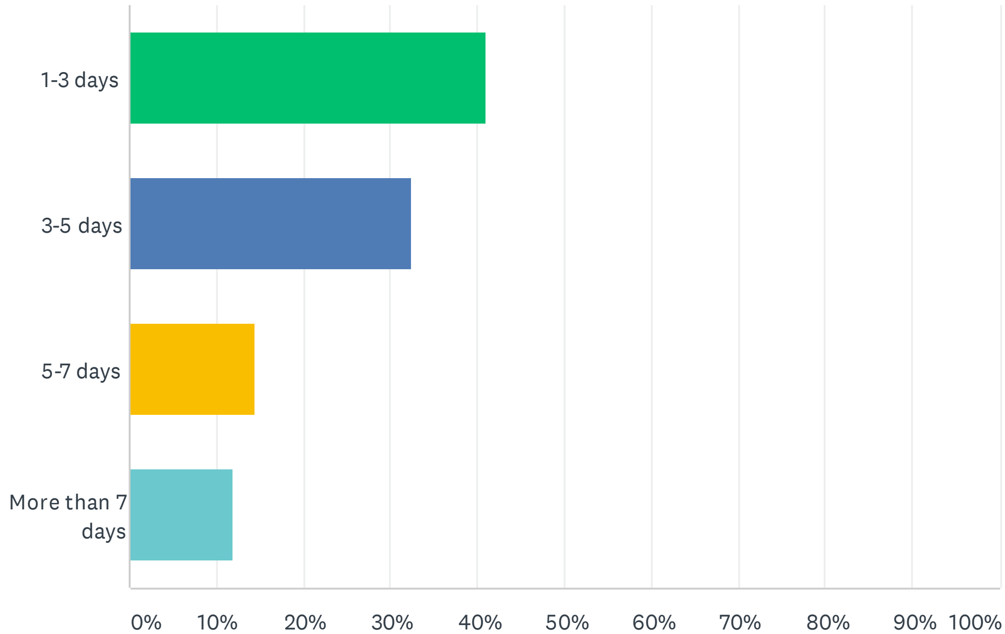
Answered: 112 Skipped: 5



	NOT PREPARED AT ALL	SOMEWHAT PREPARED	PREPARED	MORE THAN PREPARED	VERY PREPARED	TOTAL	WEIGHTED AVERAGE
Preparedness Assessment	13.39% 15	49.11% 55	29.46% 33	3.57% 4	4.46% 5	112	2.37

Q9 If water service was temporarily disrupted, how long could you continue without any drinking water? (Select One)

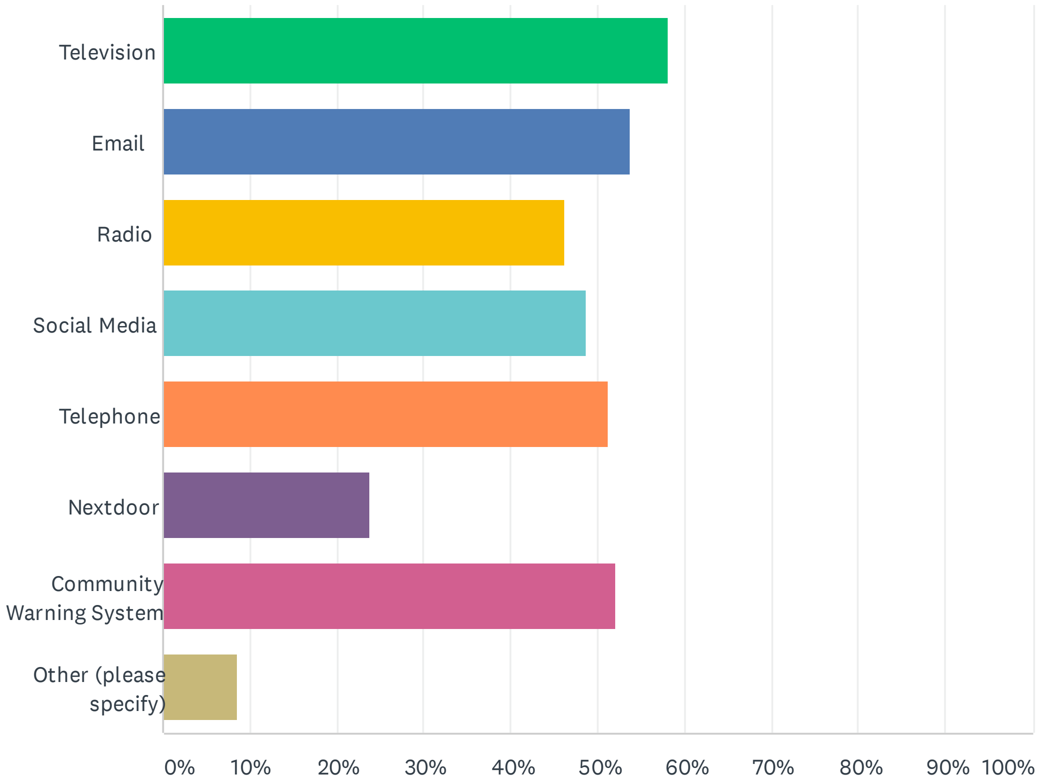
Answered: 117   Skipped: 0



ANSWER CHOICES	RESPONSES	
1-3 days	41.03%	48
3-5 days	32.48%	38
5-7 days	14.53%	17
More than 7 days	11.97%	14
TOTAL		117

Q10 How would you expect to be notified in case of an immediate threat caused by a local hazard? (Check all that apply)

Answered: 117   Skipped: 0

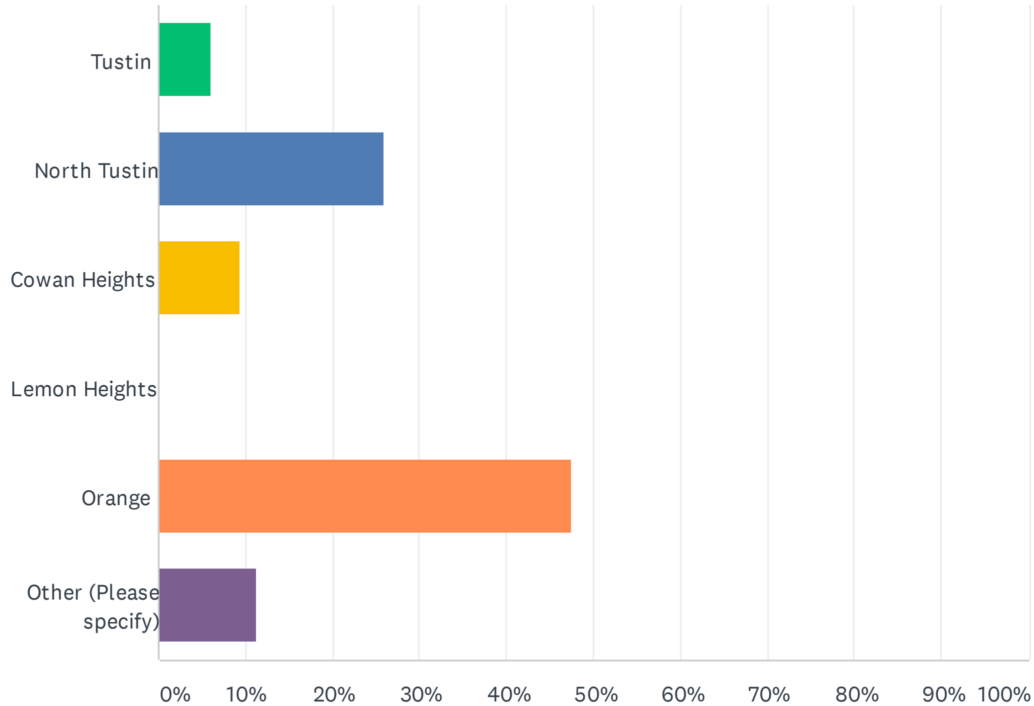


ANSWER CHOICES	RESPONSES	
Television	58.12%	68
Email	53.85%	63
Radio	46.15%	54
Social Media	48.72%	57
Telephone	51.28%	60
Nextdoor	23.93%	28
Community Warning System	52.14%	61
Other (please specify)	8.55%	10
Total Respondents: 117		

#	OTHER (PLEASE SPECIFY)	DATE
1	Text	6/26/2020 2:16 PM
2	Self awareness	6/25/2020 9:35 PM
3	Text message	6/25/2020 8:57 PM
4	Text	6/25/2020 8:39 PM
5	Oki	6/25/2020 6:35 PM
6	Text	6/25/2020 6:04 PM
7	Text	6/25/2020 5:22 PM
8	Text	6/25/2020 8:21 AM
9	it happens first then you have everyone panic	6/22/2020 12:17 PM
10	SMS (text message)	6/20/2020 11:15 PM

Q11 I live or work in: (needed for demographic data)

Answered: 116 Skipped: 1

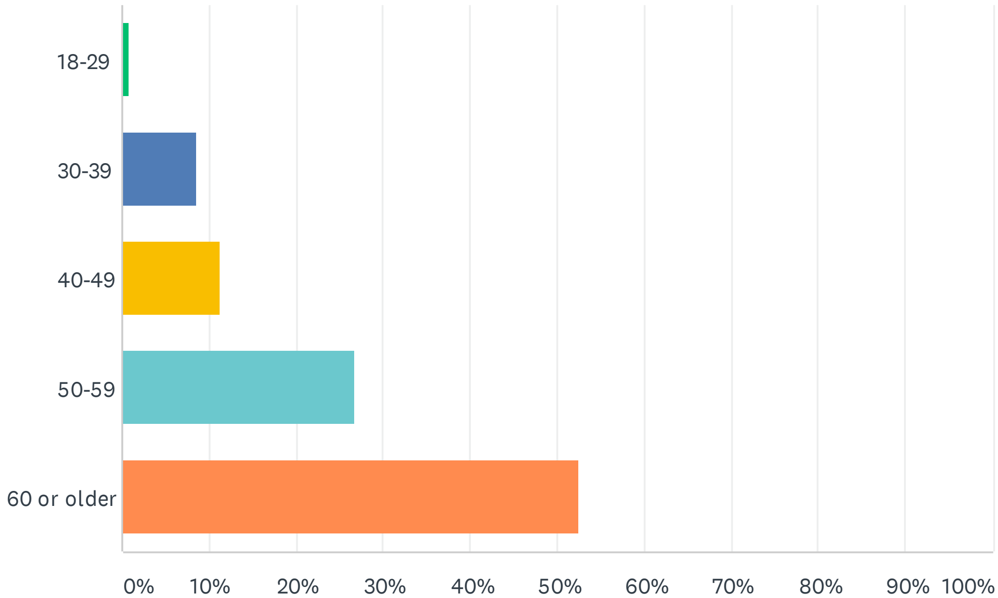


ANSWER CHOICES	RESPONSES	
Tustin	6.03%	7
North Tustin	25.86%	30
Cowan Heights	9.48%	11
Lemon Heights	0.00%	0
Orange	47.41%	55
Other (Please specify)	11.21%	13
TOTAL		116

#	OTHER (PLEASE SPECIFY)	DATE
1	North Tustin unincorporated area	6/27/2020 9:12 AM
2	Panorama Heights	6/26/2020 8:35 AM
3	south county	6/26/2020 7:40 AM
4	In incorporated orange county	6/26/2020 7:02 AM
5	N. Tustin/ nta Ana	6/25/2020 8:38 PM
6	Retired	6/25/2020 6:29 PM
7	Los Angeles	6/25/2020 5:43 PM
8	Panorama Heights!	6/25/2020 5:11 PM
9	Santa ana	6/23/2020 2:19 PM
10	Anaheim	6/23/2020 10:45 AM
11	airports and other places	6/22/2020 12:17 PM
12	Orange County	6/6/2020 4:23 PM
13	Westminster	5/25/2020 10:08 PM

Q12 What is your age range? (needed for demographic data)

Answered: 116 Skipped: 1



ANSWER CHOICES	RESPONSES	
18-29	0.86%	1
30-39	8.62%	10
40-49	11.21%	13
50-59	26.72%	31
60 or older	52.59%	61
TOTAL		116

Q13 Would you like to receive general updates on EOCWD (including the results of this survey)? If so, please type your email below.

Answered: 53 Skipped: 64

To: Lisa Ohlund, *General Manager, EOCWD*
From: Maria Gonzalez, *Account Executive, Communications LAB*
Date: Friday, August 7, 2020
Re: HMP Virtual Public Meeting Outreach and Results

At Communications LAB, we appreciate the opportunity to develop and promote your HMP Virtual Public Meeting. We conducted online outreach through social media and email, detail below. The resulting views of the meeting on both are also listed below, as well as a tally of the engagement received.

When compared with a similar public meeting which might be held in-person outside of the COVID-19 outbreak, we believe you were able to reach a significantly greater audience online.

Thank you again for the opportunity to assist East Orange County Water District.

OUTREACH

E-mail Stats:

45.3 % open rate = 272 open

EMAIL STATS

Open Rate 45.3%
Desktop 52.6% Mobile 47.4%

Click Rate 4.8%

Opens	272
Sent	618
Bounces	18
Successful Deliveries	600

Clicks	13
Did Not Open	328
Unsubscribed	1
Spam Reports	0

Website Blog Stats:

Most Recent Post

HMP Virtual Public Meeting to take place on August 4 at 6:30 p.m.
7/31/2020

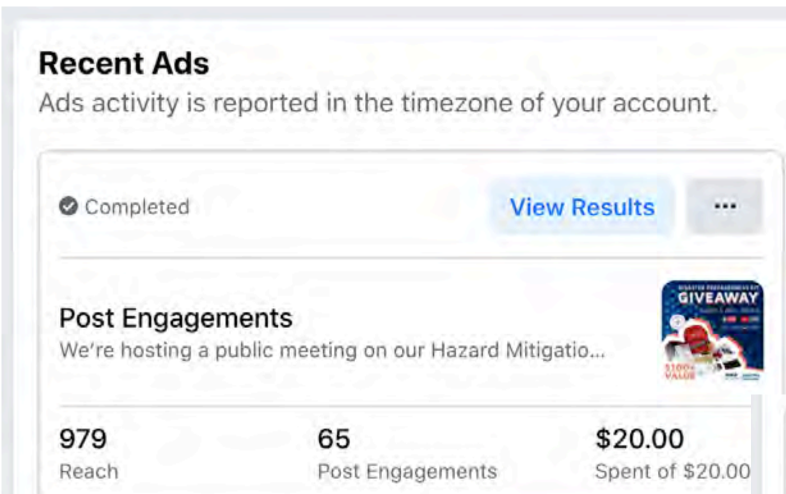
VIEWS	UNIQUE VIEWS	LIKES	SHARES
29	11	0	0

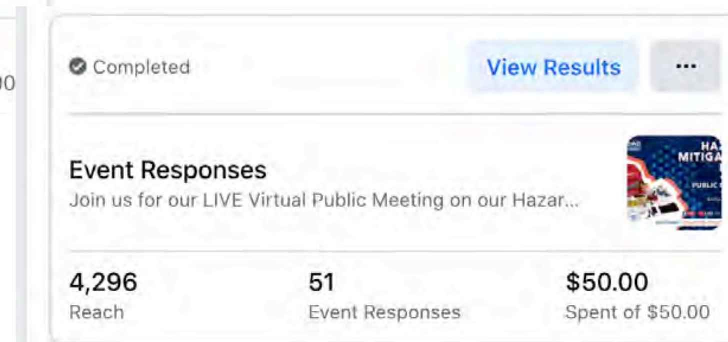
To: Lisa Ohlund, *General Manager, EOCWD*
From: Maria Gonzalez, *Account Executive, Communications LAB*
Date: Friday, August 7, 2020
Re: HMP Virtual Public Meeting Outreach and Results

Facebook (Neighborhood) Outreach:

To: Lisa Ohlund, *General Manager, EOCWD*
From: Maria Gonzalez, *Account Executive, Communications LAB*
Date: Friday, August 7, 2020
Re: HMP Virtual Public Meeting Outreach and Results

Facebook/Instagram Ads:





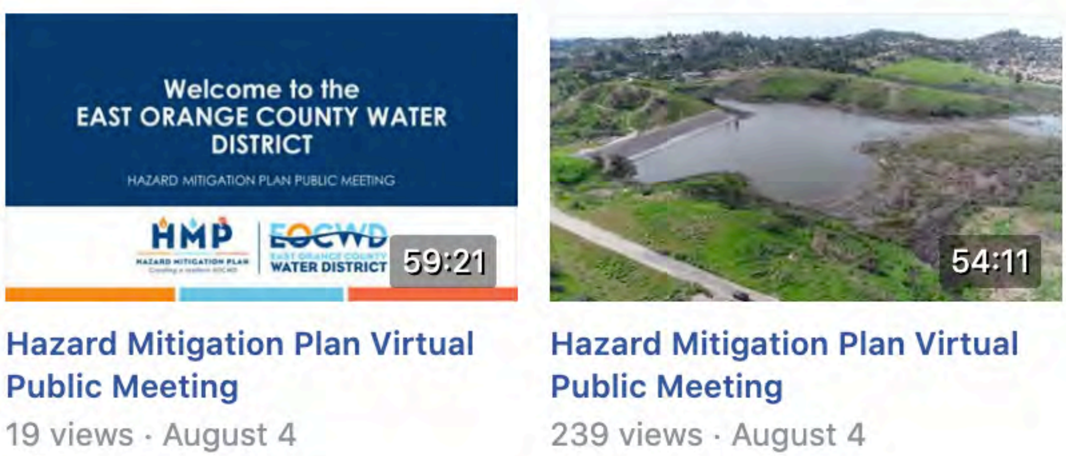
To: Lisa Ohlund, *General Manager, EOCWD*
From: Maria Gonzalez, *Account Executive, Communications LAB*
Date: Friday, August 7, 2020
Re: HMP Virtual Public Meeting Outreach and Results

RESULTS

Total views to date: 321

(views) – Youtube: 63

(views) – Facebook: 258



Sign-in tallies:
18 registered participants
View the list here: https://bit.ly/HMPList

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 the 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 regards 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 (see Section 3.7).

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

CCR 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 CCR 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),

Appendix C. Detailed Risk Assessment Results

C. Detailed Risk Assessment Results

DAM FAILURE SCENARIOS

Villa Park Dam Failure Scenario							
Facility Name	Structure Replacement Cost	Contents Replacement Cost	% Damage to Structure	% Damage to Contents	Structure Loss	Contents Loss	Total Loss
Administrative Building	$3,500,000	$500,000	31.5	46.0	$2,380,428	$282,592	$2,663,020
Employee Facility	$1,500,000	$250,000	36.5	50.5	$548,011	$252,670	$800,682
Maintenance Yard—Enclosed Storage Fac	$800,000	$600,000	13.3	49.7	$106,032	$298,064	$404,096
Retail Zone Well E1	$2,500,000	--	29.2	--	$728,930	--	$728,930
Retail Zone Well W1	$2,500,000	--	27.6	--	$690,060	--	$690,060
Total/Average	$10,800,000	$1,350,000	34.9	52.2	$4,453,461	$833,326	$5,286,788

Santiago Dam Failure Scenario							
Facility Name	Structure Replacement Cost	Contents Replacement Cost	% Damage to Structure	% Damage to Contents	Structure Loss	Contents Loss	Total Loss
Administrative Building	$3,500,000	$500,000	82.8	80.5	$2,896,861	$402,675	$3,299,536
Employee Facility	$1,500,000	$250,000	50.4	60.5	$755,444	$302,268	$1,057,712
Maintenance Yard—Enclosed Storage Fac	$800,000	$600,000	28.9	75.9	$231,519	$455,639	$687,157
Retail Zone Well E1	$2,500,000	--	30.0	--	$750,000	--	$750,000
Retail Zone Well W1	$2,500,000	--	30.0	--	$750,000	--	$750,000
Barrett Site Pump Station	$350,000		40.0	--	$140,000	--	$140,000
Total/Average	$11,150,000	$1,350,000	43.7	72.3	$5,523,824	$1,160,582	$6,684,405

EARTHQUAKE SCENARIOS

Anaheim-M6.4, Facilities										
			Probability of Damage					Losses (in Dollars)		
Facility Name	Structure Replacement Cost	Contents Replacement Cost	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Structure Damage	Contents Damage	Total Damage
Administrative Building	$3,500,000	$500,000	1.53%	17.04%	62.85%	18.31%	0.24%	$104,011	$239,099	$343,110
Employee Facility	1,500,000	$250,000	41.72%	49.15%	9.01%	0.10%	0.00%	$5,661	$27,741	$33,402
Maintenance Yard - Enclosed Storage Fac	$800,000	$600,000	0.65%	3.81%	38.21%	51.30%	6.01%	$92,027	$85,210	$177,237
Retail Zone Well E1	$2,500,000	--	2.60%	10.49%	49.30%	35.98%	1.60%	$777,688	--	$777,688
Retail Zone Well W1	$2,500,000	--	2.60%	10.49%	49.30%	35.98%	1.60%	$777,688	--	$777,688
East Well Pump Station Pump/Motor/Elect/Controls	$1,000,000	--	2.60%	10.49%	49.30%	35.98%	1.60%	$108,876	--	$108,876
West Well - Pump Station Pump Motor/Elect Controls	$5,000	--	48.86%	27.88%	21.39%	1.85%	0.00%	$57,125	--	$57,125
Vista Panorama – Pump Station	$150,000	--	30.50%	29.94%	34.50%	5.02%	0.02%	$14,556	--	$14,556
Barrett Site Pump Station	$350,000	--	48.86%	27.88%	21.39%	1.85%	0.00%	$42,844	--	$42,844
11.5 MG Andres Reservoir	$18,500,000	--	18.04%	27.00%	46.40%	8.47%	0.07%	$2,490,470	--	$2,490,470
1MG Newport Blvd Reservoir	$3,500,000	--	18.04%	27.00%	46.40%	8.47%	0.07%	$471,170	--	$471,170
Barrett Reservoir	$1,500,000	--	8.56%	19.55%	54.01%	17.54%	0.31%	$298,695	--	$298,695
6MG Peters Canyon Reservoir	$10,000,000	--	48.86%	27.88%	21.39%	1.85%	0.00%	$571,250	--	$571,250
Panorama Heights Reservoir	$1,200,000	--	17.74%	26.82%	44.99%	10.36%	0.06%	$172,386	--	$172,386
Panorama Hydro Tank	$40,000	--	17.74%	26.82%	44.99%	10.36%	0.06%	$5,746	--	$5,746
Totals/Average	$47,045,000.00	$1,350,000.00	19.31%	21.39%	37.09%	15.21%	0.73%	$5,990,193.00	$352,050.00	$6,342,243.00

Anaheim-M6.4, Pipelines

Owner	Replacement Cost	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
Potable Water Pipelines								
Retail Zone	$80,471,481	4.0	1.5	5.5	0.0	0.0	0.1	$27,264
Wholesale Zone	$35,615,601	1.4	0.5	1.8	0.0	0.0	0.0	$12,972
Total	$116,087,082	5.4	1.9	7.4	0.1	0.0	0.1	$40,237
Wastewater Pipelines								
Sewer Zone	$740,200,000	27.5	6.9	34.4	0.3	0.1	0.4	$66,649
Total	$170,212,176	27.5	6.9	34.4	0.3	0.1	0.4	$66,649

Anaheim-M6.4, Functionality

	Functionality (%)					
Facility Name	At Day 1	At Day 3	At Day 7	At Day 14	At Day 30	At Day 90
Administrative Building	39.70	41.90	86.40	86.50	95.10	99.00
Employee Facility	39.70	41.90	86.40	86.50	95.10	99.00
Maintenance Yard - Enclosed Storage Fac	0.60	0.70	4.20	4.20	40.60	93.00
Retail Zone Well E1	30.70	60.60	71.80	85.70	98.80	99.90
Retail Zone Well W1	30.70	60.60	71.80	85.70	98.80	99.90
20190305034304 - Pump Station	71.30	87.30	97.00	99.00	99.80	99.90
20190626105057 - Pump Station	71.30	87.30	97.00	99.00	99.80	99.90
20190705113621 - Pump Station	56.90	77.30	92.90	97.00	99.50	99.90
McPherson Site Pump Station	23.10	40.90	65.90	79.50	96.50	99.90
11.5 MG Andres Reservoir	37.60	68.70	89.30	92.90	93.30	95.50
1MG Newport Blvd Reservoir	32.20	56.60	72.80	76.00	77.40	84.30
Barrett Reservoir	27.00	51.80	73.10	77.10	78.50	85.30
6MG Peters Canyon Reservoir	62.30	87.30	96.80	98.40	98.50	99.00
Panorama Heights Reservoir	37.20	67.80	87.80	91.30	91.90	94.60
Panorama Hydro Tank	37.20	67.80	87.80	91.30	91.90	94.60

Whittier-M7.0, Facilities										
			Probability of Damage					Losses (in Dollars)		
Facility Name	Structure Replacement Cost	Contents Replacement Cost	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Structure Damage	Contents Damage	Total Damage
Administrative Building	$3,500,000	$500,000	0.65%	10.48%	56.55%	30.22%	2.09%	$144,030	$433,378	$577,408
Employee Facility	1,500,000	$250,000	38.55%	45.42%	8.32%	6.17%	1.51%	$18,330	$121,411	$139,741
Maintenance Yard - Enclosed Storage Fac	$800,000	$600,000	0.23%	1.77%	26.51%	58.93%	12.53%	$115,723	$172,278	$288,001
Retail Zone Well E1	$2,500,000	--	1.26%	6.52%	41.08%	46.50%	4.61%	$974,950	--	$974,950
Retail Zone Well W1	$2,500,000	--	1.26%	6.52%	41.08%	46.50%	4.61%	$974,950	--	$974,950
East Well Pump Station Pump/Motor/Elect/Controls	$1,000,000	--	1.26%	6.52%	41.08%	46.50%	4.61%	$136,493	--	$136,493
West Well - Pump Station Pump Motor/Elect Controls	$5,000	--	9.78%	21.29%	50.94%	17.74%	0.23%	$195,795	--	$195,795
Vista Panorama – Pump Station	$150,000	--	4.21%	12.59%	42.06%	36.64%	4.48%	$50,104	--	$50,104
Barrett Site Pump Station	$350,000	--	9.78%	21.29%	50.94%	17.74%	0.23%	$146,846	--	$146,846
11.5 MG Andres Reservoir	$18,500,000	--	0.65%	3.81%	38.21%	51.30%	6.01%	$7,901,720	--	$7,901,720
1MG Newport Blvd Reservoir	$3,500,000	--	1.22%	5.43%	35.66%	50.08%	7.57%	$1,513,348	--	$1,513,348
Barrett Reservoir	$1,500,000	--	1.31%	5.84%	38.36%	47.99%	6.47%	$619,650	--	$619,650
6MG Peters Canyon Reservoir	$10,000,000	--	7.33%	15.97%	38.20%	33.26%	5.21%	$3,169,450	--	$3,169,450
Panorama Heights Reservoir	$1,200,000	--	5.22%	15.60%	52.13%	26.38%	0.64%	$300,810	--	$300,810
Panorama Hydro Tank	$40,000	--	5.22%	15.60%	52.13%	26.38%	0.64%	$10,027	--	$10,027
Totals/Average	$47,045,000.00	$1,350,000.00	5.86%	12.98%	40.88%	36.16%	4.10%	$16,272,226.00	$727,067.00	$16,999,293.00

Whittier-M7.0, Pipelines								
Owner	Replacement Cost	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
Potable Water Pipelines								
Retail Zone	$80,471,481	10.9	3.8	14.7	0.1	0.1	0.2	$93,660
Wholesale Zone	$35,615,601	2.5	0.7	3.2	0.0	0.0	0.1	$30,764
Total	$116,087,082	13.4	4.5	17.9	0.2	0.1	0.3	$124,424
Wastewater Pipelines								
Sewer Zone	$740,200,000	44.8	11.2	56.0	0.4	0.2	0.7	$107,179
Total	$170,212,176	44.8	11.2	56.0	0.4	0.2	0.7	$107,179

Whittier-M7.0, Functionality						
	Functionality (%)					
Facility Name	At Day 1	At Day 3	At Day 7	At Day 14	At Day 30	At Day 90
Administrative Building	0.60	1.10	11.10	11.10	67.60	97.90
Employee Facility	38.50	40.70	83.80	83.90	92.20	98.40
Maintenance Yard - Enclosed Storage Fac	0.20	0.30	1.90	2.00	28.50	87.40
Retail Zone Well E1	25.50	52.10	64.10	81.30	97.90	99.90
Retail Zone Well W1	25.50	52.10	64.10	81.30	97.90	99.90
20190305034304 - Pump Station	19.30	34.70	58.00	73.50	94.80	99.90
20190626105057 - Pump Station	36.20	58.40	82.80	91.20	98.90	99.90
20190705113621 - Pump Station	25.30	42.70	65.40	78.40	95.40	99.90
McPherson Site Pump Station	36.20	58.40	82.80	91.20	98.90	99.90
11.5 MG Andres Reservoir	17.90	31.00	48.40	52.40	55.30	69.30
1MG Newport Blvd Reservoir	18.40	31.90	48.20	52.00	54.90	68.80
Barrett Reservoir	18.80	33.30	50.80	54.70	57.40	70.70
6MG Peters Canyon Reservoir	25.70	47.10	64.40	67.90	69.90	79.10
Panorama Heights Reservoir	25.10	50.00	73.20	77.60	79.00	85.90
Panorama Hydro Tank	25.10	50.00	73.20	77.60	79.00	85.90

Peralta Hills-M6.6, Facilities										
			Probability of Damage					Losses (in Dollars)		
Facility Name	Structure Replacement Cost	Contents Replacement Cost	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complet e Damage	Structure Damage	Contents Damage	Total Damage
Administrative Building	$3,500,000	$500,000	0.03%	1.59%	33.26%	57.17%	7.92%	$241,867	$797,112	$1,038,979
Employee Facility	1,500,000	$250,000	16.64%	50.57%	22.14%	8.64%	2.00%	$27,546	$175,238	$202,784
Maintenance Yard - Enclosed Storage Fac	$800,000	$600,000	0.01%	0.09%	5.51%	47.60%	46.76%	$184,306	$417,609	$601,915
Retail Zone Well E1	$2,500,000	--	0.06%	0.78%	16.79%	58.93%	23.40%	$1,532,888	--	$1,532,888
Retail Zone Well W1	$2,500,000	--	0.06%	0.78%	16.79%	58.93%	23.40%	$1,532,888	--	$1,532,888
East Well Pump Station Pump/Motor/Elect/Controls	$1,000,000	--	0.06%	0.78%	16.79%	58.93%	23.40%	$214,604	--	$214,604
West Well - Pump Station Pump Motor/Elect Controls	$5,000	--	5.22%	15.60%	52.13%	26.38%	0.64%	$250,675	--	$250,675
Vista Panorama – Pump Station	$150,000	--	1.09%	5.65%	35.58%	50.65%	7.01%	$64,529	--	$64,529
Barrett Site Pump Station	$350,000	--	5.22%	15.60%	52.13%	26.38%	0.64%	$188,006	--	$188,006
11.5 MG Andres Reservoir	$18,500,000	--	0.25%	1.92%	28.65%	57.95%	11.20%	$9,317,248	--	$9,317,248
1MG Newport Blvd Reservoir	$3,500,000	--	0.19%	1.44%	21.51%	61.21%	15.62%	$1,947,558	--	$1,947,558
Barrett Reservoir	$1,500,000	--	0.08%	0.75%	16.40%	61.29%	21.45%	$910,823	--	$910,823
6MG Peters Canyon Reservoir	$10,000,000	--	3.91%	11.70%	39.10%	39.66%	5.61%	$3,585,600	--	$3,585,600
Panorama Heights Reservoir	$1,200,000	--	0.65%	4.32%	37.65%	51.41%	5.94%	$511,794	--	$511,794
Panorama Hydro Tank	$40,000	--	0.65%	4.32%	37.65%	51.41%	5.94%	$17,060	--	$17,060
Totals/Average	$47,045,000.00	$1,350,000.00	2.27%	7.73%	28.81%	47.77%	13.40%	$20,527,392.00	$1,389,959.00	$21,917,351.00

Peralta Hills-M6.6, Pipelines								
Owner	Replacement Cost	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
Potable Water Pipelines								
Retail Zone	$80,471,481	16.9	6.0	22.9	0.2	0.1	0.4	$152,339
Wholesale Zone	$35,615,601	3.5	1.1	4.6	0.1	0.0	0.1	$41,720
Total	$116,087,082	20.3	7.1	27.5	0.3	0.2	0.5	$194,059
Wastewater Pipelines								
Sewer Zone	$740,200,000	63.6	15.9	79.6	0.6	0.3	1.0	$150,885
Total	$170,212,176	63.6	15.9	79.6	0.6	0.3	1.0	$150,885

Peralta Hills-M6.6, Functionality						
	Functionality (%)					
Facility Name	At Day 1	At Day 3	At Day 7	At Day 14	At Day 30	At Day 90
Administrative Building	0.00	0.10	1.60	1.60	34.80	92.00
Employee Facility	16.60	19.00	67.00	67.20	89.30	97.90
Maintenance Yard - Enclosed Storage Fac	0.00	0.00	0.00	0.10	5.60	53.20
Retail Zone Well E1	13.30	26.30	38.50	62.20	90.60	99.90
Retail Zone Well W1	13.30	26.30	38.50	62.20	90.60	99.90
20190305034304 - Pump Station	11.10	18.50	32.90	51.10	82.70	99.90
20190626105057 - Pump Station	29.20	50.00	75.90	86.70	98.20	99.90
20190705113621 - Pump Station	17.90	31.70	53.10	69.50	93.10	99.90
McPherson Site Pump Station	29.20	50.00	75.90	86.70	98.20	99.90
11.5 MG Andres Reservoir	16.30	25.60	38.90	42.30	45.70	62.20
1MG Newport Blvd Reservoir	15.40	22.50	32.70	35.80	39.50	57.40
Barrett Reservoir	14.50	19.80	27.80	30.60	34.40	53.30
6MG Peters Canyon Reservoir	22.10	40.90	58.50	62.30	64.60	75.60
Panorama Heights Reservoir	17.90	31.20	48.40	52.40	55.20	69.30
Panorama Hydro Tank	17.90	31.20	48.40	52.40	55.20	69.30

Newport/Inglewood-M7.2, Facilities											
			Probability of Damage					Losses (in Dollars)			
Facility Name	Structure Replacement Cost	Contents Replacement Cost	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Structure Damage	Contents Damage	Total Damage
Administrative Building	$3,500,000	$500,000	6.70%	32.04%	52.02%	8.59%	0.63%	$75,510	$203,817	$279,327
Employee Facility	1,500,000	$250,000	57.67%	35.60%	3.69%	2.42%	0.59%	$8,372	$64,790	$73,162
Maintenance Yard - Enclosed Storage Fac	$800,000	$600,000	1.58%	7.03%	46.13%	41.94%	3.29%	$75,029	$78,259	$153,288
Retail Zone Well E1	$2,500,000	--	7.70%	18.75%	50.28%	22.32%	0.92%	$569,788	--	$569,788
Retail Zone Well W1	$2,500,000	--	7.70%	18.75%	50.28%	22.32%	0.92%	$569,788	--	$569,788
East Well Pump Station Pump/Motor/Elect/Controls	$1,000,000	--	7.70%	18.75%	50.28%	22.32%	0.92%	$79,770	--	$79,770
West Well - Pump Station Pump Motor/Elect Controls	$5,000	--	48.86%	27.88%	21.39%	1.85%	0.00%	$57,125	--	$57,125
Vista Panorama – Pump Station	$150,000	--	34.95%	28.99%	29.24%	6.15%	0.65%	$15,263	--	$15,263
Barrett Site Pump Station	$350,000	--	48.86%	27.88%	21.39%	1.85%	0.00%	$42,844	--	$42,844
11.5 MG Andres Reservoir	$18,500,000	--	18.04%	27.00%	46.40%	8.47%	0.07%	$2,490,470	--	$2,490,470
1MG Newport Blvd Reservoir	$3,500,000	--	13.67%	20.46%	35.16%	25.78%	4.91%	$933,625	--	$933,625
Barrett Reservoir	$1,500,000	--	8.28%	18.93%	52.29%	19.53%	0.95%	$321,870	--	$321,870
6MG Peters Canyon Reservoir	$10,000,000	--	41.85%	23.88%	18.32%	13.06%	2.86%	$1,463,800	--	$1,463,800
Panorama Heights Reservoir	$1,200,000	--	24.40%	29.08%	39.44%	7.02%	0.03%	$139,344	--	$139,344
Panorama Hydro Tank	$40,000	--	24.40%	29.08%	39.44%	7.02%	0.03%	$4,645	--	$4,645
Totals/Average	$47,045,000.00	$1,350,000.00	23.49%	24.27%	37.05%	14.04%	1.12%	$6,847,243.00	$346,866.00	$7,194,109.00

Newport/Inglewood-M7.2, Pipelines								
Owner	Replacement Cost	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
Potable Water Pipelines								
Retail Zone	$80,471,481	5.2	1.9	7.1	0.1	0.0	0.1	$35,119
Wholesale Zone	$35,615,601	1.7	0.5	2.2	0.0	0.0	0.0	$16,226
Total	$116,087,082	**7.0**	**2.4**	**9.4**	**0.1**	**0.1**	**0.1**	**$51,345**
Wastewater Pipelines								
Sewer Zone	$740,200,000	41.5	10.4	51.9	0.4	0.2	0.6	$102,366
Total	$170,212,176	**41.5**	**10.4**	**51.9**	**0.4**	**0.2**	**0.6**	**$102,366**

Newport/Inglewood-M7.2, Functionality						
	Functionality (%)					
Facility Name	At Day 1	At Day 3	At Day 7	At Day 14	At Day 30	At Day 90
Administrative Building	57.60	59.30	93.10	93.20	96.90	99.30
Employee Facility	57.60	59.30	93.10	93.20	96.90	99.30
Maintenance Yard - Enclosed Storage Fac	1.50	1.90	8.50	8.60	54.70	96.60
Retail Zone Well E1	42.80	75.00	83.90	92.00	99.50	99.90
Retail Zone Well W1	42.80	75.00	83.90	92.00	99.50	99.90
20190305034304 - Pump Station	71.30	87.30	97.00	99.00	99.80	99.90
20190626105057 - Pump Station	71.30	87.30	97.00	99.00	99.80	99.90
20190705113621 - Pump Station	60.20	79.00	92.60	96.40	99.20	99.90
McPherson Site Pump Station	32.80	54.10	78.80	88.40	98.30	99.90
11.5 MG Andres Reservoir	37.60	68.70	89.30	92.90	93.30	95.50
1MG Newport Blvd Reservoir	31.70	55.40	71.20	74.40	75.90	83.20
Barrett Reservoir	28.30	55.50	78.70	83.00	84.10	89.20
6MG Peters Canyon Reservoir	62.30	87.30	96.80	98.40	98.50	99.00
Panorama Heights Reservoir	42.90	73.60	91.00	94.10	94.50	96.30
Panorama Hydro Tank	42.90	73.60	91.00	94.10	94.50	96.30

500-year Probabilistic, Facilities											
			Probability of Damage					Losses (in Dollars)		
Facility Name	Structure Replacement Cost	Contents Replacement Cost	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Structure Damage	Contents Damage	Total Damage
Administrative Building	$3,500,000	$500,000	1.35%	15.20%	56.56%	24.62%	2.24%	$131,672	$425,963	$557,635
Employee Facility	1,500,000	$250,000	25.23%	49.84%	14.64%	8.27%	2.00%	$24,832	$170,938	$195,770
Maintenance Yard - Enclosed Storage Fac	$800,000	$600,000	0.57%	3.40%	34.28%	53.78%	7.94%	$99,218	$151,750	$250,968
Retail Zone Well E1	$2,500,000	--	10.62%	11.87%	29.05%	37.86%	10.57%	$955,925	--	$955,925
Retail Zone Well W1	$2,500,000	--	10.62%	11.87%	29.05%	37.86%	10.57%	$955,925	--	$955,925
East Well Pump Station Pump/Motor/Elect/Controls	$1,000,000	--	10.62%	11.87%	29.05%	37.86%	10.57%	$133,830	--	$133,830
West Well - Pump Station Pump Motor/Elect Controls	$5,000	--	9.42%	11.44%	29.79%	37.68%	11.65%	$392,985	--	$392,985
Vista Panorama – Pump Station	$150,000	--	9.44%	10.55%	25.82%	41.77%	12.39%	$62,779	--	$62,779
Barrett Site Pump Station	$350,000	--	9.42%	11.44%	29.79%	37.68%	11.65%	$294,739	--	$294,739
11.5 MG Andres Reservoir	$18,500,000	--	6.19%	8.21%	29.46%	39.04%	17.08%	$8,386,698	---	$8,386,698
1MG Newport Blvd Reservoir	$3,500,000	--	4.80%	6.38%	22.89%	45.23%	20.68%	$1,804,968	--	$1,804,968
Barrett Reservoir	$1,500,000	--	5.13%	6.80%	24.41%	43.79%	19.84%	$751,733	--	$751,733
6MG Peters Canyon Reservoir	$10,000,000	--	7.06%	8.58%	22.34%	45.93%	16.06%	$4,739,801	--	$4,739,801
Panorama Heights Reservoir	$1,200,000	--	11.80%	13.19%	32.28%	33.96%	8.74%	$415,410	--	$415,410
Panorama Hydro Tank	$40,000	--	11.80%	13.19%	32.28%	33.96%	8.74%	$13,847	--	$13,847
Totals/Average	$47,045,000.00	$1,350,000.00	8.94%	12.92%	29.45%	37.29%	11.38%	$19,164,362.00	$748,651.00	$19,913,013.00

500-Year Probabilistic, Pipelines

Owner	Replacement Cost	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
Potable Water Pipelines								
Retail Zone	$80,471,481	16.0	7.5	23.5	0.2	0.2	0.4	$134,488
Wholesale Zone	$35,615,601	4.2	1.4	5.6	0.1	0.0	0.1	$53,856
Total	$116,087,082	20.2	8.9	29.2	0.3	0.2	0.5	$188,344
Wastewater Pipelines								
Sewer Zone	$740,200,000	0.1	0.0	0.1	0.0	0.0	0.0	$258
Total	$170,212,176	0.1	0.0	0.1	0.0	0.0	0.0	$258

500-Year Probabilistic, Functionality

	Functionality (%)					
Facility Name	At Day 1	At Day 3	At Day 7	At Day 14	At Day 30	At Day 90
Administrative Building	30.30	31.90	63.40	63.50	85.10	97.40
Employee Facility	30.30	31.90	63.40	63.50	85.10	97.40
Maintenance Yard - Enclosed Storage Fac	1.70	1.90	5.10	5.10	23.50	63.80
Retail Zone Well E1	23.70	41.10	51.30	68.60	91.00	99.90
Retail Zone Well W1	23.70	41.10	51.30	68.60	91.00	99.90
20190305034304 - Pump Station	18.00	28.80	44.50	58.40	82.60	99.90
20190626105057 - Pump Station	18.00	28.80	44.50	58.40	82.60	99.90
20190705113621 - Pump Station	29.10	42.10	58.30	71.40	91.60	99.90
McPherson Site Pump Station	19.20	30.30	46.20	60.30	84.20	99.90
11.5 MG Andres Reservoir	16.20	24.10	33.30	35.90	39.00	54.40
1MG Newport Blvd Reservoir	15.40	21.70	29.10	31.60	34.90	51.30
Barrett Reservoir	22.30	35.00	47.00	50.00	52.80	66.20
6MG Peters Canyon Reservoir	19.00	30.30	41.60	44.50	47.40	61.40
Panorama Heights Reservoir	31.10	50.00	64.80	67.90	69.80	78.90
Panorama Hydro Tank	31.10	50.00	64.80	67.90	69.80	78.90

MEMO

TO: BOARD OF DIRECTORS

FROM: GENERAL MANAGER

SUBJECT: DELEGATION OF AUTHORITY – MUNICIPAL WATER DISTRICT OF ORANGE COUNTY ("MWDOC") COMMON INTEREST AGREEMENT

DATE: OCTOBER 22, 2020

BACKGROUND

On or about September 29, 2020, EOCWD, along with all other agencies participating in the Allen McColloch Pipeline (collectively, "Participating Agencies"), received a memorandum from the Municipal Water District of Orange County ("MWDOC"), seeking to enter into a common interest arrangement with the Participating Agencies, so that MWDOC can share certain confidential information. Approval of this item would delegate authority to the General Manager to, for this matter, approve and execute a Common Interest Agreement with MWDOC.

FINANCIAL IMPACT

None

RECOMMENDATION

The Board approve the delegation of authority to the General Manager to approve and execute a Common Interest Agreement with MWDOC as necessary to efficiently collaborate with similarly-situated parties engaged in legal matters.

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