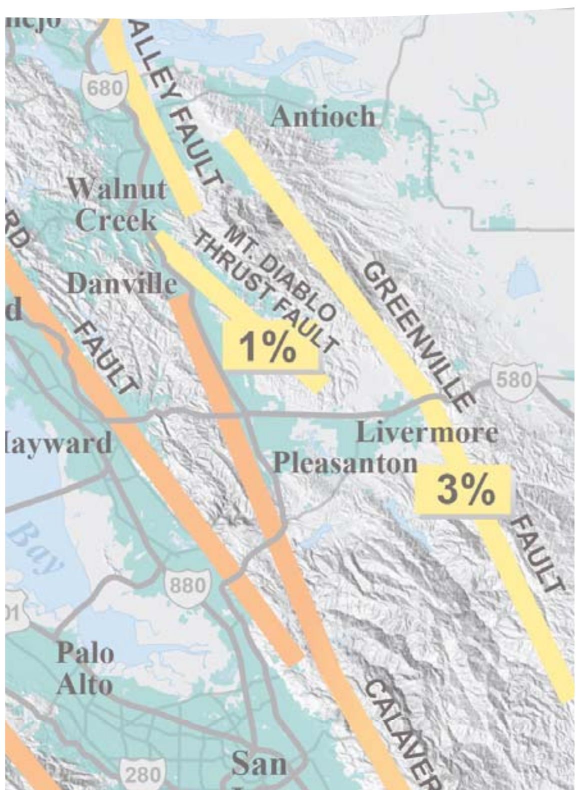
THE CITY OF PLEASANTON

LIVERMORE CALIFORNIA

DUBLIN CALIFORNIA

TRI-VALLEY LOCAL HAZARD MITIGATION PLAN

Volume 1—Planning Area-Wide Elements



September 2018

TETRA TECH

Tri-Valley Local Hazard Mitigation Plan

Volume 1—Planning-Area-Wide Elements

September 2018

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CONTENTS

Appendices

Tables

Figures

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EXECUTIVE SUMMARY

HAZARD MITIGATION OVERVIEW

Hazard mitigation is the use of policies, programs, projects, and other activities to alleviate the death, injury, and property damage that can result from a disaster. The Cities of Dublin, Livermore and Pleasanton, along with the Dublin San Ramon Services District (the Tri-Valley Planning Partnership), have collaborated to develop a hazard mitigation plan to reduce risks from natural disasters that complies with federal requirements for hazard mitigation planning.

In 2004, the Association of Bay Area Governments (ABAG) led a regional hazard mitigation planning effort for jurisdictions within its area of responsibility. Numerous Bay-area counties and cities used ABAG's template to meet federal hazard mitigation planning requirements. In 2010, ABAG conducted its second regional planning effort. The Tri-Valley planning partners used the 2010 updated ABAG tools to meet federal hazard mitigation planning requirements.

Federal regulations require periodic updates of hazard mitigation plans. A jurisdiction covered by a plan that has expired is ineligible for certain federal natural disaster assistance funding. In 2017, the Tri-Valley Planning Partnership formed to prepare an updated multi-jurisdiction hazard mitigation plan that best suits local needs and capabilities. The planning partners developed a new plan from scratch, using lessons learned from the earlier ABAG planning efforts. The 2017 plan is an update for each member of the Tri-Valley Planning Partnership. It differs from previous plans in the following ways:

- The updated plan is not a subset of a larger regional effort. It focuses on the geographic region of Dublin, Livermore, Pleasanton and the jurisdictional boundaries for the Dublin/San Ramon Services District (the Tri-Valley planning area).
- The focus of this plan is for the hazards of concern that impact the Tri-Valley planning area.
- Newly available data and tools provide for a more detailed and accurate risk assessment.
- The risk assessment has been formatted to provide information on risk and vulnerability that will allow a measurement of cost-effectiveness, as required under Federal Emergency Management Agency (FEMA) mitigation grant programs.
- The update gave the planning partners an opportunity to engage local citizens and gauge their perception of risk and support for risk reduction through mitigation.

PLAN DEVELOPMENT APPROACH

Organize, Review and Engage the Public

A planning team assembled for the plan update conducted outreach to invite the participation of local planning partners. A 20-member steering committee was assembled to oversee the plan update, consisting of staff from each of the planning partners, citizens, and other stakeholders in the defined planning area. Coordination with other county, state, and federal agencies involved in hazard mitigation occurred throughout the plan update process.

The planning team implemented a public involvement strategy developed by the Steering Committee. The strategy included public meetings to present the risk assessment and the draft plan, a hazard mitigation survey, a project website, and multiple media releases. The planning team and Steering Committee also reviewed the existing hazard mitigation plan, the California statewide hazard mitigation plan, and existing programs that may support hazard mitigation actions.

Assemble, Adopt and Maintain the Plan

The planning team and Steering Committee assembled a document to meet federal hazard mitigation planning requirements. A mitigation plan review crosswalk included in the hazard mitigation plan demonstrates its compliance with all requirements. The planning partners will formally adopt the plan once the State of California Governor's Office of Emergency Services and FEMA Region IX have granted pre-adoption approval.

The plan includes a schedule for monitoring and evaluating plan progress periodically and producing a revised plan every five years. This maintenance strategy also includes processes for continuing public involvement and integrating with other programs that can support or enhance hazard mitigation.

RISK ASSESSMENT

Risk assessment is the process of measuring the potential loss of life resulting from natural hazards, as well as personal injury, economic injury and property damage. It is used to define the vulnerability of people, buildings, and infrastructure to natural hazards. For this update, risk assessment models were enhanced with new data and technologies that have become available since the ABAG planning effort in 2010. The Steering Committee used the risk assessment to rank risk and to gauge the potential impacts of each hazard of concern in the Tri-Valley planning area. The risk assessment included the following:

- Hazard identification and profiling
- Assessment of the impact of hazards on physical, social, and economic assets
- Identification of particular areas of vulnerability
- Estimates of the cost of potential damage.

Based on the risk assessment, hazards were ranked for the risk they pose to the overall planning area, as shown in Table ES-1. Each planning partner also ranked hazards for its own area. Table ES-2 summarizes all jurisdictions' numerical ratings of high, medium and low. The results indicate the following general patterns:

- The earthquake hazard was most commonly ranked as high.
- The severe weather, wildfire and landslide hazards were most commonly ranked as medium.
- The dam failure, flood and drought hazards were most commonly ranked as low.

Table ES-1. Hazard Risk Ranking for the Overall Planning Area

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

Table ES-2. Summary of Hazard Ranking Result by Individual Planning Partners

	Number of Jurisdictions Assigning Ranking to Hazard		
	High	Medium	Low
Dam Failure	0	1	3
Drought	0	1	3
Earthquake	4	0	0
Flood	0	1	3
Landslide	2	2	0
Severe weather	0	4	0
Wildfire	1	3	0

MITIGATION PRINCIPLE, GOALS AND OBJECTIVES

The Steering Committee developed the following guiding principle for the 2017 planning effort:

> Through community partnerships, establish a plan to reduce the vulnerability to hazards in order to protect the health, safety, welfare, environment and economy of the planning area.

The Steering Committee established the following goals for the plan update:

1. Ensure that hazards are identified and considered in land use decisions.
2. Improve local emergency management capability.
3. Promote community awareness, understanding, and interest in hazard mitigation policies and programs.
4. Incorporate hazard mitigation as an integrated public policy and standard practice.
5. Reduce community exposure and vulnerability to hazards where the greatest risk exists.
6. Increase resilience of infrastructure and critical facilities.
7. Promote an adaptive and resilient planning area that responds proactively to future conditions.
8. Develop and implement mitigation strategies that identify the best alternative to protect natural resources, promote equity, and use public funds in an efficient and cost-effective manner.

The objectives listed in Table ES-3 were identified to meet multiple goals, helping to establish priorities for recommended mitigation actions.

MITIGATION ACTION PLAN

The planning partnership selected a range of mitigation actions to work toward achieving the goals set forth in this plan update. The recommended mitigation actions are activities designed to reduce or eliminate losses resulting from natural hazards. The update process resulted in the identification of 73 mitigation actions for implementation by individual planning partners, as presented in Volume 2 of the hazard mitigation plan. In addition, the Steering Committee identified planning-area-wide actions benefiting the whole partnership, as listed in Table ES-4.

Table ES-3. Objectives for 2017 Hazard Mitigation Plan

Number	Objective	Applicable Goals
1	Develop and provide updated information to improve the understanding of the locations, potential impacts, and linkages among threats, hazards, vulnerability, and measures needed to protect life safety health, property and the environment.	3, 5, 7
2	Use local general plan, zoning, and subdivision requirements to help establish resilient and sustainable communities.	1, 3, 4, 5, 7, 8
3	Improve systems that provide warning and emergency communications.	2, 3
4	Encourage the retrofit of vulnerable structures in the planning area.	5, 6
5	Consider programs that incentivize risk reduction.	3, 4, 5
6	Reduce repetitive property losses due to all hazards by updating land use, design, and construction policies.	3, 4, 5, 6
7	Continually build linkages and promote dialog about emergency management within the public and private sectors.	2, 3, 4
8	Incorporate risk reduction considerations in new and updated infrastructure and development plans to reduce the impacts of natural hazards.	4, 5, 6
9	Inform the public, including underrepresented community groups, on the risk of exposure to natural hazards and ways to increase the public's capability to prepare for, respond to, recover from, and mitigate the impacts of these events.	3, 4, 5
10	Identify projects that simultaneously reduce risk while increasing planning area resilience and sustainability.	5, 6, 7
11	Where feasible and cost-effective, research, develop, and promote adoption of building and development laws, regulations, and ordinances exceeding the minimum levels needed for life safety.	1.4.8
12	Encourage hazard mitigation measures that promote and enhance natural processes, minimize adverse impacts on the ecosystem, and promote social equity.	3, 5, 8

Table ES-4. Planning-Area-Wide Hazard Mitigation Actions

Action Number and Description	Priority
Action AW-1— Continue to maintain a planning area-wide hazard mitigation website that will store the hazard mitigation plan and provide the public an opportunity to monitor plan implementation progress. Each planning partner can support this action by including an action in its own action plan of creating a link to the planning-area-wide hazard mitigation website.	High
Action AW-2— Leverage public outreach partnering capabilities in the planning area (such as Community Emergency Response Teams) to promote a uniform and consistent message on the importance of proactive hazard mitigation.	High
Action AW-3— Coordinate mitigation planning and project efforts in the planning area to leverage all resources available to the planning partnership.	High
Action AW-4— Where appropriate, support retrofitting, purchase, or relocation of structures in hazard-prone areas to protect the structures from future damage, with repetitive loss and severe repetitive loss properties as a priority. Seek opportunities to leverage partnerships in the planning area in these pursuits.	Medium
Action AW-5— Continue to update hazard mapping with best available data and science as it evolves, within the capabilities of the partnership. Support FEMA's RiskMAP initiative.	High
Action AW-6— To the extent possible based on available resources, provide coordination and technical assistance in applying for grant funding.	High
Action AW-7— Maintain a steering committee as a working body over time to monitor progress of the hazard mitigation plan, provide technical assistance to planning partners, manage data, and oversee the update of the plan according to schedule. This body will continue to operate under the ground rules established at its inception.	High
Action AW-8— All planning partners will collaborate and share information to support the development of debris management plans for the planning area. While each planning partner will be responsible for the development of their own plans, they will attempt to standardize the content and format based on a regional template.	High

IMPLEMENTATION

The Steering Committee developed a plan implementation and maintenance strategy that includes mid-term progress reporting, a strategy for continued public involvement, a commitment to plan integration with other relevant plans and programs, and a recommitment from the planning partners to actively maintain the plan over the five-year performance period.

Full implementation of the recommendations of this plan will require time and resources. The measure of the plan’s success will be its ability to adapt to changing conditions. The Tri-Valley Planning Partnership will assume responsibility for adopting the recommendations of this plan and committing resources toward implementation. The framework established by this plan commits all planning partners to pursue actions when the benefits of a project exceed its costs. The planning partnership developed this plan with extensive public input, and public support of the actions identified in this plan will help ensure the plan’s success.

Tri-Valley Local Hazard Mitigation Plan

PART 1—PLANNING PROCESS AND COMMUNITY PROFILE

1. INTRODUCTION TO HAZARD MITIGATION PLANNING

1.1 WHY PREPARE THIS PLAN?

1.1.1 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.

For many years, federal disaster funding focused on relief and recovery after disasters occurred, with limited funding for hazard mitigation planning in advance. The Disaster Mitigation Act (DMA; Public Law 106-390), passed in 2000, shifted the federal emphasis toward planning for disasters before they occur. The DMA requires state and local governments to develop hazard mitigation plans and update them every five years 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 responsibility for hazard mitigation lies with many, including private property owners, commercial interests, and local, state and federal governments. The DMA encourages cooperation among state and local authorities in pre-disaster planning. The enhanced planning network called for by the DMA helps local government's articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk-reduction projects.

The DMA also 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.

1.1.2 Purposes for Planning

In response to the requirements of the DMA, the cities of Dublin, Livermore and Pleasanton, California and the Dublin San Ramon Services District have developed this multi-jurisdiction hazard mitigation plan. The three cities make up the incorporated area of the Alameda County portion of California's Tri-Valley region, on the east side of the San Francisco Bay area. This multi-jurisdiction plan represents an update to each city's component of the Association of Bay Area Governments (ABAG) 2010 *Multi-Jurisdictional Local Hazard Mitigation Plan for the San Francisco Bay Area*. The three cities prepared annexes for the ABAG 2010 hazard mitigation plan that were approved and adopted from 2011 to 2012.

The *Tri-Valley Local Hazard Mitigation Plan* fulfills the five-year plan update requirement for these planning partners. It identifies resources, information, and strategies for reducing risk from natural hazards in the Tri-Valley planning area. Components of the hazard mitigation plan were selected because they meet a program requirement and because they best meet the needs of the planning partners (the cities and participating special districts) and their citizens. One benefit of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. The

Federal Emergency Management Agency (FEMA) encourages multi-jurisdictional planning under its guidance for the DMA. Local special districts that participated with the cities to develop this hazard mitigation plan are the Dublin San Ramon Services District, the Livermore Valley Joint Unified School District, and the Dublin Unified School District.

The plan will help guide and coordinate mitigation activities throughout the planning area. It was developed to meet the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment that focuses on local hazards of concern.
- Meet the planning requirements of the Federal Emergency Management Agency's (FEMA's) Community Rating System (CRS), allowing planning partners that participate in the CRS program to maintain or enhance their CRS classifications.
- Coordinate existing plans and programs so that high-priority projects to mitigate possible disaster impacts are funded and implemented.

The long-term benefits of mitigation planning include the following:

- An increased understanding of hazards faced by all planning partners
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the communities
- Reduced long-term impacts and damage to human health and structures, and reduced repair costs.

1.2 WHO WILL BENEFIT FROM THIS PLAN?

All citizens and businesses of the planning area are the ultimate beneficiaries of this hazard mitigation plan. The hazard mitigation plan reduces risk for those who live in, work in, and visit the planning area. It provides a viable planning framework for all foreseeable natural hazards. Participation in development of the hazard mitigation plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable across the planning area, and the plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.3 CONTENTS OF THIS PLAN

This plan has been set up in two volumes so that jurisdiction-specific elements may be easily distinguished from those that apply to the whole planning area:

- **Volume 1**—Volume 1 includes all federally required elements of a disaster mitigation plan that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, goals and objectives, planning area hazard risk assessment, planning area mitigation actions, and a plan maintenance strategy.
- **Volume 2**—Volume 2 includes all federally required jurisdiction-specific elements in annexes for each participating jurisdiction. It includes a description of the participation requirements established by the Steering Committee, as well as instructions and templates that the partners used to complete their annexes. Volume 2 also includes "linkage" procedures for eligible jurisdictions that did not participate in development of this plan but wish to adopt it in the future.

Both volumes include elements required under federal guidelines. DMA compliance requirements are cited at the beginning of subsections as appropriate to demonstrate compliance.

The following appendices provided at the end of Volume 1 include information or explanations to support the main content of the plan:

- Appendix A—Public outreach information used in preparation of this update
- Appendix B—Data sources and methods used for hazard mapping
- Appendix C—Plan adoption resolutions from Planning Partners
- Appendix D—A template for progress reports to be completed as this plan is implemented.

All planning partners will adopt Volume 1 in its entirety, including the appendices, and at least the following parts of Volume 2: Part 1, and each partner’s jurisdiction-specific annex.

2. PLAN UPDATE—WHAT HAS CHANGED

2.1 THE PREVIOUS PLAN

In 2004, ABAG led a regional effort to address hazard mitigation planning for jurisdictions in the San Francisco Bay Area. The ABAG process equipped local governments with a template and tools to complete individual planning processes for their jurisdictions, while pooling resources and eliminating redundant planning efforts. Alameda County's first annex to the ABAG hazard mitigation plan was developed and adopted in 2007. In 2010, ABAG conducted its second regional planning effort. Dublin, Livermore and Pleasanton participated in the 2010 planning process, along with Alameda County, other cities, and the Alameda County Water District including the Zone 7 Water Agency; these jurisdictions used the ABAG tools to achieve DMA compliance. The single-jurisdiction annexes in the previous hazard mitigation, developed using the ABAG template and tools, contained the following components:

- Introduction
- Description of the local planning process
- Hazards and risk assessment
- Summary of the National Flood Insurance Program and repetitive loss properties
- Mitigation goals, activities and priorities
- Regional mitigation strategies
- Incorporation of the plan into existing planning mechanisms
- Description of the plan update process
- Exhibits to illustrate the planning process.

The Dublin Unified School District and the Livermore Valley Joint Unified School District have not previously participated in a hazard mitigation plan.

2.2 WHY UPDATE?

In 2015, ABAG again provided tools for counties and cities in the Bay Area to revise their previous plans and annexes, but decided not to revise the regional 2010 ABAG hazard mitigation plan. As a result, multiple counties and cities that participated in the previous ABAG hazard mitigation plan needed to undertake a planning process independently, or as part of a new partnership, in order to remain eligible for federal hazard mitigation assistance. Alameda County set out to develop a stand-alone plan focusing on unincorporated areas; Dublin, Livermore and Pleasanton pooled resources to develop this multi-jurisdictional hazard mitigation plan. The following factors are the basis for the Tri-Valley hazard mitigation planning effort:

- The planning area has significant exposure to numerous natural hazards.
- Limited local resources make it difficult to be pre-emptive in risk reduction actions. Being able to leverage federal financial assistance is paramount to successful hazard mitigation in the area.
- The planning partners want to be proactive in preparedness for the probable impacts of natural hazards.

2.2.1 Federal Eligibility

Title 44 of the Code of Federal Regulations (44 CFR) stipulates that hazard mitigation plans must present a schedule for monitoring, evaluating, and updating the plan. This provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies. A jurisdiction covered by a plan that has expired is not able to pursue funding under the Robert T. Stafford Act that requires a current hazard mitigation plan.

2.2.2 Changes in Development

Hazard mitigation plan updates must be revised to reflect changes in development in the planning area since the previous plan was completed (44 CFR Section 201.6(d)(3)). The plan must describe changes in development in hazard-prone areas that increased or decreased vulnerability for each jurisdiction since the last plan was approved. If no changes in development impacted the jurisdiction's overall vulnerability, plan updates may validate the information in the previously approved plan. The intent of this requirement is to ensure that the mitigation strategy continues to address the risk and vulnerability of existing and potential development and takes into consideration possible future conditions that could impact vulnerability.

The planning area experienced an 18.1 percent increase in population from 2000 to 2010, an average growth of 1.81 percent per year. Between 2010 and 2017, the California Department of Finance estimates that the total populations of Dublin, Livermore and Pleasanton grew an additional 14.17 percent, to 225,250 (CA DOF, 2017).

This plan update assumes that some new development triggered by the increase in population occurred in hazard areas. Because all such new development would have been regulated pursuant to local programs and codes, it is assumed that vulnerability did not increase, even if exposure did. Participating planning partners have adopted general plans, strategic plans, and emergency plans that govern land-use decisions and policy-making, as well as building codes and specialty ordinances based on state and federal mandates. A detailed analysis of development patterns in the planning area is provided in Section 4.5 and in the individual partner annexes in Volume 2.

2.3 THE UPDATED PLAN—WHAT IS DIFFERENT?

The Cities of Dublin, Livermore and Pleasanton are the primary partners in developing this hazard mitigation plan. The three jurisdictions acquired contractor support to facilitate the development of this plan. The plan is a revision of the 2010 ABAG hazard mitigation plan annexes, but it represents the initial plan for the combined Tri-Valley planning area. This plan differs from the 2010 annexes in a variety of ways:

- This plan has been re-structured to focus on the Tri-Valley planning area. The risk assessment is not a part of a larger regional effort. It addresses only the Tri-Valley planning area, focusing on hazards of concern specific to that planning area.
- This updated hazard mitigation plan includes the Dublin San Ramon Services District and the Dublin Unified School District as planning partners.
- The risk assessment has been formatted to best support future grant applications by providing risk and vulnerability information directly supportive of the cost-effectiveness measurement required under FEMA mitigation grant programs.
- Newly available data (such as FEMA's countywide Digital Flood Insurance Rate Maps) and tools (such as FEMA's Hazus computer model) provide for a more detailed and accurate risk assessment.
- The process of updating the 2010 ABAG annexes gave the planning partners an opportunity to engage local citizens and gauge their perception of risk and support for risk reduction through mitigation. This plan update demonstrates that engagement process.

Table 2-1 indicates the major changes between the two plans as they relate to 44 CFR planning requirements.

Table 2-1. Plan Changes Crosswalk

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: • 1. An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; • 2. An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and • 3. Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.	Appendix A of the ABAG Plan includes a description of the planning process. It includes detail of coordination with other agencies and review of the previous plan.	The plan development process deployed for this update differed significantly from that of the ABAG plan. Volume 1 Chapters 2, 3, and 5 describe the planning process for the 2017 updated plan.
§201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.	Appendix C of the ABAG plan includes a risk assessment for nine hazards (earthquake, tsunami, flood, landslide, wildfire, drought, climate change, dam failure, and delta levee failure) for the nine-county regional area.	Volume 1 Part 2 presents a risk assessment of 10 hazards of concern: dam failure, drought, earthquake, flood, landslide, severe weather, wildfire, human caused hazards, health hazards, and climate change. These hazards are profiled as they impact the Tri-Valley planning area. Including a qualitative assessment of human caused hazards and health hazards provides a more complete picture of the hazards facing the planning area.
§201.6(c)(2)(i): [The risk assessment shall include a] description of the ... location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.	Appendix C of the ABAG plan includes a risk assessment for nine hazards (earthquake, tsunami, flood, landslide, wildfire, drought, climate change, dam failure, and delta levee failure) for the nine-county regional area.	Volume 1 Part 2 presents a risk assessment of each hazard of concern. Each hazard chapter includes the following components: • Hazard profile, including maps of extent and location, historical occurrences, frequency, severity, and warning time • Secondary hazards • Climate change impacts • Exposure of people, property, critical facilities and environment • Vulnerability of people, property, critical facilities and environment • Future trends in development • Scenarios • Issues

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i). This description shall include an overall summary of each hazard and its impact on the community	Utilizing existing studies and documents, the ABAG plan discussed vulnerability with an emphasis on exposure and land use. There was extensive discussion on the vulnerability to the earthquake hazard. The ABAG risk assessment attempts to estimate potential damage from future events. ABAG concluded that Hazus was not an adequate tool for planning purposes.	Vulnerability was assessed for all hazards of concern. The Hazus computer model was used for the dam failure, earthquake, and flood hazards, incorporating local data sets. Site-specific data on Steering Committee-identified critical facilities were entered into the Hazus model. Vulnerability was assessed for other hazards by applying varying damage percentages to an asset inventory extracted from Hazus.
§201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods	The ABAG plan includes summary information by county on identified repetitive losses. The plan includes a link to a website with more information on repetitive losses, but the site is no longer maintained. The plan provides inventories of structures in repetitive loss areas, but there is no description of the causes of repetitive flooding.	Dublin, Livermore and Pleasanton have no identified Repetitive Loss or Severe Repetitive Loss structures insured through the National Flood Insurance Program.
§201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.	The focus of the ABAG plan is on existing land use without detailed discussion on future land use. There is no consistent inventory of the number and types of structures exposed to each hazard of concern. The plan does provide an inventory of identified critical facilities.	A complete inventory of the numbers and types of buildings exposed was generated for each hazard of concern. The Steering Committee defined and identified "critical facilities" for the planning area, and these facilities were inventoried by exposure. Each hazard chapter provides a discussion on future development trends.
§201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) and a description of the methodology used to prepare the estimate.	The ABAG plan relied on creating regional correlations from past observed damage to create estimates of future losses from the hazards of concern. Appendix F assesses vulnerability by providing private building exposure estimates for earthquake, landslide, wildfire, dam failure, and 100-year flood.	Loss estimations in terms of dollar loss were generated for all hazards of concern. These estimates were generated by Hazus for the dam failure, earthquake, and flood hazards. For the other hazards, loss estimates were generated by applying varying damage percentages to an asset inventory extracted from Hazus.
§201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.	A strong component of the ABAG plan is its look at existing land use in hazard areas, especially for earthquake. Appendix E provides additional detail on existing land use, with a brief discussion of future land use (through 2030) by county.	There is a discussion on future development trends as they pertain to each hazard of concern. This discussion looks predominantly at the existing land use and the current regulatory environment that dictates this land use.

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.	The ABAG plan identified a comprehensive list of mitigation strategies for each planning partner to consider when creating annexes to the plan. These strategies were created via a facilitated process chronicled in the plan.	The plan contains a guiding principle, goals, objectives, and actions. The actions are jurisdiction-specific and strive to meet multiple objectives. The objectives of this plan are broad, similar to the strategies identified in the ABAG plan. All objectives meet multiple goals and stand alone as components of the plan. Each planning partner was asked to complete a capability assessment that looks at its regulatory, technical and financial capabilities.
§201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.	The ABAG plan has identified one overall goal and basic "commitments" for the plan.	The Steering Committee developed a new overall guiding principle for the plan, and developed eight goals and 12 objectives, as described in Chapter 17. The goals and objectives are specifically for this hazard mitigation plan and are completely new. They were identified based upon the capabilities of the Planning Partnership.
§201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.	The ABAG plan contains a discussion on the process used to generate the mitigation strategies, and includes an alternatives review.	Volume I, Part 3 includes a hazard mitigation catalog that was developed through a facilitated process. This catalog identifies actions that manipulate the hazard, reduce exposure to the hazard, reduce vulnerability, and increase mitigation capability. The catalog further segregates actions by scale of implementation. A table in the action plan chapter analyzes each action by mitigation type to illustrate the range of actions selected.
§201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program, and continued compliance with the program's requirements, as appropriate.	Strategy GOVT-c-5 deals with maintaining compliance and good standing in the National Flood Insurance Program. Strategies HSNG-h-1, LAND-c-4, and ECON-f-1 encourage participation in the CRS program.	Dublin, Livermore and Pleasanton participate in the National Flood Insurance Program and have identified an action stating their commitment to maintain compliance and good standing under the National Flood Insurance Program.

44 CFR Requirement	Previous Plan	Updated Plan
§201.6(c)(3)(iii): [The mitigation strategy shall describe] how the actions identified in Section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.	Under the ABAG plan, priorities are organized based on the following categories: • Existing • Existing/underfunded • Very High • High • Moderate • Under study • Not applicable • Not yet considered	Each of the recommended actions is prioritized using a qualitative methodology that looked at the objectives the project will meet, the timeline for completion, how the project will be funded, the impact of the project, the benefits of the project and the costs of the project. This prioritization scheme is detailed in Chapter 19. Since this planning effort was the first for all the Tri-Valley planning partners working together on a plan, the prioritization concept is entirely different from what was applied in the ABAG planning effort. Since each planning partner was asked to review all risks and prior actions, any action that was carried over to this plan from the prior plan had the opportunity to have its priority reviewed and if necessary, changed. Therefore, every risk and action in this plan, whether new or carried over from the prior plan, was prioritized as described in the introduction section of Volume 2.
§201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.	Appendix B of the ABAG plan contains a plan maintenance and update process.	Volume I, Part 3 presents a plan maintenance strategy that contains additional detail to address deficiencies observed during the 2010 update process. This update includes a more defined role and vehicle for facilitating the annual review of the plan.
§201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.	Appendix B of the ABAG plan contains a brief discussion on incorporation of the plan into other planning mechanisms.	Volume I, Part 3 details recommendations for incorporating the plan into other planning mechanisms, such as: • General plans • Emergency response plans • Capital improvement programs • Municipal codes Specific current and future plan and program integration activities are detailed in each participating jurisdiction's annex in Volume 2.
§201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.	The ABAG plan does not contain a process for how each jurisdiction will continue public participation in the plan maintenance process. However, some of the local government annexes contain this discussion.	Volume I, Part 3 details a comprehensive strategy for continuing public involvement.
§201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commission, Tribal Council).	All agencies utilizing the ABAG tools submitted to the state and FEMA individually.	An appendix in Volume 1 contains the resolutions of all planning partners that adopted this plan.

3. PLAN UPDATE APPROACH

This chapter describes the planning process used to develop the *Tri-Valley Local Hazard Mitigation Plan*, including how it was prepared, who was involved, and how the public participated. The process was broadly defined by the following objectives and activities:

- Form a planning team
- Defining stakeholders
- Establish a steering committee
- Establish a planning partnership
- Define the planning area
- Coordinate with other agencies
- Review existing programs
- Engage the public.

These objectives and activities ensure that the plan meets requirements of the DMA and has the broad and effective support of the participating jurisdictions, regional and local stakeholders and the public. They are discussed in the following sections.

3.1 FORMATION OF THE PLANNING TEAM

Project management has been the joint responsibility of staff members from the Cities of Dublin, Livermore, and Pleasanton. A contract planning consultant (Tetra Tech, Inc.) was tasked with the following:

- Assist with organization of a steering committee and planning team
- Assist with development and implementation of a public and stakeholder outreach program
- Collect data
- Facilitate and attend meetings (steering committee, planning team, stakeholder, public and other)
- Review and update the hazards of concern, hazard profiles and risk assessment
- Assist with review and update of mitigation planning goals and objectives
- Assist with review of progress of past mitigation strategies
- Assist with the screening, identification and prioritization of mitigation actions
- Author the draft and final hazard mitigation plan documents.

The Tetra Tech project manager assumed the role of the lead planner, reporting directly to the planning team. In addition to the Tetra Tech project team, the main planning team consisted of the following members:

- Tracy Hein, Disaster Preparedness Coordinator, Livermore-Pleasanton Fire Department
- Hazel Wetherford, Assistant to the City Manager, City of Dublin
- Adam Weinstein, Planning Manager, City of Pleasanton
- Shweta Bonn, Senior Planner, Advanced Planning; City of Pleasanton
- Steve Stewart, Planning Manager, City of Livermore.

3.2 DEFINING STAKEHOLDERS

At the beginning of the planning process, the planning team identified a list of stakeholders to engage during the update of the Tri-Valley Hazard Mitigation Plan. “Stakeholder” was defined as any person or public or private entity that owns or operates facilities that would benefit from the mitigation actions of this plan, and/or has an authority or capability to support mitigation actions identified by this plan. Stakeholders were separated into two categories:

- **Participatory Stakeholders**—Stakeholders that actively participated in the planning process as planning partners or members of the Steering Committee.
- **Coordinating Stakeholders**—Stakeholders that were not able to commit to actively participating in the process but were kept apprised of plan development milestones or were able to provide data that was used in the plan development.

The following stakeholders played a role in the planning process:

- **Federal Agencies—**FEMA Region IX
- **State Agencies—The** California Governor’s Office of Emergency Services (Cal OES)
- **Regional and Local Stakeholders—**The following regional and local organizations received information about the planning process and invitations to provide input and participated in the planning process as full members of the Steering Committee:
  - Alameda County Fire Department
  - Alameda County Voluntary Organizations Active in Disaster
  - Zone 7 Water Agency
  - Bay Area Rapid Transit
  - Lawrence Livermore National Laboratory
  - Livermore Area Recreation & Park District
  - Livermore-Pleasanton Fire Department
  - Pleasanton Chamber of Commerce
  - Stanford Health Care – ValleyCare.

3.3 THE STEERING COMMITTEE

A Steering Committee provided guidance to the hazard mitigation plan effort and ensured that the document will be accepted by agencies and the public. For a project kickoff meeting on March 7, 2017, the planning team assembled a list of planning area candidates who could have recommendations for the plan or be impacted by its recommendations. The planning team requested these candidates’ participation in the planning process. The planning team confirmed a committee of 20 members. Table 3-1 lists the Steering Committee members.

Leadership roles and ground rules were established during the Steering Committee’s meeting on March 7, 2017. The Steering Committee agreed to meet once a month as needed throughout the course of the plan’s development. The planning team facilitated each Steering Committee meeting to address a set of objectives based on an established work plan. The Steering Committee met nine times from March 2017 through November 2017. All Steering Committee meetings were open to the public and agendas and meeting notes were posted to the hazard mitigation plan website. Steering Committee meeting summaries are included in Appendix A of this volume.

The Steering Committee included key planning partner staff, citizens, and other stakeholders from within the planning area. Members combined expertise in preventive measures, property protection, natural resource protection, emergency services, structural flood control projects, public safety, and public information. They applied their expertise on behalf of all planning partners participating in the plan process.

Table 3-1. Steering Committee Members

Name	Title	Jurisdiction/Agency
Julie Carter	Human Resources Director	City of Dublin
Hazel Wetherford[a]	Assistant to the City Manager	City of Dublin
Susan Frost	Special Projects Coordinator	City of Livermore, Community Development Department
Steve Stewart	Planning Manager	City of Livermore
Shweta Bonn	Senior Planner, Advanced Planning	City of Pleasanton
Adam Weinstein[b]	Planning Manager	City of Pleasanton
Stanley Kolodzie	Associate Engineer	Dublin San Ramon Services District
Brian Fritz	Maintenance and Operations Supervisor	Dublin Unified School District
Lincoln Casimere	Emergency Manager	Alameda County Fire Department
Marla Blagg	Emergency Manager	Bay Area Rapid Transit
Cary Fukada	Citizen	Community Emergency Response Teams
John Richards	Emergency Management Expert	Lawrence Livermore National Laboratory
John Lawrence	Assistant General Manager	Livermore Area Recreation & Park District
Mike Trudeau	Lieutenant	Livermore Police Department
Chris Van Schaack	Assistant Superintendent	Livermore Valley Joint Unified School District
Joe Testa	Deputy Chief	Livermore-Pleasanton Fire Department
Tracy Hein	Disaster Preparedness Coordinator	Livermore-Pleasanton Fire Department
Scott Ratay	President/CEO	Pleasanton Chamber of Commerce
Caryn Thornburg	Safety, Emergency Management, and Sustainability Officer	Stanford Health Care – Valley Care
Colter Anderson	Production Manager	Zone 7 Water Agency

a. Chairperson
b. Vice-Chairperson

3.4 ESTABLISHMENT OF THE PLANNING PARTNERSHIP

Hazard mitigation planning enhances collaboration among diverse parties whose interests can be affected by hazard losses. In June 2016, the Cities of Dublin, Livermore and Pleasanton identified eligible special districts within the planning area of the pending planning process and invited them to formally participate. All special districts were asked to identify planning points of contact to serve as planning partners and represent the interests of their district.

During the first Steering Committee meeting on March 7, 2017, the planning team introduced the opportunity for special districts to participate as planning partners. A follow-up to the Steering Committee meeting was sent via email on April 17, 2017, listing potential special purpose district planning partners. This follow-up outlined planning partner expectations and sought commitment.

The municipal planning partners covered under this plan are shown in Table 3-2. The special purpose district planning partners are shown in Table 3-3. Together these jurisdictions make up the Planning Partnership for the hazard mitigation plan. While all participating jurisdictions authorized the Steering Committee to carry out certain activities on their behalf, all planning partners were invited to attend and participate in all aspects of the plan update process. Linkage procedures have been established (see Volume 2 of this plan) for any jurisdiction wishing to link to the *Tri-Valley Local Hazard Mitigation Plan* in the future.

Table 3-2. Municipal Planning Partners

Jurisdiction	Point of Contact	Title
Dublin	Hazel Wetherford	Assistant to the City Manager
Livermore	Steve Stewart Steve Reily	Planning Manager Principle Planner
Pleasanton	Adam Weinstein	Planning Manager
	Shweta Bonn	Senior Planner, Advanced Planning

Table 3-3. Special District Planning Partners

Special District	Point of Contact	Title
Dublin San Ramon Services District	Stanley Kolodzie	Associate Engineer

3.5 DEFINING THE PLANNING AREA

The planning area was defined to consist of the jurisdictional area of the Cities of Dublin, Livermore, and Pleasanton within Alameda County as well as the service area for the Dublin San Ramon Services District that extends in to Contra Costa County. The planning area is surrounded by unincorporated Alameda County. All partners to this plan have jurisdictional authority within this planning area. A map showing the geographic boundary of the defined planning area for this plan update is provided in Chapter 4, along with a description of planning area characteristics.

3.6 COORDINATION WITH OTHER AGENCIES

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.6(b)(2)). The planning team accomplished this task as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones:
  - Alameda County Fire Department, Emergency Management Division
  - Alameda County Voluntary Organizations Active in Disaster (ALCO VOAD)
  - Alameda County Emergency Management Association (ALCO-EMA)
  - American Red Cross Bay Area Chapter
  - Association of Bay Area Governments, Resilience Program Coordinator
  - Bay Area Rapid Transit
  - California Department of Water Resources, National Flood Insurance Program Coordinator
  - Cal OES
  - Contra Costa County Office of Emergency Services
  - East Bay Parks and Recreation District
  - FEMA Region IX, Lead Community Planner
  - Lawrence Livermore National Laboratory
  - Livermore Area Recreation & Park District
  - Livermore-Pleasanton Fire Department
  - Pleasanton Chamber of Commerce

- ➢ San Ramon Valley Fire District
- ➢ Stanford Health Care – Valley Care
- ➢ Zone 7 Water Agency

These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process. They supported the effort by attending meetings or providing feedback on issues.

- **Pre-Adoption Review**— All the agencies listed above were provided an opportunity to review and comment on this plan, primarily through the hazard mitigation plan website (see Section 3.8). All were sent an e-mail message informing them that draft portions of the plan were available for review. Upon completion of a public comment period, a complete draft plan was sent to Cal OES for a pre-adoption review to ensure program compliance.

Special involvement in and assistance with the planning process was provided by the following federal and state agencies:

- FEMA Region IX provided updated planning guidance, provided summary and detailed data for the planning area from the National Flood Insurance Program (NFIP) (including repetitive loss information), and conducted plan review.
- The U.S. Geological Survey (USGS) provided earthquake event mapping to support the earthquake risk assessment.
- Cal OES facilitated FEMA review, provided updated planning guidance, and reviewed the draft and final versions of the plan prior to FEMA review.
- The California Department of Forestry and Fire Protection (CAL FIRE) provided fire severity mapping to support the wildfire risk assessment.
- The California Department of Water Resources provided information on NFIP compliance for local cities.

3.7 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)). Section 4.8 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 Fire Code
- 2013 California Building Code
- California State Hazard Mitigation Forum
- Five-year and biennial capital improvement programs
- Local emergency operations plans
- Local general plans
- Local strategic plans
- Housing elements
- Safety elements
- Local zoning ordinances
- Climate action plans.

An assessment of all planning partners’ regulatory, technical and financial capabilities to implement hazard mitigation actions is presented in the jurisdiction-specific annexes in Volume 2.

3.8 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)). This section details the outreach to, and involvement of, the many agencies, departments, organizations, non-profit organizations, districts, authorities and other entities that have a stake in managing hazard risk and mitigation, commonly referred to as stakeholders.

3.8.1 Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Steering Committee.
- Engage the public in two phases during the planning effort:
    - Phase 1—Gauge the public's perception of risk by sharing the results of the risk assessment.
    - Phase 2—Provide opportunity for the public to comment on a draft of the plan.
- Use a survey to determine if the public's perception of risk and support of hazard mitigation has changed since the initial planning process.
- Attempt to reach as many planning area citizens as possible using multiple media.
- Identify and involve planning area stakeholders.

Diligent efforts were made to ensure broad regional, county, and local representation in this planning process. Stakeholder outreach was performed early and throughout the planning process. In addition to mass media notification efforts, identified stakeholders were invited to attend meetings and provide input on draft documents. Information and input provided by these stakeholders has been included throughout this plan where appropriate.

The sections below describe Steering Committee and planning team efforts toward public outreach throughout the development and review of the hazard mitigation plan.

Survey

A hazard mitigation plan survey (see Figure 3-1) was developed for this planning process. 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. This survey was designed to help identify areas vulnerable to one or more natural hazards. The answers to its questions helped guide the Steering Committee in selecting goals, objectives, and mitigation strategies. The survey was made available on the hazard mitigation plan website and was distributed to citizens of the planning area as follows:

- Via social media outlets, including Facebook, Twitter and NextDoor
- At public meetings as hard copies and via QR code access with smart phones
- On the City of Dublin's platform, "Open City Hall."

Over 500 surveys were completed during the course of this planning process. The complete survey and a summary of its findings can be found in Appendix A of this volume.

Tri-Valley Local Hazard Mitigation Plan Survey

1. Survey Introduction

Tri-Valley Hazard Mitigation Questionnaire

A range of natural and human-caused disasters can affect any community. The Cities of Livermore, Pleasanton and Dublin and their special district planning partners work diligently to mitigate threats and prepare for disasters. Natural disasters are those hazards that occur as a force of nature, such as a flood or earthquake. Non-natural disasters are those that occur as part of an intentional act or failure of technology. For the purpose of this plan, non-natural hazards also include health hazards, such as epidemics.

To maintain a high level of preparedness, we need your help to identify and plan for future disasters by completing this survey.

Thank you for taking the time to participate in the 2017 Hazard Mitigation Survey!

Tri-Valley Local Hazard Mitigation Plan Survey

2. Hazard Knowledge

First, this set of questions is about your experience and knowledge of natural hazards and steps your household has taken to prepare for disasters:

1. Which of the following natural hazard events have you experienced in the Tri-Valley planning area (Check all that apply)

- ☐ Dam/Levee Failure
- ☐ Drought
- ☐ Earthquake
- ☐ Flood
- ☐ Landslide & Mass Movements (sinkholes, geologic hazards)
- ☐ Severe Weather (high wind, heavy rain, lightning, etc.)
- ☐ Wildfire
- ☐ None
- ☐ Other (please specify)

Figure 3-1. Hazard Mitigation Survey

Phase 1 Public Outreach—Informational Booths

Informational booths were staffed at the following events:

- July 27, 2017 in Dublin as part of the Dublin Farmers' Market
- September 16, 2017 in Pleasanton as part of the Pleasanton Farmers' Market.
- September 21, 2017 in Livermore as part of the Livermore Farmers' Market

During these events (see Figure 3-2 through Figure 3-5), project team members spoke with members of the public about the project and invited them to take the survey and visit the project website. Members of the public were invited to receive a personalized risk assessment based on the project risk assessment results. A Hazus workstation allowed citizens to see information on their property, including exposure and damage estimates for earthquake and flood hazard events. Participating property owners were provided printouts of this information for their properties.

Figure 3-2. Dublin Farmer's Market

Figure 3-3. Pleasanton Farmers Market

Figure 3-4. A Resident Receives a Risk Assessment

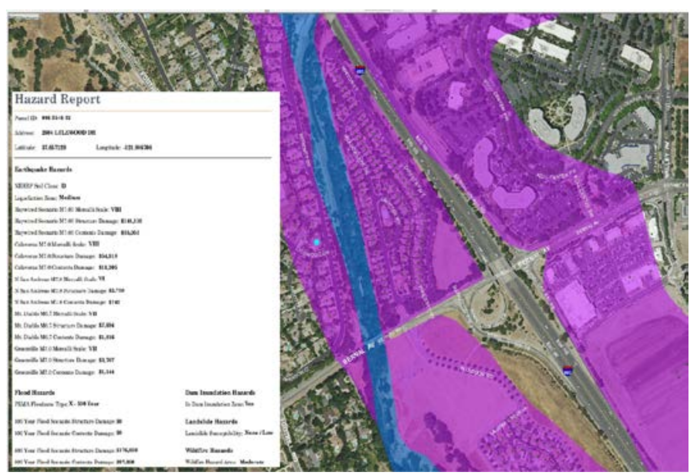


Figure 3-5. Example "Workstation" Report

Press Releases

The planning team distributed press releases over the course of the plan's development as key milestones were achieved and prior to each public meeting. All planning partners were also encouraged to distribute press releases on the project. Press releases and resulting press coverage included the following:

- May 4, 2017—The Independent: Valley Roundup article on commencement of the planning project and invitation to the public to visit the project website (copy of article provided in Appendix A).
- May 18, 2017—Dublin Patch: Announcement of commencement of the planning project and invitation to the public to visit the project website (copy of article provided in Appendix A).
- June 28, 2017—Press release regarding Tri-Valley hazard mitigation plan survey.
- December 8, 2017—Press release announcing the final public comment period for the Draft Plan.
- December 20, 2017— Pleasanton Weekly: Article announcing the final public comment meeting on 12/22/2017 (copy of article provided in Appendix A)

Internet

At the beginning of the plan development process, a website was created to keep the public posted on plan development milestones and to solicit relevant input (see Figure 3-6). The site's address (https://www.tri-valley-hmp.com/) 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 planning partners intend to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

As part of this website, visitors were encouraged to sign up for project update emails. Two members of the public signed up for continued information through this mailing list. These members received notices of upcoming public meetings and scheduled changes.

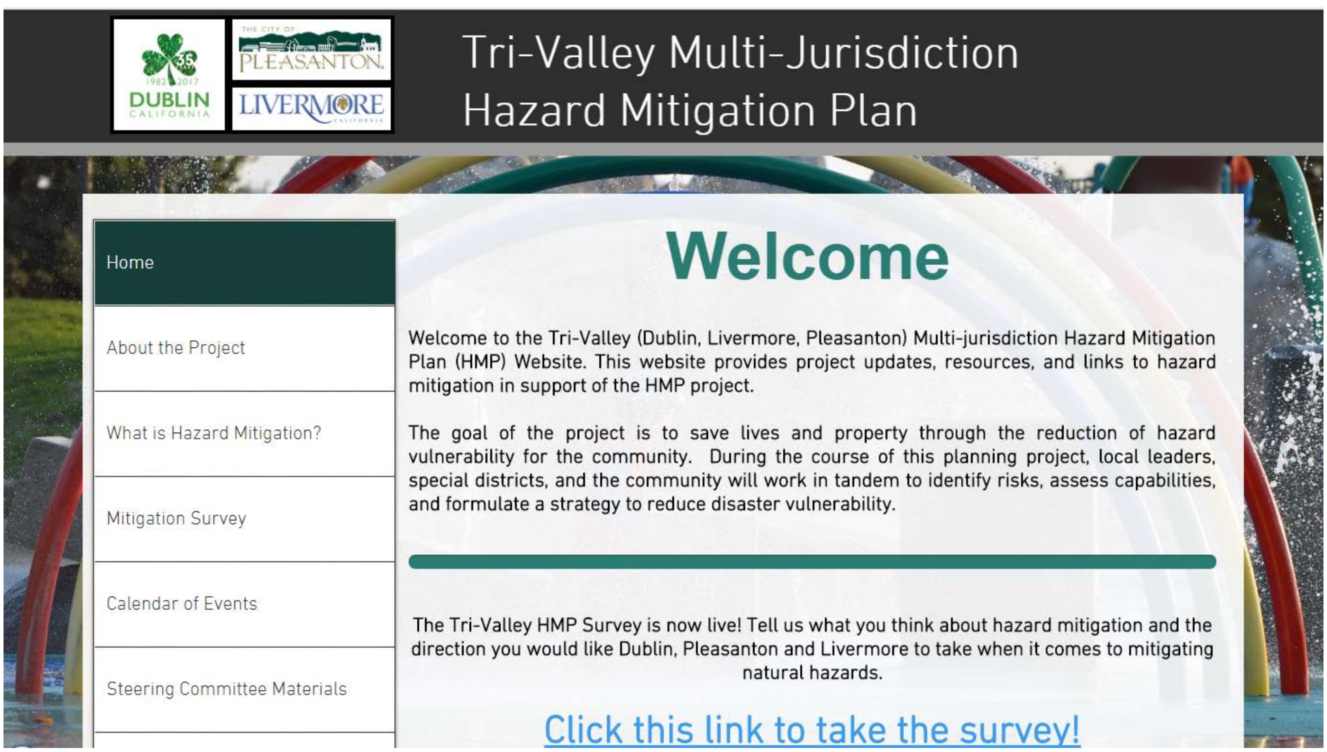


Figure 3-6. Hazard Mitigation Plan Web Site Homepage

Phase 2 Public Outreach—Final Public Comment Process

A 30-day public comment period, from December 12, 2017 to January 11, 2018, provided the public an opportunity to comment on the draft plan update prior to its submittal to Cal OES. The principle mechanism for public comment on the draft plan was the website established for this plan update. Additionally, a public meeting held on Friday, December 22, 2017 to allow an opportunity to provide comment on the draft plan update. This meeting was advertised via an area-wide press release distributed by the City of Pleasanton Public Information Office and received press coverage from the Pleasanton Weakly on December 20, 2017. At the public meeting, a 30-minute presentation was given, followed by a period for questions and answers by those in attendance. Comments received on the draft plan are available upon request. Additionally, a presentation on the draft plan was presented to the Livermore City County on January 8, 2018 (Agenda Item 6.01). This meeting was open to the public.

All comments received during the Phase 2 public outreach were reviewed by the planning team and incorporated into the draft plan as appropriate.

3.8.2 Public Involvement Results

The public involvement strategy used for this hazard mitigation plan update introduced the concept of mitigation to the public and provided the Steering Committee with feedback to use in developing the plan. All citizens of the planning area were provided opportunities to participate and give feedback during all phases of the planning process. Details of attendance and comments received from the public meetings during the public comment period are provided in Appendix A. Table 3-4 provides a summary of public meetings held in support of this project.

Table 3-4. Summary of Public Meetings

Date	Location	Number of Public Contacts	Number of Written Comments Received
July 27, 2017	Dublin Farmers' Market	100	None
September 16,2017	Pleasanton Farmer's Market	85	None
September 21, 2017	Livermore Farmer's Market	45	None
December 22, 2017	Dublin San Ramon Services District Office	3	None
January 8, 2018	Livermore City Council Meeting	20	None
Total		253	None

3.8.3 Continued Public Involvement

The planning partners are committed to the continued involvement of the public in hazard mitigation. Therefore, the draft hazard mitigation plan will be made available for review on the mitigation website. After the hazard mitigation plan has been completed, implementation and ongoing maintenance will become a function of the Planning Partnership. The Planning Partnership will be responsible for reviewing the hazard mitigation plan and accepting public comment as part of an annual review and as part of the five-year mitigation plan update process.

3.9 PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

A summary of Planning Partnership activities, including Steering Committee meetings held during development of this hazard mitigation plan, is included in Table 3-5.

Table 3-5. Plan Development Chronology/Milestones

Date	Event	Description	Attendance
2016			
11/18	Planning Process	Contract executed with Tetra Tech, Inc. to facilitate the plan update process	N/A
12/1	Planning Process	Planning team Conference Call #1, project organization	9
2017			
1/17	Planning Process	Planning Team Conference Call #2	8
1/30	Planning Process	Planning Team Conference Call #3, Confirm Steering Committee and initiate invitation process.	6
3/7	Steering Committee Meeting #1	Planning Partners convened to kickoff planning project with a project overview, Steering Committee's role, previous plan, and public involvement strategy.	16
4/11	Steering Committee Meeting #2	Discussed the hazards of concern, public involvement strategy, and plan mission statement and goals.	12
5/5	Public Outreach	Press coverage on the planning process in The Independent's Valley Roundup.	N/A
5/16	Steering Committee Meeting #3	Discussed plan mission statement and goals, public involvement, hazards of concern, critical facilities, and national policy briefing.	11
5/18	Public Outreach	Announcement in Dublin Patch of commencement of the planning project and invitation to the public to visit the project website	N/A
6/13	Steering Committee Meeting #4	Discussed the planning process, risk assessment update, finalized plan goals, and public involvement.	10
6/28	Pres Release – Hazard Mitigation Plan Survey	Coordinated jurisdictional release of the public survey. Planning partners were encouraged to link to the survey from their jurisdictional webpages	NA
7/11	Steering Committee Meeting #5	Planning process, risk assessment update, objective setting, jurisdictional annex process, public involvement, and plan maintenance schedule discussed.	11
7/27	Dublin's Farmer's Market	Hazard mitigation information booth as part of Farmer's Market. Residents were provided with a mitigation flier that provided information on the project and advertised the project website and survey, property risk assessment, and general preparedness materials.	100+
8/8	Steering Committee Meeting #6	Risk assessment update, draft plan maintenance strategy, jurisdictional annex process, and public involvement.	13
9/12	Steering Committee Meeting #7	Risk assessment update, jurisdictional annex process, public involvement, and strengths, weaknesses, obstacles and opportunities of mitigation actions.	14
9/16	Pleasanton Farmer's Market	Hazard mitigation information booth as part of Farmer's Market. Residents were provided with a mitigation flier that provided information on the project and advertised the project website and survey, property risk assessment, and general preparedness materials.	85+
9/21	Livermore Farmer's Market	Hazard mitigation information booth as part of Farmer's Market. Residents were provided with a mitigation flier that provided information on the project and advertised the project website and survey, property risk assessment, and general preparedness materials.	45+
10/10	Steering Committee Meeting #8	Confirm catalog of hazard mitigation best management practices, Phase 3, jurisdictional annex process, initiate plan review process	14
11/14	Steering Committee Meeting #9	Go over SC comments on Volume 1, finalize phase 2 public engagement strategy, confirm area wide actions, and phase 3 of the Jurisdictional annex status.	
12/8	Public Outreach	Press release announcing final public comment period disseminated by PIO	N/A
12/12 to 1/11	Public Outreach	Final Public Comment Period	N/A
12/22	Phase 2 Public Meeting	Public meeting held at Dublin San Ramon Services District for public comment	3

Date	Event	Description	Attendance
2018			
1/8	Phase 2 Public Meeting	Presentation on draft plan presented to the Livermore City Council. This was an open public meeting	20
1/16	Plan submittal	Pre-adoption review draft of the plan submitted to Cal OES.	N/A
6/25	Approval	Final plan approval issued by FEMA Region IX	N/A

4. COMMUNITY PROFILE

4.1 GEOGRAPHIC OVERVIEW

The Tri-Valley planning area is in north-central Alameda County in the San Francisco Bay area, east of San Francisco and north of San Jose. The cities of Dublin, Livermore and Pleasanton are located along Interstate 580, which runs east-west through the county. The City of Dublin is north of the intersection of Interstates 580 and 680 and is generally bounded by the City of San Ramon to the north, Castro Valley to the west, the City of Pleasanton to the south, and the City of Livermore to the east. The City of Livermore is north and south of Interstate 580. The Livermore Valley is edged to the north, south, and east by rolling hills, with the cities of Pleasanton and Dublin to the west. The City of Pleasanton extends south of Interstate 580 along Interstate 680, bounded by the City of Dublin on the north, the City of Livermore to the east, the Sunol Valley to the south, and the steep, rugged Pleasanton and main ridges on the west. Figure 4-1 shows the 66.2-square-mile planning area.

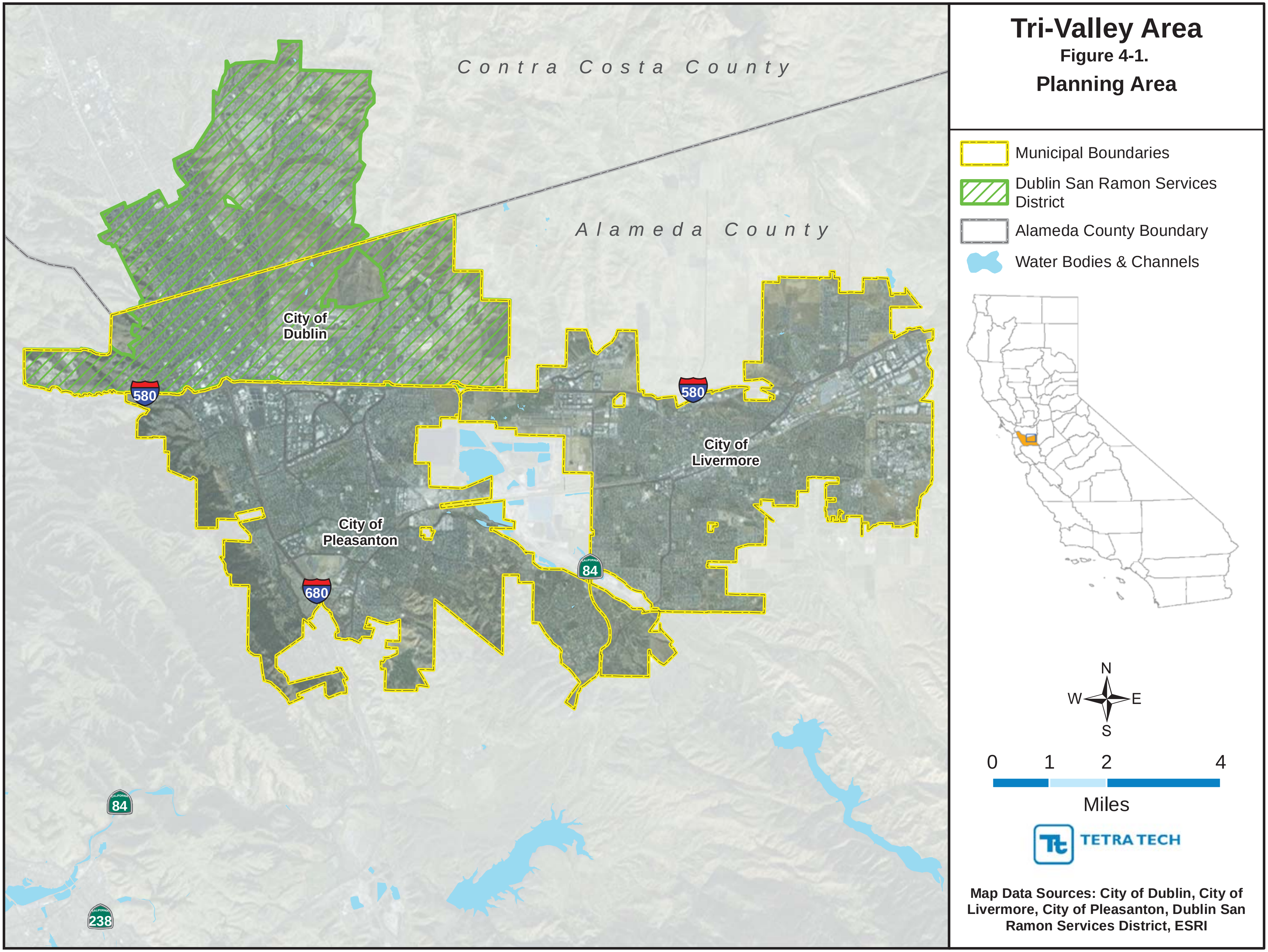
4.2 HISTORICAL OVERVIEW

For thousands of years until the arrival of Spanish settlers in the late 1700s, the Ohlone people, also referred to as Costanoans (the Spanish word for “coast”), lived in and around the Bay Area. Living in small villages, they survived on the abundance of natural resources, including acorns from oak trees and shellfish in the bay. Mission San Jose was founded on June 11, 1797, by Father Fermín Francisco de Lasuén. It was the 14th of the 21 Spanish missions in what is now the western United States. The missionaries required the Indians to move to the mission, and this disruption, as well as new diseases the Spanish brought, destroyed the Indian way of life even before the influx of gold seekers in the mid-1800s (Alameda County Library, 2017).

The Amador-Livermore Valley was first sighted by a Spanish solder in 1772 while on an expedition searching for new mission sites. After 1822, Mexico succeeded Spain in jurisdiction over Alta California. Beginning in 1839, the former mission lands were secularized and broken up into large ranchos as the result of grants to citizens by Mexico. It was a half-century after the initial discovery that Jose Amador, in 1826, brought the first settlement to the valley and Spanish families were awarded large tracts of land.

California became part of the United States after the Mexican War of 1846–1847. The territory was formally ceded in the treaty of Guadalupe Hidalgo in 1848 and was admitted as a state in 1850. Pressure from the United States was a major factor leading to the disintegration of Mexican control in California. The first American settler in the tri-valley area arrived in 1850 and settlement continued. The area was on one of the main routes to the gold fields and became a mercantile stopover for miners on their way to those fields.

Ranchers and thoroughbred horse breeders, also came to the area, attracted to the favorable climate and abundance of water, and were followed by dairy farms, hop fields, and vineyards. The Central Pacific Railroad was completed in 1869, resulting in the establishment of more towns.



Tri-Valley Area
Figure 4-1.
Planning Area
Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels
Contra Costa County
Alameda County
City of Dublin
City of Pleasanton
City of Livermore
580
580
680
84
84
238
N
W
E
S
0
1
2
4
Miles
TETRA TECH
Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, Dublin San Ramon Services District, ESRI

In 1925, the section of the Lincoln Highway through the area (by 1874 known as Dublin Road) was incorporated into the U.S. Highway system as U.S. Highway 50. In 1928, it was also designated State Route 84. By 1953, U.S. Highway 50 had become a divided four-lane road; Interstate 680 was completed in 1967. By 1973, U.S. Highway 50 had become Interstate 580. Prior to the 1950s, small agricultural towns history and economy were integrated with those of the agricultural areas around them. Since the 1950s, urbanization of the area has grown across former agricultural land, and urban development now dominate the area (Alameda County CDA, 2005).

4.3 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Since 1953, 18 presidential disaster declarations have been issued for Alameda County, which includes the cities of Dublin, Livermore, and Pleasanton as listed in Table 4-1.

Table 4-1. Presidential Disaster Declarations

Type of Event	FEMA Disaster Number	Declaration Date
Severe Winter Storms, Flooding, Mudslides	DR-4308	April 1, 2017
Severe Winter Storms, Flooding, Mudslides	DR-4305	March 16, 2017
Severe Winter Storms, Flooding, Mudslides	DR-4301	February 14, 2017
Severe Winter Storms, Flooding, Landslides, Mud Flows	DR-1646	June 5, 2006
Severe Winter Storms, Flooding, Landslides, Mud Flows	DR-1628	February 3, 2006
Severe Winter Storms, Flooding	DR-1203	February 9, 1998
Severe Winter Storms, Flooding	DR-1155	January 4, 1997
Severe Winter Storms, Flooding, Landslides, Mud Flows	DR-1046	March 12, 1995
Severe Winter Storms, Flooding, Landslides, Mud Flows	DR-1044	January 10, 1995
Oakland Hills Fire	DR-919	October 22, 1991
Severe Freeze	DR-894	February 11, 1991
Loma Prieta Earthquake	DR-845	October 17, 1989
Severe Storms, Flooding	DR-758	February 12, 1986
Coastal Storms, Floods, Slides, Tornadoes	DR-677	January 21, 1983
Severe Storms, Flood, Mudslides, High Tide	DR-651	January 7, 1982
Drought	EM-3023	January 20, 1977
Forest, Brush Fires	DR-295	September 29, 1970
Severe Storms, Flooding	DR-283	February 16, 1970

Source: FEMA, 2017

Review of these events helps identify targets for risk reduction and ways to increase a community’s capability to mitigate damage from large-scale events in the future. Still, many natural hazard 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 hazards of concern.

4.4 PHYSICAL SETTING

4.4.1 Topography and Geology

The planning area is in the east-central part of the California Coast Range Province that is characterized by elongated ranges and narrow valleys parallel to the coast. It lies in a depression within the Diablo Range where there are three valleys: Amador Valley, Livermore Valley, and San Ramon Valley. The Livermore and Amador Valleys, which are adjacent in an east-west orientation, make up the major part of the basin. San Ramon is a smaller valley that trends northwest from the northwest edge of Amador Valley. Elevations in the planning area range from approximately 300 feet above sea level at the drainage exit of Amador Valley southwest of Pleasanton, to approximately 700 feet above sea level along Livermore Valley's eastern margin. The mean elevation above sea level is 486 feet in the City of Livermore and 354 feet in the City of Dublin. North and east of the Tri-Valley area, the Diablo Range rises to elevations between approximately 1,000 and 2,000 feet above sea level, with Mount Diablo reaching an elevation of 3,849 feet above sea level.

Geologic conditions are controlled by the planning area's location along the complex boundary between the North American and Pacific Plates and the interaction of these two plates. The Pacific Plate moves northwestward relative to the North American Plate at a rate of about 5 centimeters per year. Much of this relative movement at the latitude of the San Francisco Bay Area is accommodated primarily by strike-slip motion along a number of major faults, including the San Gregorio, San Andreas, Hayward, Calaveras, and Greenville faults. Countless other faults in the region accommodate relative motion between major faults and relieve compression stress along the plate boundary.

4.4.2 Hydrology

The Tri-Valley area consists of sub-watersheds of the Alameda Creek Watershed. Arroyo Las Positas, Arroyo Seco, and Arroyo Mocho drain the northeastern and southeastern hills, and Arroyo del Valle drains the southern hills. These drainages converge and flow through the central Tri-Valley area, collecting the flow of Cayetano, Collier, Cottonwood, Tassajara, and Alamo Creeks from the northern hills. These streams join San Ramon Creek, which flows south through the San Ramon Valley and exits the basin along Arroyo de la Laguna. Figure 4-2 shows the entire Alameda Creek Watershed and major water bodies around the Tri-Valley area.

4.4.3 Climate

The climate of the planning area is moderated by its proximity to the San Francisco Bay, with average annual temperatures ranging from 46.7°Fahrenheit (F) to 72.1°F. Climate records from the NOAA National Weather Service Forecast Office describe the region's climate as Mediterranean type. This classification is characterized by sharply contrasting wet and dry seasons, with the wet season from November through March bringing more than 80 percent of the total annual precipitation. Rainfall is sparse from May through September. Mean precipitation in June, July and August in Livermore normally totals only 0.14 inches. Wet seasons are cool but mild, with mean monthly temperatures of 47.2°F in January to 53.1°F in March. Dry season weather is very consistent, with warm sunny days and average temperatures reaching 85.9°F in June, July, August, and September. Average temperature and precipitation across the planning area are shown in Table 4-2.

Source: Alameda Creek Alliance, 2017

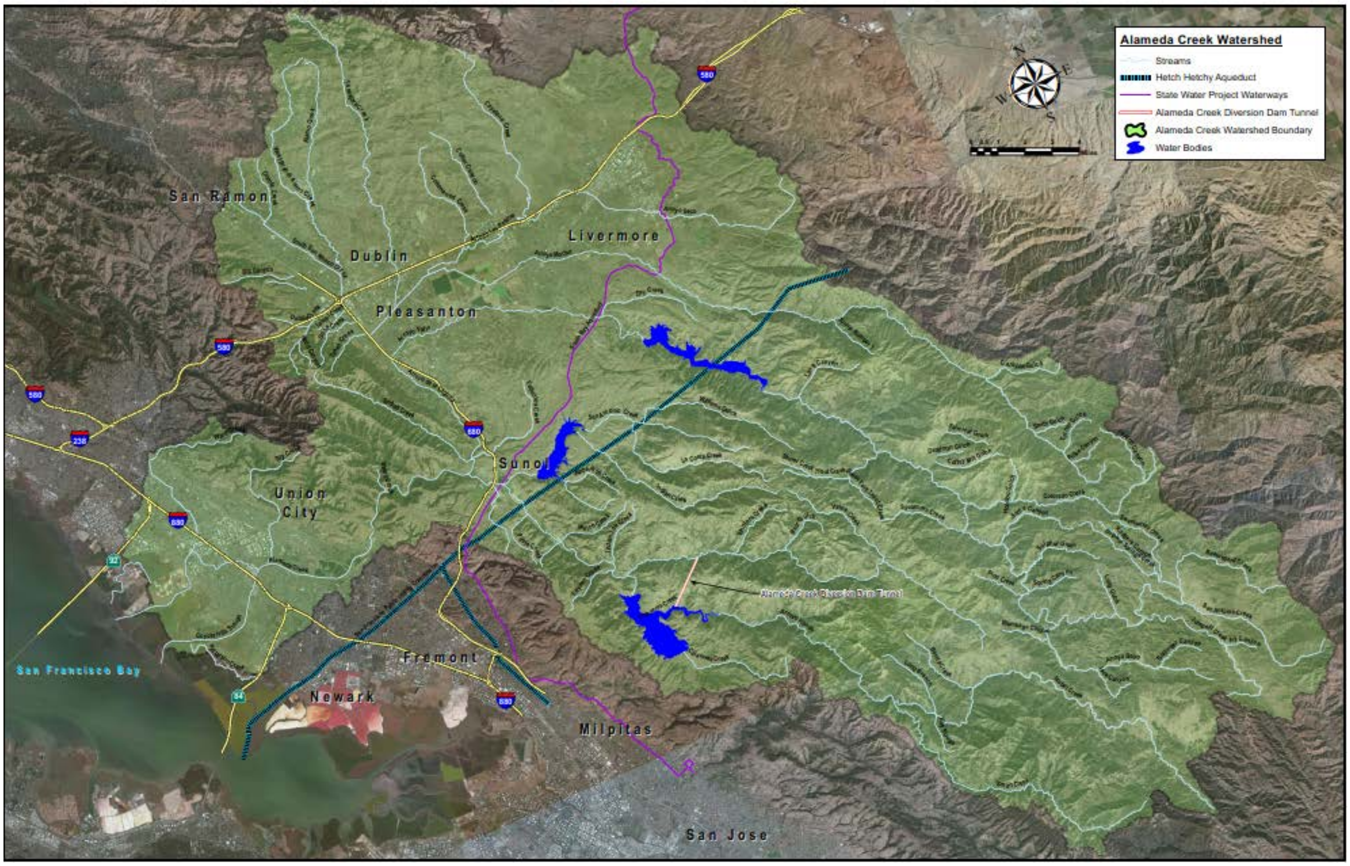


Figure 4-2. Watersheds and Water Bodies in the Planning Area

Table 4-2. Normal Precipitation and Temperatures in Planning Area, 1998-2016

	Precipitation (inches)	Minimum Temperature (ºF)	Maximum Temperature (ºF)
January	2.22	37.3	57.0
February	2.72	39.4	60.1
March	1.92	41.5	64.7
April	1.14	44.0	68.0
May	0.57	48.9	75.0
June	0.13	53.4	81.8
July	0.0	56.6	87.1
August	0.01	56.5	87.4
September	0.08	54.8	85.4
October	0.93	49.1	76.2
November	1.41	41.9	64.6
December	2.82	37.5	57.6
Annual	13.94	46.7	72.1

Source: Western U.S. Climate Historical Summaries, 2017

4.5 DEVELOPMENT PROFILE

4.5.1 Land Use

Dublin

The City of Dublin, located north of Interstate 580, covers 15.51 square miles, or 9,923.6 acres. As of 2017, the city accommodates 20,931 housing units. The City has defined the following planning areas:

- The Primary Planning Area consists of the original city boundaries and annexations completed through 1991. It covers roughly 3,100 acres.
- The Eastern Extended Planning Area is east of the Primary Planning Area and south and east of the U.S. Army's Parks Reserve Forces Training Area (Camp Parks). It covers roughly 4,300 acres.
- The Western Extended Planning Areas is west of the Primary Planning Area. It consists of 3,200 acres, mostly outside Dublin's urban limit line, which encompasses the city areas with access to city utilities and road maintenance services.
- The Dublin Crossing Planning Area, a portion of Camp Parks, covers 189 acres in the center of the city where existing buildings are scheduled for demolition to be replaced with a residential mixed-use project.

The city's land use includes a mixture of public open space, commercial/industrial, and residential. Development guidelines for the Eastern Extended Planning Area consider visually sensitive ridge lands and biologically sensitive habitat areas to preserve key elements of the area's physical character. A development elevation cap keeps growth within the 770-foot elevation that is the highest serviceable elevation for water service. Development is allowed in only a small portion of the Western Extended Planning Area; that area is out of view from the major ridgelines so it can be developed without disrupting scenic values (General Plan, 2014).

Livermore

The City of Livermore, on the eastern side of the Tri-Valley planning area, covers 26.46 square miles, or 16,931.3 acres. As of 2017, the city accommodates 31,848 housing units. Single-family residential development is the predominant land use within the city limits, with residential subdivisions scattered throughout the city. Other land uses are agriculture, open space and parks, industry, retail and office space, and community facilities. The city has a defined urban growth boundary to protect agricultural uses and natural resources outside the city from future urban development (General Plan, 2014).

Pleasanton

The City of Pleasanton covers 24.24 square miles, or 15,513.8 acres, and he City designates future land use for an additional 75-square-mile area. A 42-square-mile sphere-of-influence area represents the probable ultimate physical boundary and service area of the city. As of 2017, the City accommodates 27,176 housing units. City land use policy allows for well-planned neighborhoods and a separation between residential and non-residential uses. As of 2017, there are 77 residential neighborhoods and 17 commercial, office, and industrial development sub-areas. The City's growth management ordinance regulates the location and rate of new residential growth. (General Plan, 2015).

Summary

Table 4-3 summarizes current land use across the Tri-Valley planning area. Land use information is analyzed in this plan for each identified hazard that has a defined spatial extent and location. For hazards that lack this spatial reference, the information in Table 4-3 serves as a baseline estimate of land use and exposure for the planning area. The distribution of land uses within the planning area will change over time.

Table 4-3. Present Land Use in Planning Area

Present Use Classification	Area (acres)	% of total
Residential	14,343	33.9%
Commercial	3,737	8.8%
Industrial	1,599	3.8%
Agriculture	99	0.2%
Religion / Assembly	567	1.3%
Government / Institutional	2,576	6.1%
Education	952	2.2%
Vacant / Rights-of-Way / Water / Open Space	18,496	43.7%
Total	42,369	100.0%

4.5.2 Critical Facilities and Infrastructure

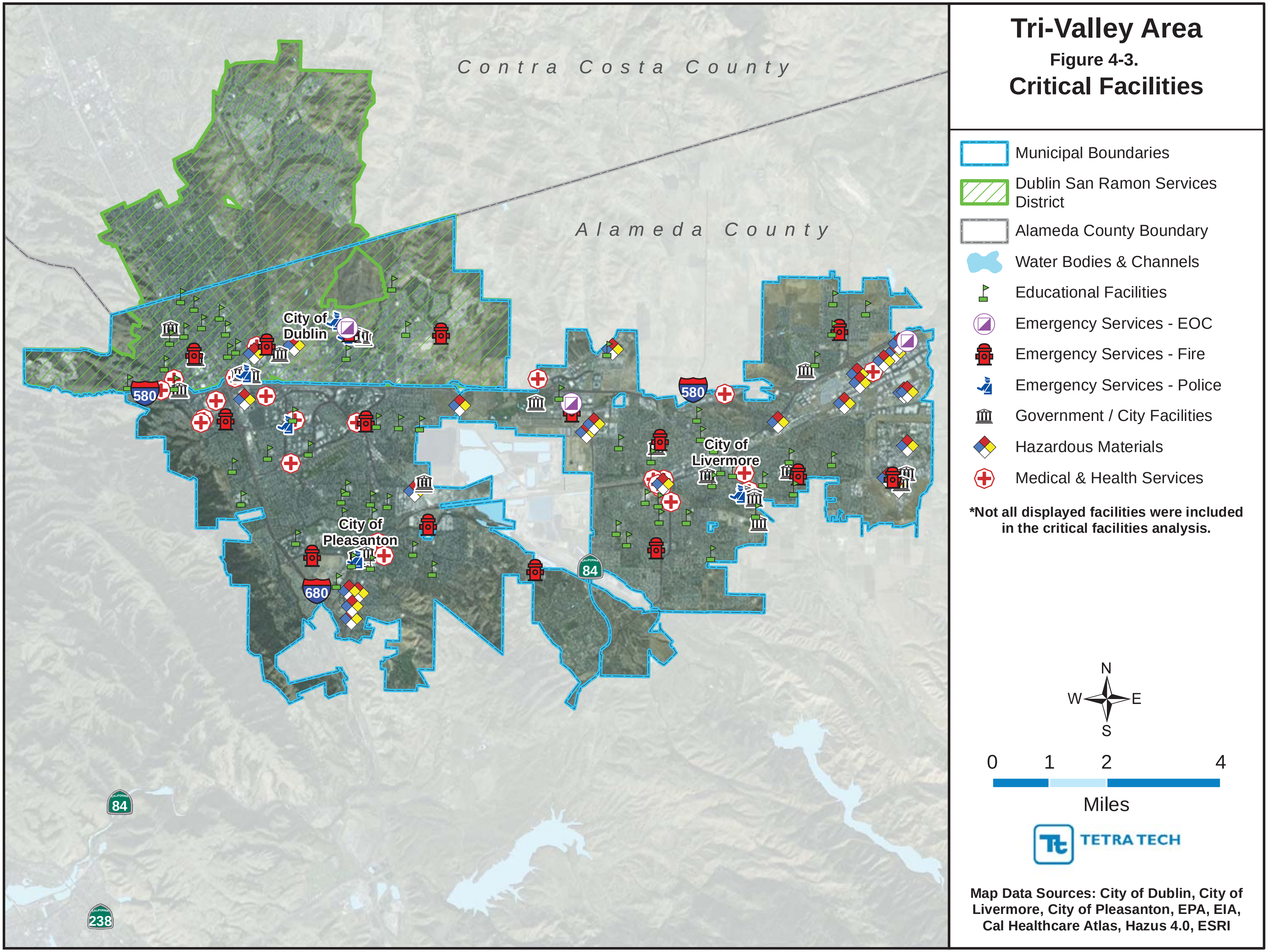
Facilities and infrastructure that are essential to the health and welfare of the population are designated as critical facilities and infrastructure. These are especially important after a hazard event. Critical facilities typically include police and fire stations, schools and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need, as well as the utilities that provide water, electricity and communication services to the community. Also included are facilities and railroads that hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event. For this hazard mitigation plan, a critical facility is defined as follows:

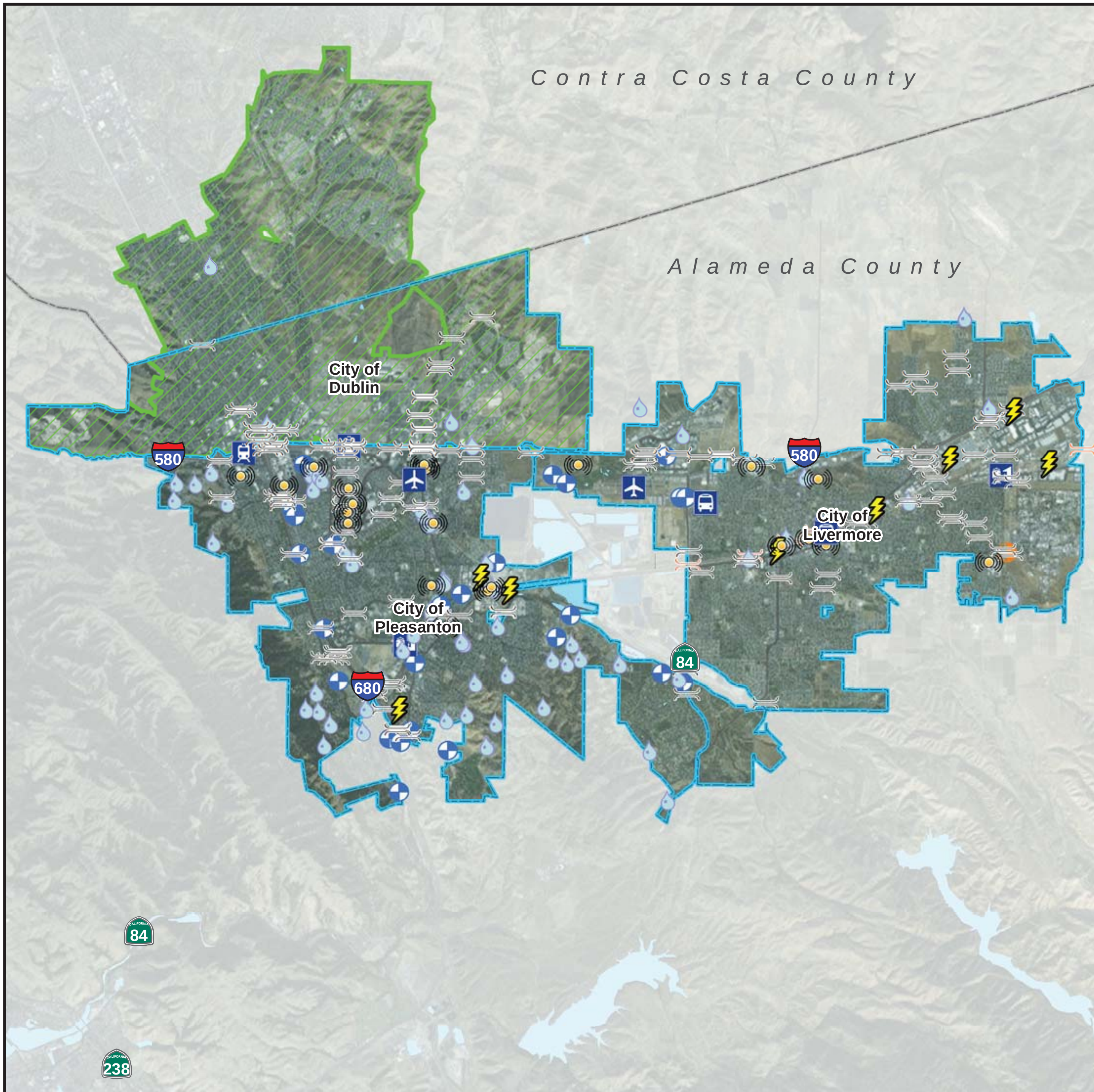
> *A structure or other improvement that, because of its function, size, service area, or uniqueness, has the potential to cause serious bodily harm, extensive property damage, or disruption of vital socioeconomic activities if it is destroyed or damaged or if its functionality is impaired. Critical facilities include potential shelters, transportation facilities, potential morgue facilities, private facilities, levees, health and safety facilities, utilities, government facilities, and hazardous materials facilities.*

Figure 4-3 and Figure 4-4 show the location of critical facilities and infrastructure in the planning area. Due to the sensitivity of this information, a detailed list of facilities is not provided. Table 4-4 provides summaries of the general types of critical facilities and infrastructure. All critical facilities/infrastructure were analyzed in Hazus to help rank risk and identify mitigation actions. The risk assessment for each hazard qualitatively discusses critical facilities with regard to that hazard.

Table 4-4. Planning Area Critical Facilities

	Number of Facilities								
	Medical and Health Services	Emergency Services	Educational Facilities	Government	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	5	10	16	11	3	26	2	0	73
Livermore	11	9	26	11	28	61	16	0	162
Pleasanton	9	7	20	7	101	62	7	0	213
Total	25	26	62	29	132	149	25	0	448


Contra Costa County
Alameda County
City of Dublin
City of Pleasanton
City of Livermore
580
680
84
238
Tri-Valley Area
Figure 4-3.
Critical Facilities
Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels
Educational Facilities
Emergency Services - EOC
Emergency Services - Fire
Emergency Services - Police
Government / City Facilities
Hazardous Materials
Medical & Health Services
*Not all displayed facilities were included in the critical facilities analysis.
N
W
E
S
0
1
2
4
Miles
TETRA TECH
Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, EPA, EIA, Cal Healthcare Atlas, Hazus 4.0, ESRI



Tri-Valley Area

Figure 4-4.

Critical Infrastructure

- Municipal Boundaries
- Dublin San Ramon Services District
- Alameda County Boundary
- Water Bodies & Channels
- Airport Facilities
- Bus Facilities
- Communication Facilities
- Electric Power Facilities
- Highway Bridges
- Light Rail Facilities
- Oil Facilities
- Potable Water Facilities
- Rail Facilities
- Railway Bridges
- Waste Water Facilities

***Not all displayed facilities were included in the critical facilities analysis.**

N W E S

0 1 2 4

Miles

TETRA TECH

Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, EPA, EIA, Cal Healthcare Atlas, Hazus 4.0, ESRI

4.5.3 Future Trends in Development

The planning area municipal partners have adopted general and economic development strategic plans to guide future growth, both local and area-wide, and ensure the orderly development of the communities. Development forecasts and development trends assist in providing a long-term vision for the planning area's future and a strategy for achieving the desired vision. This plan aligns with these development programs and provides vital information on the risk associated with natural hazards in the planning area to support wise land use in the future.

Tracking building permit volume can be a way of looking at the potential increase in exposure within the planning area. Weather a permit is issued for new construction or improvement to existing construction, the permit volume can be associated with an increase in exposed value. The number of residential building permits reported in the planning area has fluctuated significantly from a high of 965 permits in 2014 to a low of 227 permits in 2007. The permit number jumped in 2012 and stayed steady through 2014. In 2014, the City of Dublin issued residential building permits for 816 buildings, which was significantly higher than the City of Livermore with 71 and the City of Pleasanton with 78 (City-Data.com, 2017).

Figure 4-5 shows the trends in residential development projects in the planning area since 2005. Additional city-specific development trend information is provided in the city-specific annexes in Volume 2 of this plan.

Source: City-Data.com, 2017

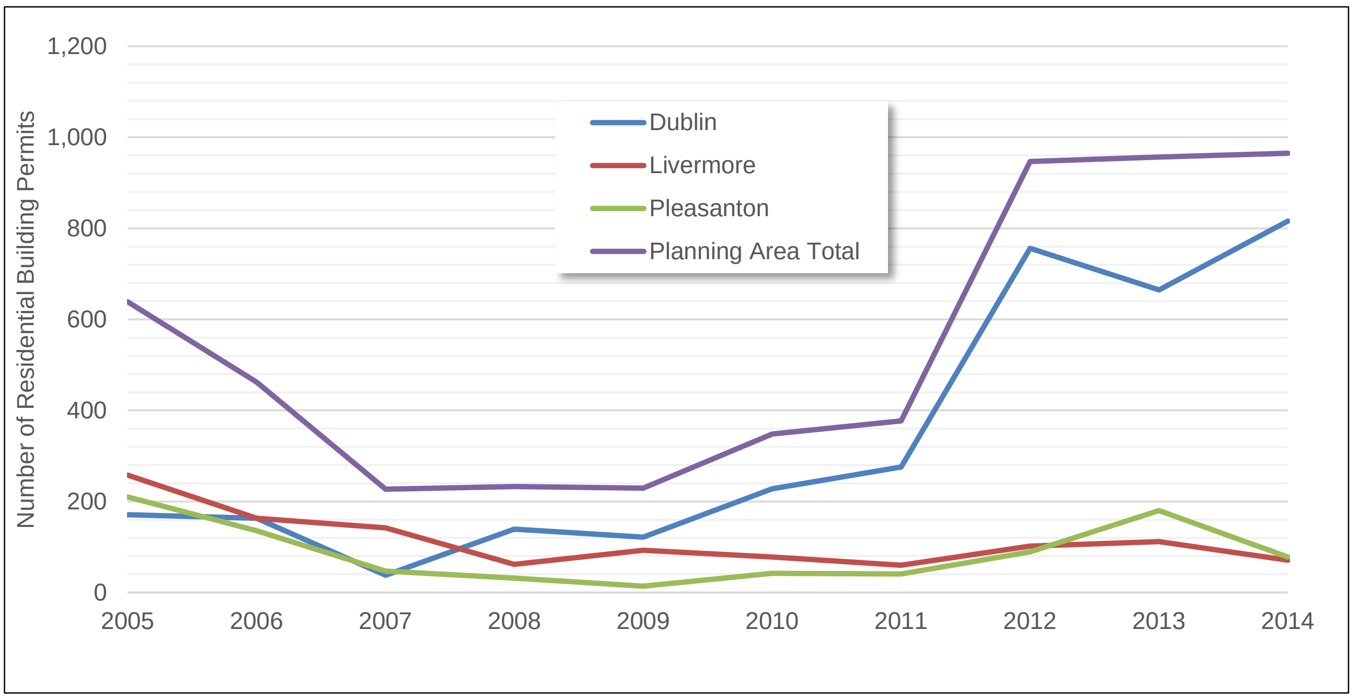


Figure 4-5. Residential Building Permit Trends, 2005 to 2014

The municipal partners will incorporate this hazard mitigation plan in their general plans by reference. This will ensure that future development trends can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan. The planning partners intend to pursue the following:

- Discourage development within vulnerable areas, areas with the potential for high population density, and Special Flood Hazard Areas.
- Encourage higher regulatory standards at the local level.

Future development is expected to focus on infill as identified through current land use practices. Dublin, Livermore and Pleasanton are largely built out, and with sustainability practices and urban growth boundaries in place, there is little opportunity for new growth.

4.6 DEMOGRAPHICS

In general, the functional and access needs 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 (especially older single men), people with disabilities, women, children, ethnic minorities and renters all experience, to some degree, 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 citizens.

4.6.1 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. The California Department of Finance (CA DOF) estimated the planning area population at 225,250 as of January 1, 2017.

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline. Figure 4-6 shows the planning area and Alameda County population change from 1970 to 2017 according to the California Department of Finance. Between 1970 and 2017, Alameda County's population grew by 53.32 percent and the planning area's population increased by 223.30 percent. Much of the growth in the planning area occurred between 1970 and 1990, though double-digit growth continues and the local growth still exceeds that of the county. The population of the planning area increased 72.55 percent from 1990 to 2017, with Dublin gaining 36,457 residents, Livermore gaining 32,907, and Pleasanton gaining 25,346. Table 4-5 shows population in the planning area from 2010 to 2017 (CA DOF, 2017a).

4.6.2 Age Distribution

As a group, the elderly are more apt 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 accessing information or evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need individualized 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.

Source: CA DOF, 2017a

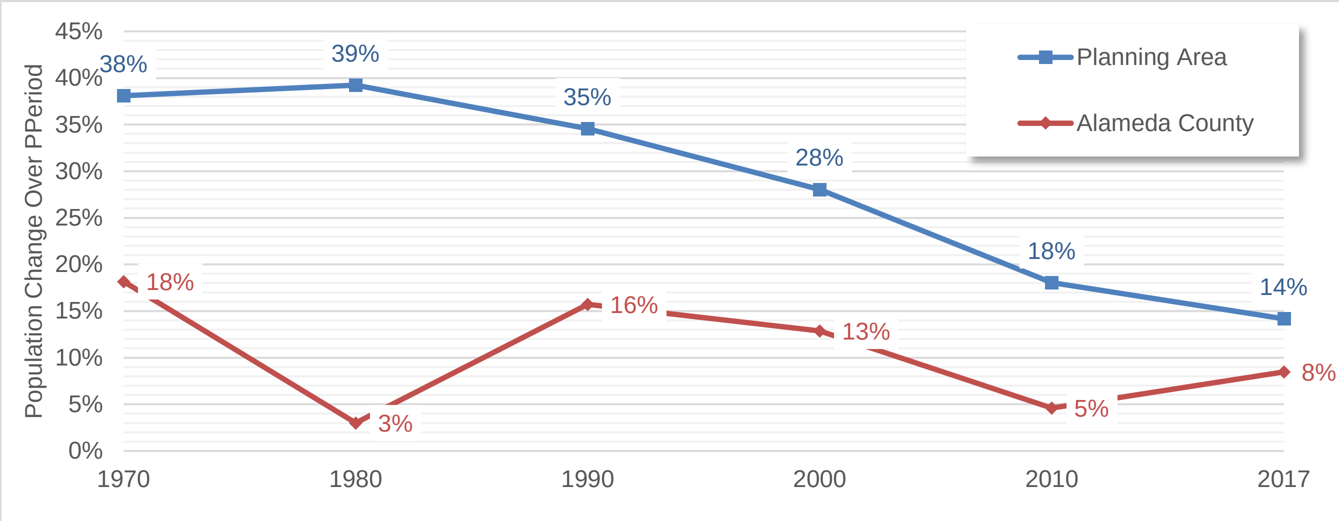


Figure 4-6. Alameda County vs. Planning Area Population Growth

Table 4-5. Annual Population Data

	Population			
	Dublin	Livermore	Pleasanton	Tri-Valley Planning Area
2010	46,036	80,968	70,285	197,289
2011	46,408	81,948	70,813	199,169
2012	46,956	82,772	71,117	200,845
2013	50,079	83,768	71,153	205,000
2014	53,512	85,049	71,990	210,551
2015	56,014	86,368	73,776	216,158
2016	57,349	88,138	74,982	220,469
2017	59,686	89,648	75,916	225,250

Source: CA DOF, 2017a

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 for the planning area is shown in Figure 4-7. Based on the U.S. Census 2011-2015 American Community Survey (ACS) 5-year estimates, 11.41 percent of the planning area's population is 65 or older, compared to Alameda County's average of 12.1 percent. The Census data also show that 4.23 percent of the under-65 population has disabilities of some kind and 4.7 percent have incomes below the poverty line. It is also estimated that 26.8 percent of the population is 18 or younger, compared to Alameda County's average of 21.7 percent (U.S. Census, 2016).

Source: U.S. Census, 2016

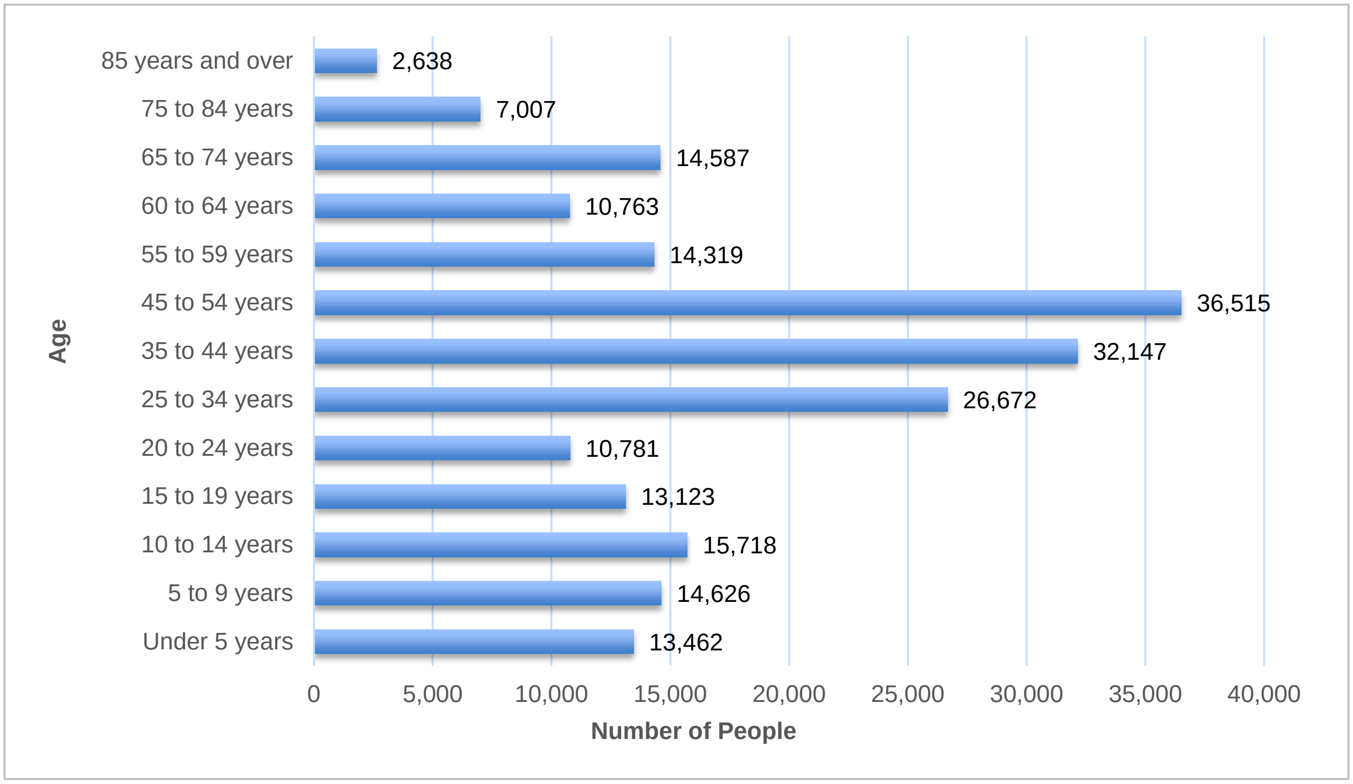


Figure 4-7. Planning Area Age Distribution

4.6.3 Race, Ethnicity and Language

Research shows that 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. According to the U.S. Census 2011-2015 ACS 5-year estimates, the racial composition of the planning area is predominantly white, at 67 percent, with 22 percent Asian and 3 percent black or African American. Figure 4-8 shows the racial distribution in the planning area. Census data also indicate that 15 percent of individuals in the planning area are Hispanic or Latino (of any race) and that 24.33 percent of the planning area population is foreign-born.

4.6.4 Individuals with Disabilities and Others with Access and Functional Needs

The 2010 U.S. Census estimates that 54 million non-institutionalized people with disabilities and others with access and functional needs live in the U.S. This equates to about one-in-five persons. This population is 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 needs is paramount to life safety efforts. Knowing the percentage of population with a disability or access and functional need will allow emergency management personnel and first responders to have personnel available who can provide services needed by this population. According to the 2011-2015 ACS 5-year estimates, there are 15,044 individuals with some form of disability, access, or functional need within the planning area (U.S. Census, 2016a).

Source: U.S. Census, 2016

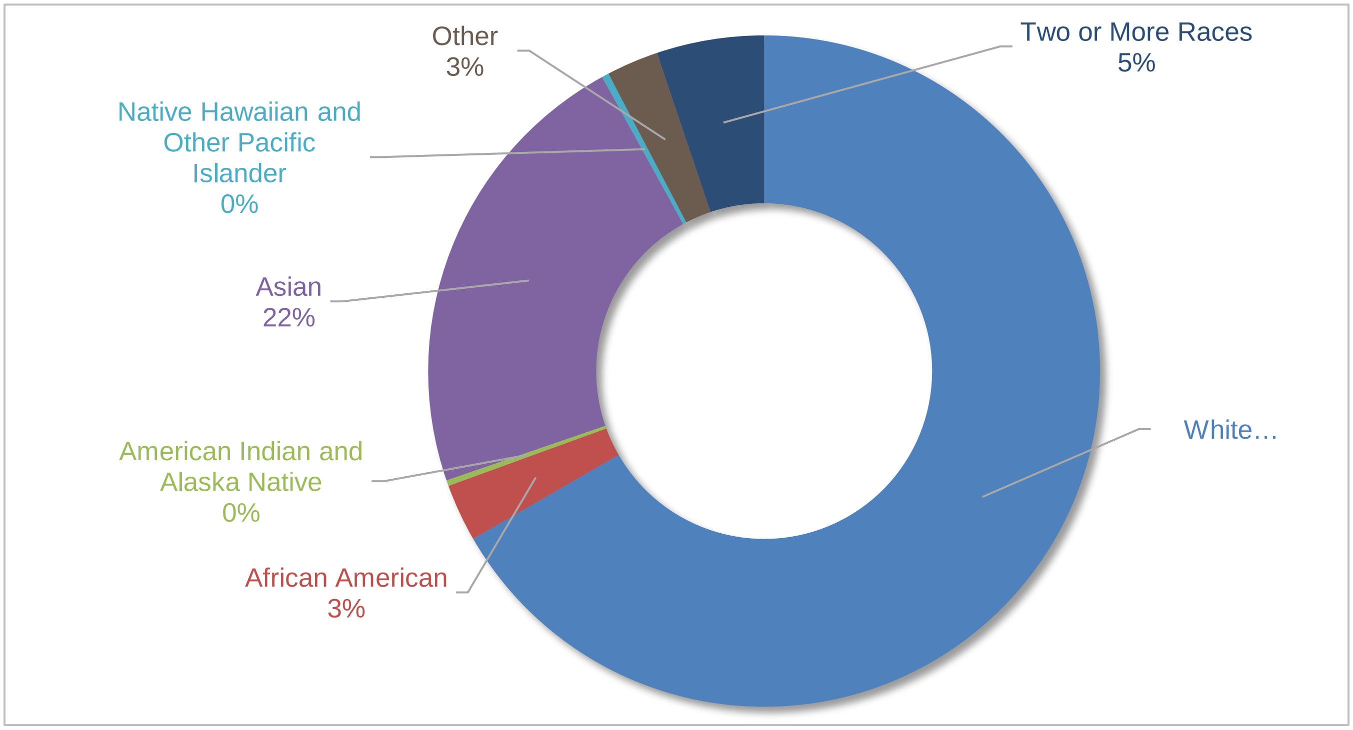


Figure 4-8. Planning Area Race Distribution

4.7 ECONOMY

4.7.1 Income

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This expectation means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the economically disadvantaged typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the economically disadvantaged often live in older houses and apartment complexes, which are more likely to be made of unreinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decisions on evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on 2011-2015 ACS 5-year estimates, average per capita income in the planning area in 2015 was $47,658 and the median household income was $114,841. As defined by the Office of Management and Budget and U.S. Census Bureau, the poverty threshold in 2015 was $24,257 for a household with two adults and two children, and $12,082 for one person (unrelated individual) (U.S. Census, 2016b).

2011-2015 ACS 5-year estimates showed that roughly 22.45 percent of households in the planning area receive an income between $100,000 and $149,999 per year and over 34.50 percent of household incomes are above $150,000 annually. About 8.10 percent of the households in the planning area make less than $25,000 per year.

4.7.2 Industry, Businesses and Institutions

Figure 4-9 shows the planning area breakdown of employment by U.S. Census-defined industry types from 2011-2015 ACS 5-year estimates. Professional, scientific, and management, and administrative and waste management services has the highest percentage of employees with 15.5 percent. Followed by educational services, and health care and social assistance with 13.3 percent.

Source: U.S. Census, 2016c

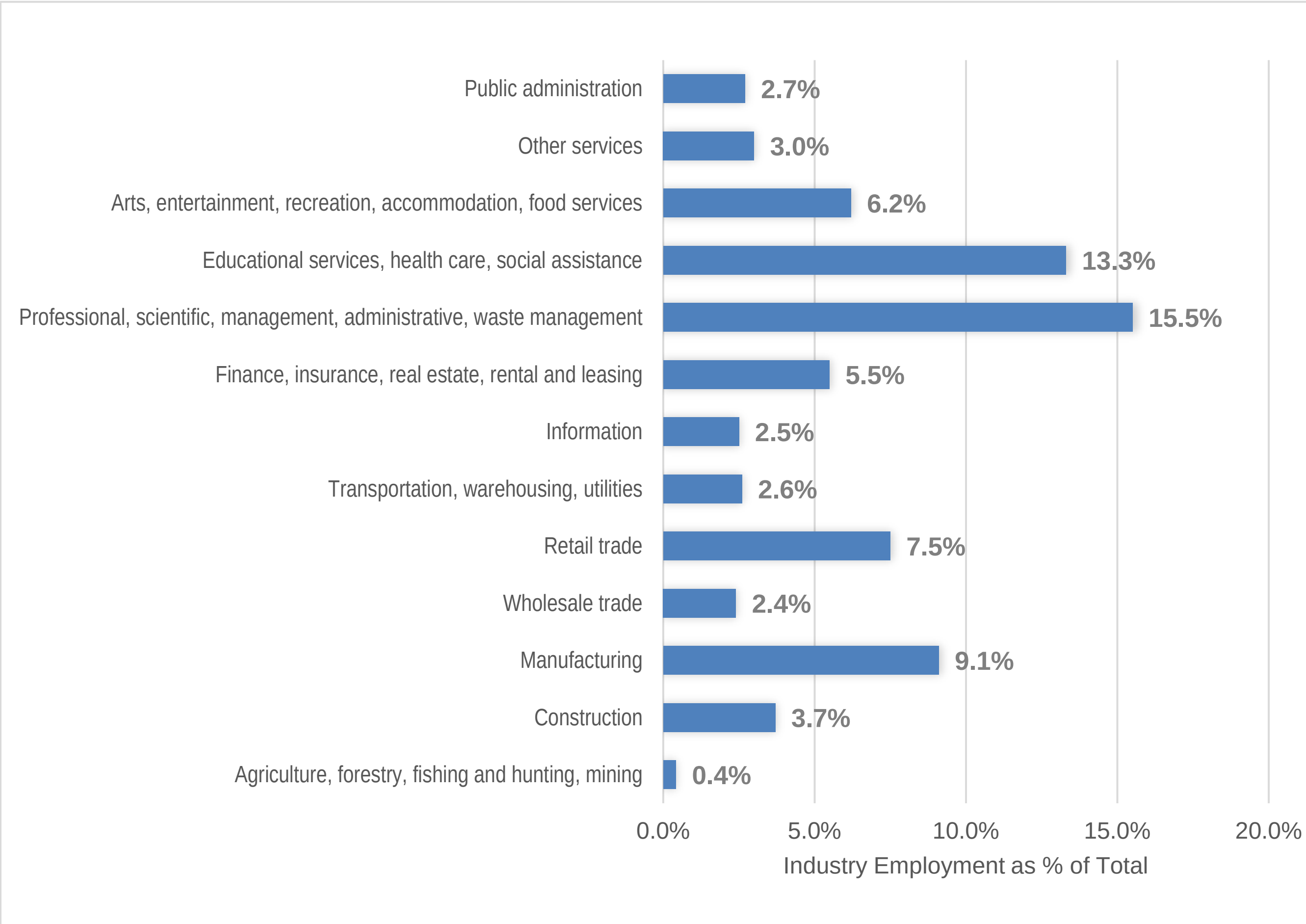


Figure 4-9. Industry in the Planning Area by Population Employed

The planning area benefits from a variety of business activity. Major businesses with headquarters in Dublin include Ross Stores, Challenge Dairy, Tria Beauty and DeSilva Gates Construction. Technology firms in Dublin include Micro Dental Laboratories, Callidues Cloud, Carl Zeiss Meditec, and Epicor. Top employers in City of Livermore include Lawrence Livermore National Laboratory, Valley Care Health System Lifestyle Rx Fitness Center, Livermore Valley Joint Unified School District, Comcast Cable, and Sandia National Laboratory, and Form Factor, Inc., Gillig Bus, and Tesla warehouse. Top employers in City of Pleasanton include Kaiser Permanente, Safeway, Oracle, Workday Inc., Pleasanton Unified School District, Macy's, and Valley Care Medical Center.

4.7.3 Employment Trends and Occupations

According to the 2011-2015 ACS 5-year estimates, about 50 percent of the planning area's population is in the labor force. Of the working-age population group (ages 18 – 64), 48 percent of the population in the labor force are employed. Figure 4-10 shows the distribution of workers by occupation category.

Source: U.S. Census, 2016d

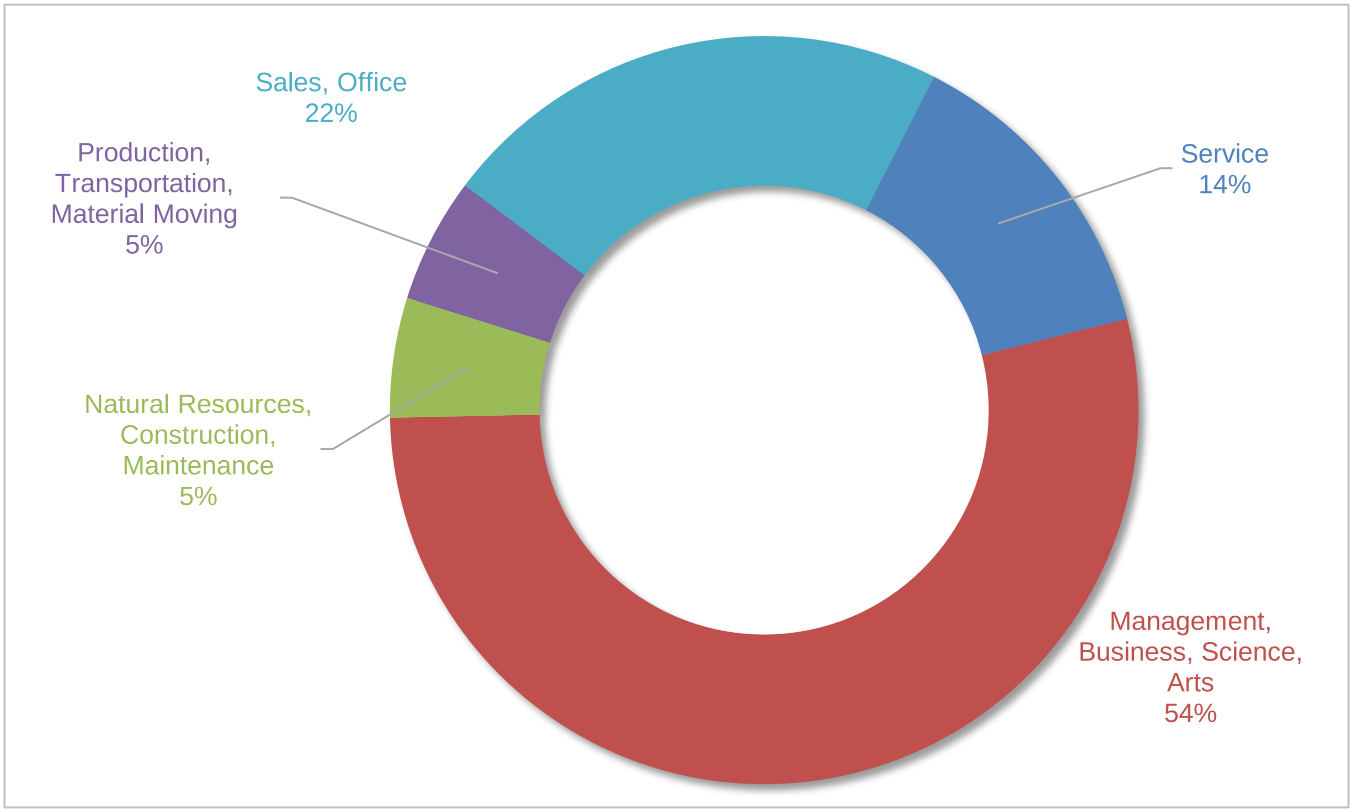


Figure 4-10. Occupations in the Planning Area

Figure 4-11 compares California and planning area unemployment trends from 2010 through 2016. Unemployment in the planning area has remained lower than the state average, and is lowest in 2016, at 4.20 percent. Unemployment rates have been on the decline since until 2010 in both the state and the planning area.

The 2011-2015 ACS 5-year estimates show that over 70 percent of the employed population 16 years and older in the planning area, or 97,722 individuals, commute to work. Of those, 80.90 percent drove alone (by car, truck or van) to work, and 8.18 percent carpooled (by car, truck or van). The mean travel time to work in the planning area is 32 minutes; the state average is 27.6 minutes (U.S. Census, 2016e).

Source: CA EDD, 2017

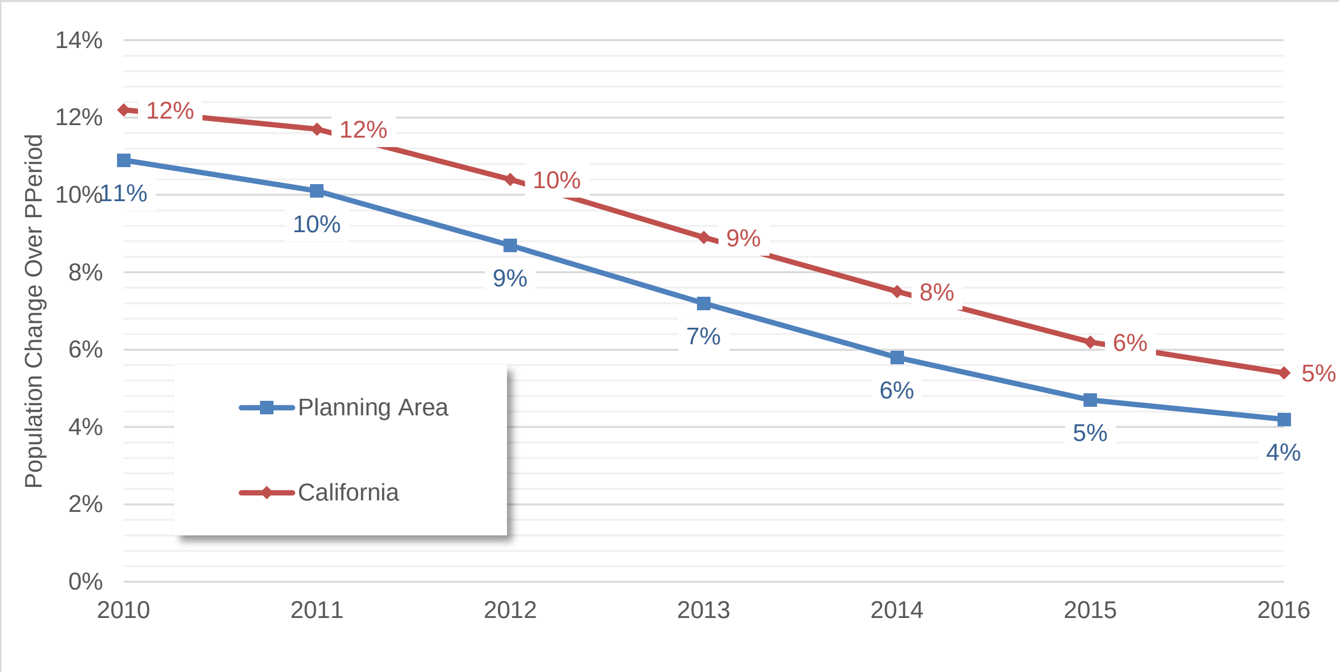


Figure 4-11. California State and Planning Area Unemployment Rate

4.8 LAWS AND ORDINANCES

Existing laws, ordinances, plans and programs at the federal, state and local 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 in the review of local capabilities to implement the actions found in the jurisdictional annexes of Volume 2. Each planning partner has individually reviewed existing local plans, studies, reports, and technical information in its jurisdictional annex, presented in Volume 2.

4.8.1 Federal

Disaster Mitigation Act

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

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to consider the environmental impacts of proposed actions and reasonable alternatives to those actions, alongside technical and economic considerations. NEPA established the Council on Environmental Quality (CEQ), whose regulations (40 CFR Parts 1500-1508) set standards for NEPA 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.

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.

The 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, 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. A full array of 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.

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.

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.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. Dublin, Livermore and Pleasanton participate in the NFIP and have adopted regulations that meet the NFIP requirements. At the time of the preparation of this plan, all municipal jurisdictions were in good standing with NFIP requirements.

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 other instances, success depends on the involvement of multiple jurisdictions, levels of government, functional agencies, and emergency-responder disciplines. These instances necessitate coordination across the 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, terrorist activities, and other human-caused disasters) 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.

Americans with Disabilities Act and Amendments

The Americans with Disabilities Act (ADA) seeks to prevent discrimination against people with disabilities in employment, transportation, public accommodation, communications, and government activities. The most recent amendments became effective in January 2009 (P.L. 110-325). 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 any 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 visual alerts. Two stand-alone technical documents have been issued for shelter operators to meet the needs of people with disabilities. These documents address physical accessibility as well as medical needs and service animals.

The ADA also 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 (such as 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.

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.

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.

Emergency Watershed Program

The USDA Natural Resources Conservation Service administers the Emergency Watershed Protection 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, wind-storms, and other natural occurrences. The Emergency Watershed Protection is an emergency recovery program. Financial and technical assistance are available for the following activities (NRCS, 2005):

- 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.

Presidential Executive Orders 11988 and 13690

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, 1977):

- 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.

Executive Order 13690 expands Executive Order 11988 and acknowledges that the impacts of flooding are anticipated to increase over time due to the effects of climate change and other threats. It mandates a federal flood risk management standard to increase resilience against flooding and help preserve the natural values of floodplains. This standard expands management of flood issues from the current base flood level to a higher vertical elevation and corresponding horizontal floodplain when federal dollars are involved in a project. The goal is to address current and future flood risk and ensure that projects funded with taxpayer dollars last as long as intended (FEMA, 2015). All actions identified in this plan will seek full compliance with all applicable presidential executive orders.

The Federal Flood Risk Management Standards established by EO 13690 were revoked on August 15, 2017.

Presidential Executive Order 11990

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 (FEMA, 1977):

- 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 Programs

The U.S. Army Corps of Engineers has several civil works authorities and programs related to flood risk and flood hazard management:

- Floodplain Management Services are 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 afforded under PL 84-99 is broken down in to the following 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—**PL 84-99 allows the Corps of Engineers to supplement state and local entities in flood-fighting for 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 (PCA) signed by the public sponsor and a requirement for the sponsor to remove all flood-fight material after the flood has receded. PL 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 PL 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 eligible for PL 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.

All of these authorities and programs are available to the planning partners to support any intersecting mitigation actions.

4.8.2 State

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 (California Department of Conservation, 2010). All seismic hazard mitigation actions identified in this plan will seek full compliance with the Alquist-Priolo Earthquake Fault Zoning Act.

California General Planning Law

California state law requires that every county and city prepare and adopt a comprehensive long-range plan to serve as a guide for community development. The general plan expresses the community’s goals, visions, and policies relative to future land uses, both public and private. The general plan is mandated and prescribed by state law (Cal. Gov. Code §65300 et seq.), and forms the basis for most local government land use decision-making.

The plan must consist of an integrated and internally consistent set of goals, policies, and implementation measures. In addition, the plan must focus on issues of the greatest concern to the community and be written in a clear and concise manner. City actions, such as those relating to land use allocations, annexations, zoning, subdivision and design review, redevelopment, and capital improvements, must be consistent with the plan.

All municipal planning partners to this plan have general plans that are currently compliant with this law and have committed to integrating this mitigation plan with their general plans through provisions referenced below (AB-2140 and SB-379)

California Environmental Quality Act

The California Environmental Quality Act (CEQA) was passed in 1970, shortly after the federal government passed 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 analyses on projects to determine if there are potentially significant environmental impacts, identify mitigation measures, and propose possible project alternatives by preparing environmental reports for projects that require CEQA review. This environmental review is required before an agency takes action on any policy, program, or project.

Dublin, Livermore and Pleasanton have all sought exemption from CEQA for this hazard mitigation plan, using the 15300 Categorical Exemption section of the CEQA guidelines:

- **Section 15300:** "...CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA."

AB 162: Flood Planning

This California State Assembly bill passed in 2007 requires cities and counties to address flood-related matters in the land use, conservation, and safety and housing elements of their general plans. The land use element must identify and annually review the areas covered by the general plan that are subject to flooding as identified in floodplain mapping by either FEMA or the California Department of Water Resources (DWR). Upon the next revision of the housing element on or after January 1, 2009, the conservation element of the general plan must identify rivers, creeks, streams, flood corridors, riparian habitat, and land that may accommodate floodwater for the purposes of groundwater recharge and stormwater management. The safety element must identify information regarding flood hazards including:

- Flood hazard zones
- Maps published by FEMA, DWR, the U.S. Army Corps of Engineers, the Central Valley Flood Protection Board, Cal OES, etc.
- Historical data on flooding
- Existing and planned development in flood hazard zones.

The general plan must establish goals, policies and objectives to protect from unreasonable flooding risks including:

- Avoiding or minimizing the risks of flooding new development
- Evaluating whether new development should be located in flood hazard zones
- Identifying construction methods to minimize damage.

AB 162 establishes goals, policies and objectives to protect from unreasonable flooding risks. It establishes procedures for the determination of available land suitable for urban development, which may exclude lands where FEMA or DWR has determined that the flood management infrastructure is not adequate to avoid the risk of flooding.

AB 2140: General Plans—Safety Element

This bill provides that the state may allow for more than the standard 75 percent cost share for public assistance funding under the California Disaster Assistance Act only if the local agency is in a jurisdiction that has adopted a local hazard mitigation plan as part of the safety element of its general plan. The local hazard mitigation plan needs to include elements specified in this legislation. In addition this bill requires Cal OES to give federal mitigation funding preference to cities and counties that have adopted local hazard mitigation plan. The intent of the bill is to encourage cities and counties to create and adopt hazard mitigation plans.

AB 70: Flood Liability

This bill provides that a city or county may be required to contribute a fair and reasonable share to compensate for property damage caused by a flood to the extent that it has increased the state's exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project, unless the city or county meets specified requirements.

AB 32: The California Global Warming Solutions Act

This bill addresses greenhouse gas emissions. It 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 recently 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.

AB 2800: Climate Change—Infrastructure Planning

This California State Assembly bill, in effect through 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 requires the agency to establish a climate-safe infrastructure working group by July 1, 2017, to examine how to integrate scientific data concerning projected climate change impacts into state infrastructure engineering.

Senate Bill 97: Guidelines for Greenhouse Gas Emissions

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

Senate Bill 1241: General Plans: Safety Element—Fire Hazard Impacts

In 2012, Senate Bill 1241 passed requiring that all future general plans address fire risk in state responsibility areas and very high fire hazard severity zones in their safety element. In addition, the bill requires cities and counties to make certain findings regarding available fire protection and suppression services before approving a tentative map or parcel map.

Senate Bill 1000 General Plan Amendments: Safety and Environmental Justice Elements

In 2016, Senate Bill 1000 amended California's Planning and Zoning Law in two ways:

- The original law established requirements for initial revisions of general plan safety elements to address flooding, fire, and climate adaptation and resilience. It also required subsequent review and revision as necessary based on new information. Senate Bill 1000 specifies that the subsequent reviews and revision based on new information are required to address only flooding and fires (not climate adaptation and resilience).
- Senate Bill 1000 adds a requirement that, upon adoption or revision of any two other general plan elements on or after January 1, 2018, an environmental justice element be adopted for the general plan or environmental justice goals, policies and objectives be incorporated into other elements of the plan.

Senate Bill 379: General Plans: Safety Element—Climate Adaptation

Senate Bill 379 builds upon the flood planning inclusions into the safety and housing elements and the hazard mitigation planning safety element inclusions in general plans outlined in AB 162 and AB 2140, respectively. SB 379 focuses on a new requirement that cities and counties include climate adaptation and resiliency strategies in the safety element of their general plans beginning January 1, 2017. In addition, this bill requires general plans to include a set of goals, policies and objectives, and specified implementation measures based on the conclusions drawn from climate adaptation research and recommendations.

California State Building Code

California Code of Regulations Title 24 (CCR Title 24), also known as the California Building Standards Code, is a compilation of building standards from three sources:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes
- Building standards that have been adopted and adapted from the national model code standards to meet California conditions
- Building standards authorized by the California legislature that constitute extensive additions not covered by the model codes adopted to address particular California concerns.

The state Building Standards Commission is authorized by California Building Standards Law (Health and Safety Code Sections 18901 through 18949.6) to administer the processes related to the adoption, approval, publication, and implementation of California's building codes. These building codes serve as the basis for the design and construction of buildings in California. The national model code standards adopted into Title 24 apply to all occupancies in California except for modifications adopted by state agencies and local governing bodies. Since 1989, the Building Standards Commission has published new editions of Title 24 every three years.

On January 1, 2014, California Building Code Accessibility Standards found in Chapter 11B incorporated the 2010 Americans with Disabilities Act (ADA) Standards as the model accessibility code for California. The purpose for this incorporation was to ensure consistency with federal guidelines. As a result of this incorporation, the California standards will fully implement and include 2010 ADA Standards within the California Building Code while maintaining enhanced levels of accessibility already provided by existing California accessibility regulations.

Standardized Emergency Management System

CCR Title 19 establishes the Standardized Emergency Management System (SEMS) to standardize the response to emergencies involving multiple jurisdictions. SEMS 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 SEMS by December 1, 1996 in order to be eligible for state funding of response-related personnel costs under CCR Title 19 (Sections 2920, 2925 and 2930). Individual agencies' roles and responsibilities contained in existing laws or the state emergency plan are not superseded by these regulations.

State of California Multi-Hazard Mitigation Plan

Under the DMA, California must adopt a federally approved statewide hazard mitigation plan in order 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*. 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.

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. It required the following key actions:

- 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 by early 2009. 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.

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.

Geologic Abatement Districts

Geologic Hazard Abatement Districts (GHAD) enabled by the Beverly Act of 1979 (SB 1195), are potentially useful financial mechanisms for reducing hillslope hazards. The enabling statute, (Division 17 of the Public Resources Code, Sections 26500 - 26654) provides for the formation of local assessment districts for the purpose of prevention, mitigation, abatement, or control of geologic hazards. The Act broadly defines "geologic hazard" as "an actual or threatened landslide, land subsidence, soil erosion, earthquake, or any other natural or unnatural movement of land or earth." Currently, there are over 35 GHADs in California working to prevent, mitigate and abate geologic hazards.

4.8.3 Local

Plans, reports and other technical information were identified and provided directly by participating jurisdictions and stakeholders or were identified through independent research by the planning consultant. These documents were reviewed to identify the following:

- Existing jurisdictional capabilities.
- Needs and opportunities to develop or enhance capabilities, which may be identified within the local mitigation strategies.
- Mitigation-related goals or objectives, considered during the development of the overall goals and objectives.
- Proposed, in-progress, or potential mitigation projects and actions to be incorporated into the updated jurisdictional mitigation strategies.

Local regulations, codes, ordinances and plans were reviewed for the following capabilities, in order to develop complementary and mutually supportive goals, objectives, and mitigation strategies that are consistent across local and regional planning and regulatory mechanisms:

- **Legal and regulatory—**Jurisdictions have the ability to develop policies and programs and to implement rules and regulations to protect and serve residents. Local policies are typically identified in a variety of community plans, implemented via a local ordinance, and enforced through a governmental body. Jurisdictions regulate land use through the adoption and enforcement of zoning, subdivision and land development ordinances, building codes, building permit ordinances, floodplain, and stormwater management ordinances. When effectively prepared and administered, these regulations can lead to hazard mitigation.
- **Fiscal—**Assessing a jurisdiction's fiscal capability provides local governance with 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 impact fees.

- **Administrative and technical—**Legal, regulatory, and fiscal capabilities are needed to provide the backbone for successfully developing a mitigation strategy, but without appropriate personnel the strategy may not be implemented. The administrative and technical capability assessment focuses on the availability of personnel resources for implementing hazard mitigation. These personnel resources include technical experts, such as engineers and scientists, as well as capabilities that may be found in multiple departments, such as grant writers.
- **Development and permitting—**The ability to track previous and future growth in potential hazard areas provides an overview of increased exposure to a hazard within a community. Maintaining an inventory of buildable lands allows better estimation of potential future growth and resulting hazard exposure.
- **Public education and outreach—**Assessing outreach and education capability identifies the connection between government and community members, which opens a two-way dialogue and results in a more resilient community based on education and public engagement.
- **NFIP compliance—**Community participation in the NFIP lowers flood insurance premiums and opens up opportunity for grant funding to address flooding issues. Assessment of current NFIP status and compliance provides understanding about local flood management programs and opportunities for improvement.
- **Adaptive capacity for climate change**—Given the uncertainties associated with how hazard risk may change with a changing climate, a community's ability to track such changes and adapt as needed is an important component of ongoing hazard mitigation.
- **Classification under national community mitigation programs—**Community mitigation programs—such as the Community Rating System, Storm Ready and Firewise—enhance a jurisdiction's ability to mitigate, prepare for, and respond to natural hazards. These programs indicate a jurisdiction's desire to go beyond minimum requirements set forth by local, state, and federal regulations for the purpose of creating a more resilient community. They complement each other by focusing on communication, mitigation, and community preparedness to save lives and minimize the impact of natural hazards.

Tri-Valley Local Hazard Mitigation Plan

PART 2—RISK ASSESSMENT

5. IDENTIFIED HAZARDS OF CONCERN AND RISK ASSESSMENT METHODOLOGY

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- **Hazard identification**—Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- **Exposure identification—**Estimate the total number of people and properties in the jurisdiction that are likely to experience a hazard event if it occurs.
- **Vulnerability identification and loss estimation**—Assess the impact of hazard events on the people, property, environment, economy and lands of the region, including estimates of the cost of potential damage or cost that can be avoided by mitigation.

The risk assessment for this hazard mitigation plan update evaluates the risk of natural hazards prevalent in the planning area and meets requirements of the DMA (44 CFR, Section 201.6(c)(2)). To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual personal or public properties.

5.1 IDENTIFIED HAZARDS OF CONCERN

The Steering Committee considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as 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 presents complete risk assessment for the following hazards of concern (presented in alphabetical order; the order of listing does not indicate the hazards' relative severity):

- Climate change
- Dam failure
- Drought
- Earthquake
- Flood
- Landslide
- Severe weather
- Wildfire

In addition to the hazards of concern for which full risk assessments were performed, other hazards of interest were identified for inclusion in this plan: intentional human-caused hazards, technological hazards, and public health hazards. These hazards are of interest because they present risk to the planning area. However, no methodologies are currently available to perform risk assessments on them that are equivalent to those used for the natural hazards of concern addressed in detail in this plan.

5.2 RISK ASSESSMENT TOOLS

5.2.1 Mapping

National, state and local databases were reviewed to locate 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 sections of this document. Information regarding the data sources and methodologies employed in these mapping efforts is located in Appendix B.

5.2.2 Hazus

Overview

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

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. Level 2 estimates of losses require detailed information on local geology, hydrology, hydraulics, building inventory, 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.

5.3 RISK ASSESSMENT APPROACH

The risk assessments in this plan describe the risks associated with each hazard of concern identified. 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 assessed by overlaying hazard maps with an inventory of structures, facilities, and systems to decide which of them would be exposed to each hazard.
- **Assess the vulnerability of exposed facilities**—Vulnerability of exposed structures and infrastructure was evaluated 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 Hazus were used for this assessment for the dam failure, earthquake, and flood hazards. Outputs similar to those from Hazus were generated for other hazards, using data generated through GIS.

5.3.1 Earthquake, Dam Failure, and Flood

The following hazards were evaluated using Hazus:

- **Flood**—A Level 2 user-defined analysis was performed for general building stock in flood zones and for critical facilities and infrastructure. Current flood mapping for the planning area was used to delineate flood hazard areas and estimate potential losses from the 1-percent-annual-chance, 0.2-percent-annual-chance, and 10-percent-annual-chance flood events. 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 property replacement cost values, dollar-value estimates of damage were generated.
- **Dam Failure**—A Level 2 analysis was run using the flood methodology described above.
- **Earthquake**—A Level 2 analysis was performed to assess earthquake exposure and vulnerability for five scenario events:
  - Calaveras (North Central South) Fault Scenario—A Magnitude-7.0 event with a depth of 7 km and epicenter 1 mile west of the City of Dublin.
  - Greenville Fault Scenario—A Magnitude-7.0 event with a depth of 12 km and epicenter 24 miles southeast of the City of Pleasanton.
  - Haywired Fault Scenario—This is the name given by the USGS to the fault scenario used in a 2014-2015 of Bay Area impacts from an earthquake on the Hayward Fault; it is a Magnitude-7.05 event with a depth of 8 km and epicenter 10 miles northwest of the City of Dublin.
  - Mount Diablo Fault Scenario—A Magnitude-6.7 event with a depth of 14 km and epicenter 10 miles north of the City of Livermore.
  - North San Andreas Fault Scenario—A Magnitude-7.8 event with a depth of 9.8 km and epicenter 75 miles northwest of the City of Dublin.

5.3.2 Drought

The risk assessment methodologies used for this plan focus on damage to structures. 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.

5.3.3 Landslide, Severe Weather, Wildfire

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

5.4 SOURCES OF DATA USED IN HAZUS MODELING

5.4.1 Building, Land Use and Cost Data

Replacement cost values and detailed structure information derived from parcel and tax assessor data provided by Alameda County were loaded into Hazus. When available, an updated inventory was used in place of the Hazus defaults for critical facilities and infrastructure. Land use areas were calculated using the County's parcel data and Hazus general occupancy classes.

Replacement cost is the cost to replace the entire structure with one of equal quality and utility. Replacement cost is based on industry-standard cost-estimation models published in *RS Means Square Foot Costs* (RS Means, 2017). It is calculated using the RS Means square foot cost for a structure, which is based on the Hazus occupancy class (i.e., multi-family residential or commercial retail trade), multiplied by the square footage of the structure from the tax assessor data. The construction class and number of stories for single-family residential structures also factor into determining the square foot costs.

5.4.2 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 1-percent-annual-chance, 0.2-percent-annual-chance, and 10-percent-annual-chance flood events. Using the DFIRM floodplain boundaries and base flood elevation information, and the U.S. Geological Survey's (USGS) 3-meter digital elevation model data, flood depth grids were generated and integrated into the Hazus model.
- **Dam Failure**—Dam inundation area data provided by the County and the USGS 3-meter digital elevation model were used to develop depth grids that were integrated into the Hazus model.
- **Earthquake**—Earthquake mapping prepared by the USGS was used for the analysis of this hazard. A National Earthquake Hazard Reduction Program (NEHRP) soils map from the California Department of Conservation, the Association of Bay Area Governments' (ABAG) liquefaction susceptibility data, and the California Geological Survey's landslide susceptibility data were also integrated into the Hazus model.

5.4.3 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**—Susceptibility to deep-seated landslide data were provided by the California Geological Survey. Areas categorized as moderate (susceptibility classes V and VI), high (classes VII, VIII, and IX), and very high (class X) were used in the exposure analysis.
- **Wildfire**—Fire severity data were acquired from the California Department of Forestry and Fire Protection (CAL FIRE).
- **Climate Change**—Climate change related projections, data and visualization tools were provided by Cal-Adapt, an online resource that provides information on how climate change might affect local communities in California, unless otherwise indicated. The data available on Cal-Adapt is from a variety of organizations in the scientific community and represents peer-reviewed science.

5.4.4 Data Source Summary

Table 5-1 summarizes the data sources used for the risk assessment for this plan.

Table 5-1. Risk Assessment Data Sources

Data	Source	Date	Format
Property parcel data including use code, year built, number of stories, and area	Alameda County	2017	Digital (GIS) format
Building replacement cost	RS Means	2017	Paper format
Demographic data	FEMA Hazus version 4.0 (U.S. Census)	2010	Digital (GIS and tabular) format
Flood hazard data	FEMA	2016	Digital (GIS) format
Earthquake mapping	USGS Earthquake Hazards Program website	2012-2014	Digital (GIS) format
Liquefaction susceptibility	ABAG (from USGS)	2006	Digital (GIS) format
Susceptibility to deep-seated landslides	CA Geological Survey	2011	Digital (GIS) format
NEHRP soils	California Department of Conservation	2008	Digital (GIS) format
Dam inundation areas	City of Pleasanton	Unknown	Digital (GIS) Format
Fire hazard severity zones	CAL FIRE	2008	Digital (GIS) format
National elevation data 3m	USGS	Unknown	Digital (GIS) format
Future Land Use, General Plan Land Use & Zoning Districts	City of Pleasanton, City of Livermore, ABAG	Various	Digital (GIS) format
Critical Facilities and Assets			
Critical Facilities and Assets: EOCs; fire stations; medical care facilities; police stations; schools; hazardous material facilities; airports and helipads; bus facilities; highway bridges; light rail facilities; railway bridges; rail facilities; communications facilities; electric power facilities; petroleum facilities; potable water facilities; wastewater facilities; government / city facilities	City of Dublin, City of Livermore, City of Pleasanton, Hazus 4.0 Database, EPA Toxic Reporter Inventory, EIA, California HealthCare Atlas, Caltrans	Various	Digital (GIS) format

5.5 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
- The uncertain spatial accuracy of the dam inundation area data.
- Lack of a standardized model for assessing sea level rise impacts. Multiple models provide multiple results. Not all models were run in the development of the sea level rise analysis.

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 planning partners will collect additional data to assist in estimating potential losses associated with other hazards.

6. DAM FAILURE

6.1 GENERAL BACKGROUND

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 the stated functions. Dams provide a life-sustaining resource to people in all regions of the United States. They are an important resource in the United States.

Man-made dams can be classified according to the type of construction material used, the methods used in construction, the slope or cross-section of the dam, the way the dam resists the forces of the water pressure behind it, the means used for controlling seepage, and, occasionally, according to the purpose of the dam. The materials used for construction of dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, miscellaneous materials (plastic or rubber), and any combination of these materials (Association of State Dam Safety Officials, 2013).

More than a third of the country's dams are 50 or more years old. Approximately 14,000 of those dams pose a significant hazard to life and property if failure occurs. There are also about 2,000 unsafe dams in the United States, located in almost every state.

DEFINITIONS

Dam—Any artificial barrier, together with appurtenant works, that does or may impound or divert water, and that either (a) is 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier (or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse) to the maximum possible water storage elevation; or (b) has an impounding capacity of 50 acre-feet or more. (CA Water Code, Division 3.)

Dam failure—An uncontrolled release of impounded water due to structural deficiencies in a dam.

Emergency action plan—A formal document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 2013a)

High hazard dam—Dams where failure or improper operation will probably cause loss of human life. (FEMA 2004)

Significant hazard dam—Dams where failure or improper operation will result in no probable loss of human life but can cause economic loss, environmental damage or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 2004)

6.1.1 Causes of Dam Failure

The failure of a dam can allow stored water to inundate areas downstream. Dam failures typically occur when spillway capacity is inadequate and excess flow overtops the dam, or when internal erosion (piping) through the dam or foundation occurs. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-filled waters that rush downstream damaging and/or destroying anything in its path.

Dam failures can be catastrophic to human life and property downstream. Dam failures in the United States typically occur in one of four primary 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 account for 30 percent of all dam failures.
- Piping and seepage account for 20 percent of all failures. These result from internal erosion, 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.

The remaining six percent of dam failures are due to other miscellaneous causes. Many of the historical dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, and massive snowmelt.

The most likely causes of dam failure in the planning area are age of dams, earthquakes, excessive rainfall, and landslides. Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

6.1.2 Regulatory Oversight

National Dam Safety Act

Potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of the majority of dams in the country, with exceptions for 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 (FEMA, 2013).

California Division of Safety of Dams

California DWR's Division of Safety of Dams monitors dam maintenance and safety at the state level through all of the following procedures (DWR, 2017):

- 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 accords with the approved plans and specifications.

- After construction, the Division inspects each dam annually to ensure performance as intended and to identify developing problems. Roughly a third of these inspections include in-depth reviews of instrumentation.
- The Division periodically reviews stability of dams and their major appurtenances in light of improved design approaches, requirements, and new findings regarding earthquake hazards and hydrologic estimates in California.

U.S. Army Corps of Engineers Dam Safety Program

The Army Corps of Engineers is responsible for safety inspections of some federal and non-federal dams in the United States that meet 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 dams; and developed guidelines for inspection and evaluation of dam safety (U.S. Army Corps of Engineers, 2017). The Corps of Engineers' National Inventory of Dams provides the most recent inspection dates for 26 Alameda County dams, as listed in Table 6-1. It is important to note that this data base is updated only periodically, and therefore the dates reflected may not be reflective of the most recent inspection dates for each facility listed.

Table 6-1. Alameda County Dam Inspection Dates

Alameda County Dam	Inspection Date	Alameda County Dam	Inspection Date
Almond	January 26, 2012	New U San Leandro	December 20, 2011
Bethany Forebay	November 2, 2011	Patterson	March 8, 2012
Calaveras	January 24, 2012	Patterson	November 3, 2011
Central	January 26, 2012	Piedmont	February 9, 2012
Chabot	December 20, 2011	Quarry Pits	March 9, 2012
Cull Creek	August 24, 2011	Rubber Dam 3	March 9, 2012
Decoto Reservoir	March 8, 2012	San Lorenzo Creek	August 24, 2011
Del Valle	November 3, 2011	Seneca	January 26, 2012
Dunsmuir Reservoir	January 26, 2012	Shinn	March 9, 2012
Dyer	February 10, 2012	South	January 26, 2012
Estates	February 9, 2012	Summit	February 7, 2012
James H Turner	January 23, 2012	Temescal, Lake	March 2, 2012
Middlefield Res	March 8, 2012	Ward Creek	August 24, 2011

Source: *U.S. Army Corps of Engineers, 2017*

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) has the largest dam safety program in the United States. FERC cooperates with a large number of federal and state agencies to ensure and promote dam safety and, more recently, homeland security. Approximately 3,036 dams that are part of regulated hydroelectric projects are in the FERC program. Two-thirds of these dams are more than 50 years old. As dams age, concern about their safety and integrity grows, and oversight and a regular inspection program are extremely important. FERC staff 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 consulting engineer, approved by the FERC, must inspect and evaluate projects with dams higher than 32.8 feet, or with a total storage capacity of more than 2,000 acre-feet.

FERC staff monitors and evaluates seismic research in geographic areas such as California where there are concerns about possible seismic activity. This information is applied in investigating and performing structural analyses of hydroelectric projects in these areas. FERC staff also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC staff 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 pertaining to actual or potential sudden release of water from a dam due to failure or accident. The plans include operational procedures that may be applied, such as reducing reservoir levels and downstream flows, or notifying affected residents and agencies responsible for emergency management. Updates and tests of these plans occur frequently to ensure that everyone knows what to do in emergency situations (FERC, 2016).

6.2 HAZARD PROFILE

6.2.1 Past Events

Even under normal operating conditions, dam failures can occur suddenly, without warning (referred to as a “sunny-day” failure). Dam failures may also occur during a large storm event. Significant rainfall can quickly inundate an area and cause floodwaters to overwhelm a reservoir. If the dam spillway cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows, and a failure may occur.

No dam failures have been recorded in the planning area. According to the *Alameda County Multi-Hazard Mitigation Plan*, there have been two failures in the county:

- **1918 Calaveras Dam Failure**—The San Francisco Public Utilities Commission-owned Calaveras Dam, located in Alameda County, failed during construction in 1918. A landslide damaged the upstream shell of the dam and destroyed the dam’s outlet tower.
- **2015 Rubber Dam 3 Failure**—In 2015, the inflatable dam on Alameda Creek (Rubber Dam 3) failed due to vandalism, releasing nearly 50 million gallons of water from the community’s water into the San Francisco Bay. The water was supposed to go into the Niles Cone Groundwater Basin where residents and businesses from the Cities of Newark, Union City and Fremont could access drinking water.

There is a possibility that the planning area experienced the direct or indirect impacts of these events, though no specific information on local impact is available.

6.2.2 Location

According to the Corps of Engineers’ National Inventory of Dams, there are over 87,000 dams in the country; however, this inventory only covers dams that meet minimum height and impoundment requirements; numerous small dams are not identified. According to the California Division of Safety of Dams (DSOD), as of 2017, there were 24 dams in Alameda County of which 20 were classified as high or extremely high hazard according the DSOD Downstream Hazard Classification guidelines. Of these, the Del Valle and Patterson Dams described in Table 6-2 and Table 6-3, have the potential to impact the planning area if a failure were to occur. Dam failure inundation mapping in support of emergency action planning is available for both dams, but have not been included in this plan for security purposes.

Table 6-2. Del Valle Dam Characteristics

Hazard Class[a]	Extremely High
Water Course	Arroyo Valle
Owner	California Department of Water Resources
Year Built	1968
Dam Type	Earth
Crest Length (feet)	880
Height (feet)	222
Storage Capacity (acre-feet)	77,100
Drainage area (sq. mi.)	146
Inundation Area (sq. mi.)	97.98

a. Hazard classification as identified in the National Performance of Dams Program:
Low Hazard—Downstream hazard classification for dams in which no lives are in jeopardy and minimal economic loss would occur as a result of failure of the dam.
Significant Hazard—Downstream hazard classification for dams in which one to six lives are in jeopardy and appreciable economic loss would occur as a result of failure of the dam.
High Hazard—Downstream hazard classification for dams in which more than six lives would be in jeopardy and excessive economic loss would occur as a direct result of dam failure.

Sources: California Department of Water Resources, 2017

Table 6-3. Patterson Dam Characteristics

Hazard Class[a]	High
Water Course	Off stream
Owner	California Department of Water Resources
Year Built	1962
Dam Type	Earth
Crest Length (feet)	1,275
Height (feet)	39
Storage Capacity (acre-feet)	104
Drainage area (sq. mi.)	0
Inundation Area (sq. mi.)	Information not available

a. Hazard classification as identified in the National Performance of Dams Program:
Low Hazard—Downstream hazard classification for dams in which no lives are in jeopardy and minimal economic loss would occur as a result of failure of the dam.
Significant Hazard—Downstream hazard classification for dams in which one to six lives are in jeopardy and appreciable economic loss would occur as a result of failure of the dam.
High Hazard—Downstream hazard classification for dams in which more than six lives would be in jeopardy and excessive economic loss would occur as a direct result of dam failure.

Sources: California Department of Water Resources, 2017

The Del Valle dam was constructed in 1968 to create Lake Del Valle, which provides water storage, Alameda Creek flood control, and regulatory storage for a portion of water delivered through the South Bay Aqueduct. The dam is in satisfactory condition as of September 2017, which means it has no recognized safety deficiencies. It is the only flood control dam in the Livermore Valley. The dam has a storage capacity of 77,100 acre-feet of water (California Department of Water Resources, 2017).

There are two dams listed as Patterson Dam in the DSOD inventory of dams. One of the 2 dams is listed as high hazard is owned by the California Department of Water Resources, and was built in 1962 and was constructed as part of the California State Water Project. The California State Water Project is a water storage and delivery system of reservoirs, aqueducts, power plants and pumping plants. Its main purpose is to store water and distribute it to 29 urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California. Of the contracted water supply, 70 percent goes to urban users and 30 percent goes to agricultural users. The Project makes deliveries to two-thirds of California's population. It is maintained and operated by the California Department of Water Resources. The Project is also operated to improve water quality in the Delta, control Feather River flood waters, provide recreation, and enhance fish and wildlife.

6.2.3 Frequency

Dam failures are infrequent and usually coincide with the events that cause them, such as earthquakes, landslides, and excessive rainfall and snowmelt. There is a "residual risk" associated with dams; residual risk is the risk 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 occurrence of any type of dam failure event is considered to be low in today's regulatory and dam safety oversight environment.

6.2.4 Severity

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 6-4 for the hazard potential of dam failures.

Table 6-4. 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, 1996*

6.2.5 Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, it is possible that there would 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 either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections formed during dam construction are forced apart by the escaping water. The time for breach formation ranges from a few minutes to a few hours.

Alameda County and the Cities of Dublin, Livermore and Pleasanton have established protocols for emergency warning and response through adopted emergency operations plans. These protocols are tied to the emergency action plans created by the dam owners.

6.3 SECONDARY HAZARDS

Dam failure can cause severe downstream flooding depending on the magnitude of the failure. Other potential secondary hazards of dam failure include landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat.

6.4 EXPOSURE

Exposure to dam failure hazard was assessed by use of spatial analysis. While 2 dams, Del Valle and Patterson could impact the planning area, digital dam failure inundation mapping was only available for the Del Valle Dam. Therefore, the following exposure and vulnerability sections only look at the Del Valle inundation areas based on the best available data. The inundation area for the Del Valle Dam was overlaid with planning area general building stock and critical facility databases. The Hazus flood module was used to assess damage from the dam failure. Hazus uses census data at the block level, which has a level of accuracy acceptable for planning purposes. Where possible, the Hazus default data was enhanced using GIS data from local, state and federal sources.

6.4.1 Population

All populations living in a dam failure inundation zone are exposed to the risk of a dam failure. The estimated population living in the Del Valle Dam inundation area is 57,666, or 25.6 percent of the planning area's population.

6.4.2 Property

The Hazus model estimated that there are 17,555 structures within the inundation area. The value of exposed buildings in the planning area was generated using Hazus and is summarized in Table 6-5. This methodology estimated $17 billion worth of building-and-contents exposure to the inundation area, representing 33.2 percent of the total replacement value of the planning area. Table 6-6 shows the general land use of planning area parcels exposed to the Del Valle Dam Inundation Area.

Table 6-5. Value of Property Exposed to Dam Failure

	Number of Buildings Exposed	Value Exposed			% of Total Replacement Value
		Building	Contents	Total	
Dublin	442	$639,600,057	$533,654,000	$1,173,254,056	9.6%
Livermore	1,688	$818,547,256	$509,556,562	$1,328,103,818	6.5%
Pleasanton	15,425	$8,709,927,283	$6,595,801,497	$15,305,728,780	72.8%
Total Planning Area	17,555	$10,168,074,596	$7,639,012,059	$17,807,086,655	33.2%

Table 6-6. Dam Inundation Present Land Use

	Present Land Use Within the Del Valle Dam Inundation Area	
	Area (acres)	% of total
Residential	3,374	32.8%
Commercial	1,653	16.1%
Industrial	303	2.9%
Agriculture	73	0.7%
Religion / Assembly	161	1.6%
Government / Institutional	82	0.8%
Education	253	2.5%
Vacant / Rights-of-Way / Water / Open Space	4,381	42.6%
Total	10,281	100.0%

Source: Alameda County, 2016

6.4.3 Critical Facilities

GIS analysis was used to determine the number of critical facilities in the mapped dam failure inundation areas. As Table 6-7 shows, 173 of the planning area's critical facilities and critical infrastructure (41 percent) are in the inundation areas.

Table 6-7. Critical Facilities/Infrastructure in Dam Failure Inundation Areas in the Planning Area

	Medical & Health Services	Emergency Services	Educational Facilities	Government	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	1	1	0	3	2	12	0	0	19
Livermore	0	0	1	0	1	4	0	0	6
Pleasanton	6	5	16	7	58	51	5	0	148
Total	7	6	17	10	61	67	5	0	173

6.4.4 Environment

The environment would be exposed to a number of risks in the event of dam failure. The inundation could introduce many foreign elements into local waterways. This could result in destruction of downstream habitat and could have detrimental effects on many species of animals, especially endangered species such as salmon.

6.5 VULNERABILITY

6.5.1 Population

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system. The potential for loss of life is affected by the capacity and number of evacuation routes available to populations living in areas of potential inundation.

6.5.2 Property

Vulnerable properties are those closest to the dam failure inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Transportation routes are vulnerable to dam failure inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam failure inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

It is estimated that there could be up to $8.8 billion of loss from a dam failure affecting the planning area. This represents 49 percent of the total exposure within the inundation area, or 16.3 percent of the total assessed value of the planning area. Table 6-8 summarizes the loss estimates for dam failure.

Table 6-8. Loss Estimates for Dam Failure

	Value Exposed			% of Total
	Building Loss	Contents Loss	Total Loss	Replacement Value
Dublin	$54,263,652	$134,358,432	$188,622,085	1.6%
Livermore	$249,974,304	$232,863,515	$482,837,819	2.4%
Pleasanton	$3,995,994,142	$4,100,811,972	$8,096,806,114	38.5%
Total Planning Area	$4,300,232,098	$4,468,033,919	$8,768,266,017	16.3%

6.5.3 Critical Facilities

Hazus was used to estimate the flood loss potential to critical facilities exposed to dam failure risk. Using depth/damage function curves to estimate the percent of damage to the building and contents of critical facilities, Hazus correlates these estimates into an estimate of functional down-time (the estimated time it will take to restore a facility to 100 percent of its functionality). This helps to gauge how long the planning area could have limited usage of facilities deemed critical to flood response and recovery. The Hazus critical facility results for dam failure are shown in Table 6-9.

Table 6-9. Estimated Damage to Critical Facilities and Infrastructure from Dam Failure

	Number of	Average % of Total Value Damaged		Days to 100%
	Facilities Affected	Structure	Content	Functionality
Medical and Health Services	6	35.48	81.59	730
Emergency Services	5	57.03	81.08	816
Educational Facilities	13	65.93	91.33	801
Government / City Facilities	7	55.08	86.22	N/A
Utilities	55	33.56	67.62	N/A
Transportation Infrastructure	51	3.78	70.38	N/A
Hazardous Materials	4	26.28	41.00	N/A
Total/Average	141	39.59	74.18	782

6.5.4 Environment

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce foreign elements into local waterways, resulting in destruction of downstream habitat and detrimental effects on many species of animals, especially endangered species. The extent of the vulnerability of the environment is the same as the exposure of the environment.

6.6 FUTURE TRENDS IN DEVELOPMENT

All land use decision-making is guided by the goals, policies and implementation measures contained in the land use elements of Dublin, Livermore and Pleasanton’s general plans. The Dublin general plan’s environmental resources management element, Livermore general plan's public safety element, and Pleasanton's general plan's public safety element establish standards and plans for protecting the community from hazards. Most of the areas vulnerable to the worst impacts from a dam failure correspond to the flood hazard areas. Flood-related policies in the general plans will help to reduce the risk associated with the dam failure hazard for all future development in the planning area. Table 6-10 shows the future land use within the Del Valle Dam Inundation Area.

Table 6-10. Dam Inundation Future Land Use

	Future Land Use Within the Del Valle Dam Inundation Area	
	Area (acres)	% of total
Residential	4,062	39.5%
Commercial	1,356	13.2%
Industrial	265	2.6%
Agriculture	378	3.7%
Religion / Assembly	954	9.3%
Government / Institutional	838	8.2%
Education	2,427	23.6%
Vacant / Rights-of-Way / Water / Open Space	10,281	100.0%
Total	4,062	39.5%

Source: Alameda County, 2016

6.7 SCENARIO

An earthquake within the region could lead to liquefaction of soils around the dams. 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 that impacts the planning area. The worst-case scenario for the dam failure hazard would be a full failure of the Del Valle Dam. Such a failure would result in a large portion of Pleasanton being inundated and a smaller portion of Dublin and Livermore. Critical facilities located in the dam inundation area would likely experience failure, resulting in a severe disruption of essential services.

6.8 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zones. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failure. 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. Other important issues associated with dam failure include the following:

- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans 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.
- Mapping for federally regulated dams is already required and available; however, mapping that estimates inundation depths is needed for dams that are not federally regulated, in order to better assess the risk associated with failure of these facilities.
- 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 dams that are not federally regulated, mapping of failure scenarios that are less extreme than the probable maximum flood but have a higher probability of

occurrence can be valuable to downstream community officials and emergency managers. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness actions.

- 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.

7. DROUGHT

7.1 GENERAL BACKGROUND

> **DEFINITIONS**
>
> **Drought—**The cumulative impacts of several dry years on water users. It can include deficiencies in surface and subsurface water supplies and generally impacts health, wellbeing, and quality of life.
>
> **Meteorological drought—**Precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought and are usually region-specific.
>
> **Agricultural drought—**Insufficient soil moisture to meet the needs of a particular crop at a particular time.
>
> **Hydrological drought—**Deficiencies in surface and subsurface water supplies, measured as stream flow or as lake, reservoir, or groundwater level.
>
> **Socioeconomic drought—**Drought impacts on people's health, well being, or quality of life.

Most of California's precipitation comes from storms moving across the Pacific Ocean. The path followed by the storms is determined by the position of an atmospheric high-pressure belt that normally shifts southward during the winter, allowing low pressure systems to move into the state. On average, 75 percent of California's annual precipitation occurs between November and March, with 50 percent occurring between December and February. If a persistent Pacific high-pressure zone takes hold over California mid-winter, there is a tendency for the water year to be dry.

A typical water year produces about 100 inches of rainfall over the North Coast, 50 inches of precipitation (combination of rain and snow) over the Northern Sierra, 18 inches in the Sacramento area, and 15 inches in the Los Angeles area. In extremely dry years, precipitation can be as little as a third of these amounts.

Determination of when drought begins requires knowledge of drought impacts on water users, including supplies available to local water users and stored water available to them in surface reservoirs or groundwater basins. Different local water agencies have different criteria for defining drought conditions within their jurisdictions. Some agencies issue drought watch or drought warning announcements to their customers. Determinations of regional or statewide drought conditions are usually based on a combination of hydrologic and water supply factors (DWR, 2017). The California water code does not have a statutory definition of drought; however, analysis of text in the code indicates that legal matters most frequently focus on drought conditions during times of water shortages (California Code of Regulations (CCR), 2017). The Sierra Nevada snowpack is the primary agent for replenishing water for much of California, including the planning area. A reduction in spring snowpack runoff, whether due to drier winters or to increasing temperatures that lead to more rain instead of snow, can increase the risk of summer or fall water shortages throughout the region (California Water Action Plan, 2013).

7.1.1 Types of Drought

As defined by the National Weather Service (NWS), drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people. It is a normal, recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry. If the weather pattern lasts a short time (a few weeks or a couple 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 a long-term drought. 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. There are four ways that drought can be defined:

- Meteorological drought is a measure of departure of precipitation from normal. It is defined solely on the relative degree of dryness. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.
- Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and other parameters. It occurs when there is not enough water available for a particular crop to grow at a particular time. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.
- Hydrological drought is associated with the effects of periods of precipitation shortfalls (including snowfall) on surface or subsurface water supply. It occurs when these water supplies are below normal. It is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- Socioeconomic drought is associated with the supply and demand of an economic good with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned types of drought because its occurrence depends on the processes of supply and demand to identify or classify droughts. The supply of many economic goods depends on weather (for example water, forage, food grains, fish, and hydroelectric power). Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply (Wilhite & Glantz, 1985).

7.1.2 Monitoring Drought

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity and to map their extent and locations.

- The **Palmer Crop Moisture Index** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season. Figure 7-1 shows this index for week ending May 20, 2017.
- The **Palmer Z Index** measures short-term drought on a monthly scale. Figure 7-2 shows this index for April 2017.
- The **Palmer Drought 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 Severity Index can respond fairly rapidly. Figure 7-3 shows this index through May 20, 2017.
- 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**, another long-term index, was developed to quantify hydrological effects. The Palmer Hydrological Drought Index responds more slowly to changing conditions than the Palmer Drought Index. Figure 7-4 shows this index for April 2017.
- 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 SPI is computed for time scales ranging from one month to 24 months. Figure 7-5 shows the 12-month SPI map for May 2016 through April 2017.

Source: NOAA, NWS, 2017

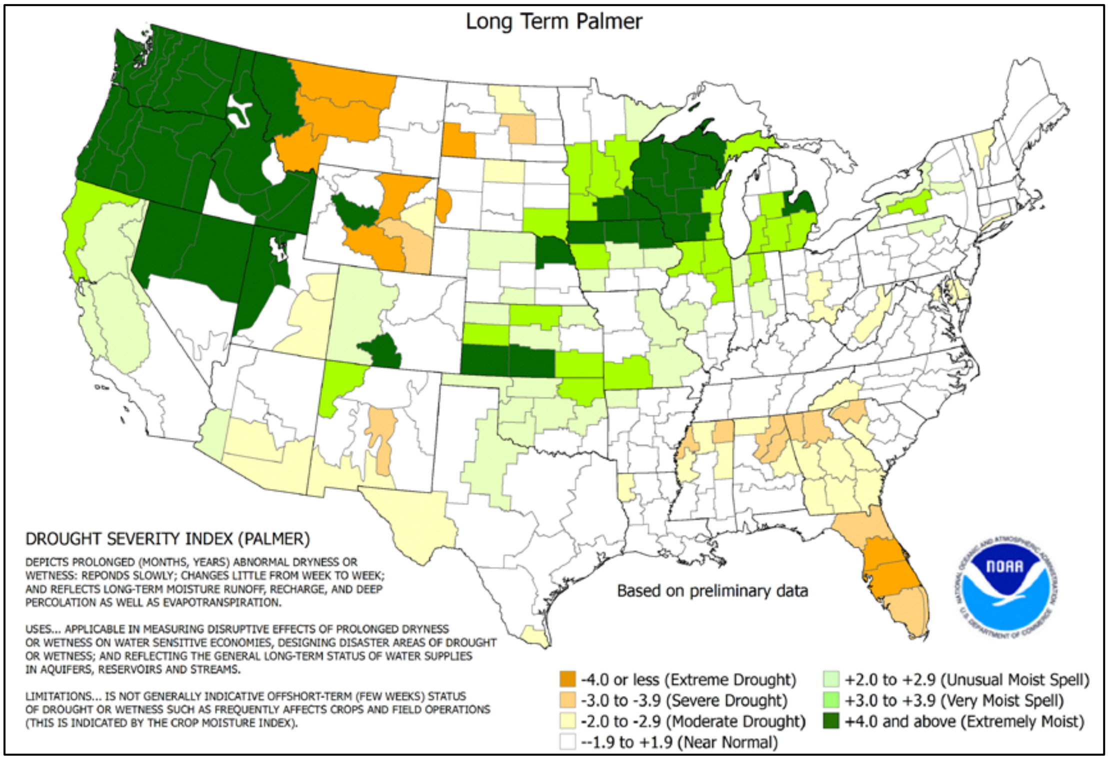


Figure 7-1. Palmer Crop Moisture Index for Week Ending May 20, 2017

Source: NOAA, NWS, 2017a

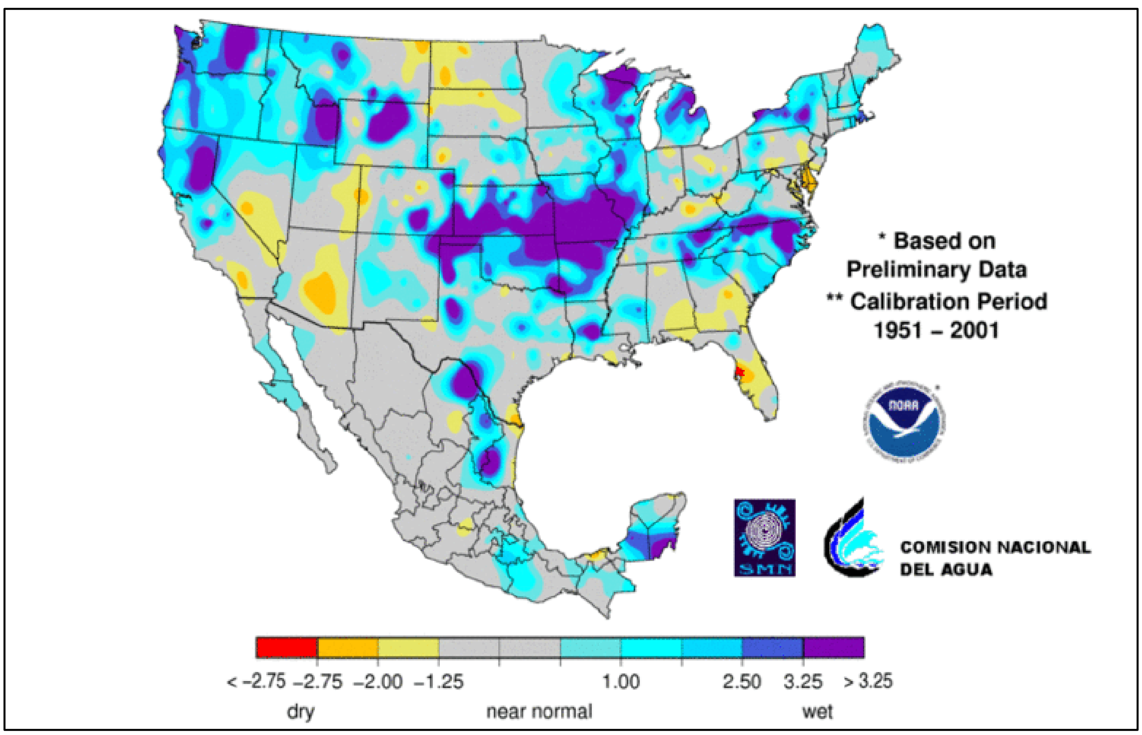


Figure 7-2. Palmer Z Index (April 2017)

Source: NOAA, NWS, 2017b

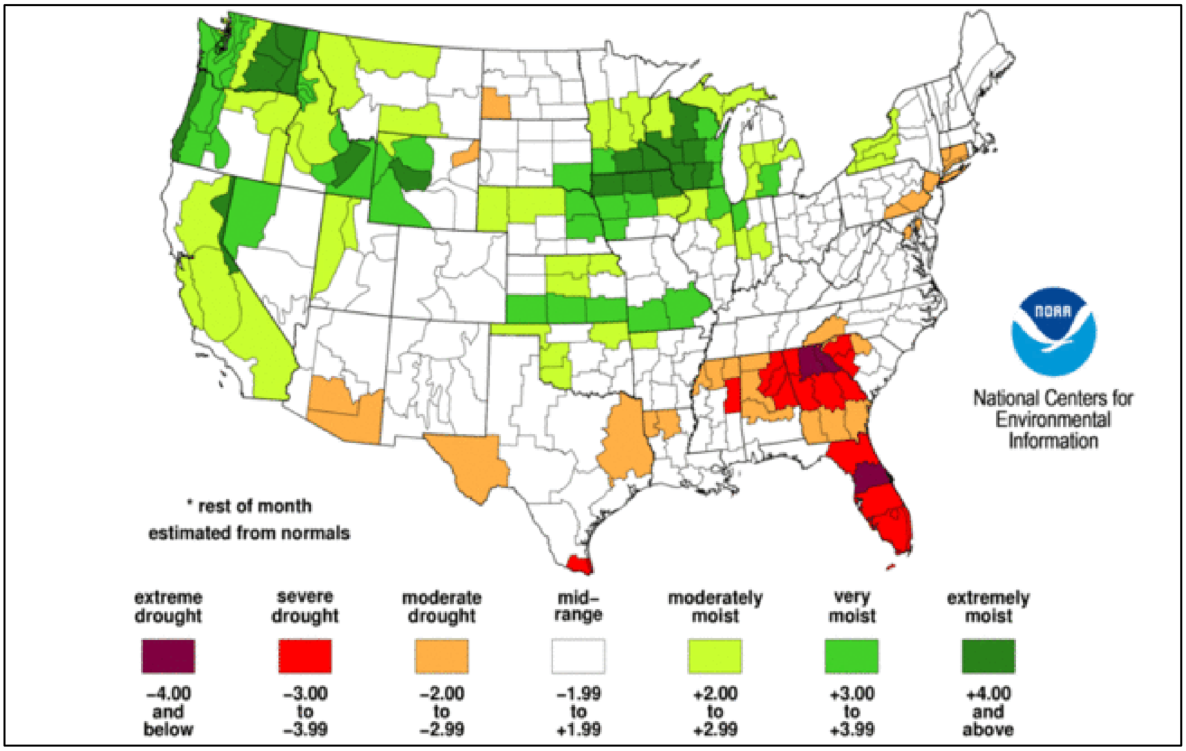


Figure 7-3. Palmer Drought Index through May 20, 2017

Source: NOAA, NWS, 2017c

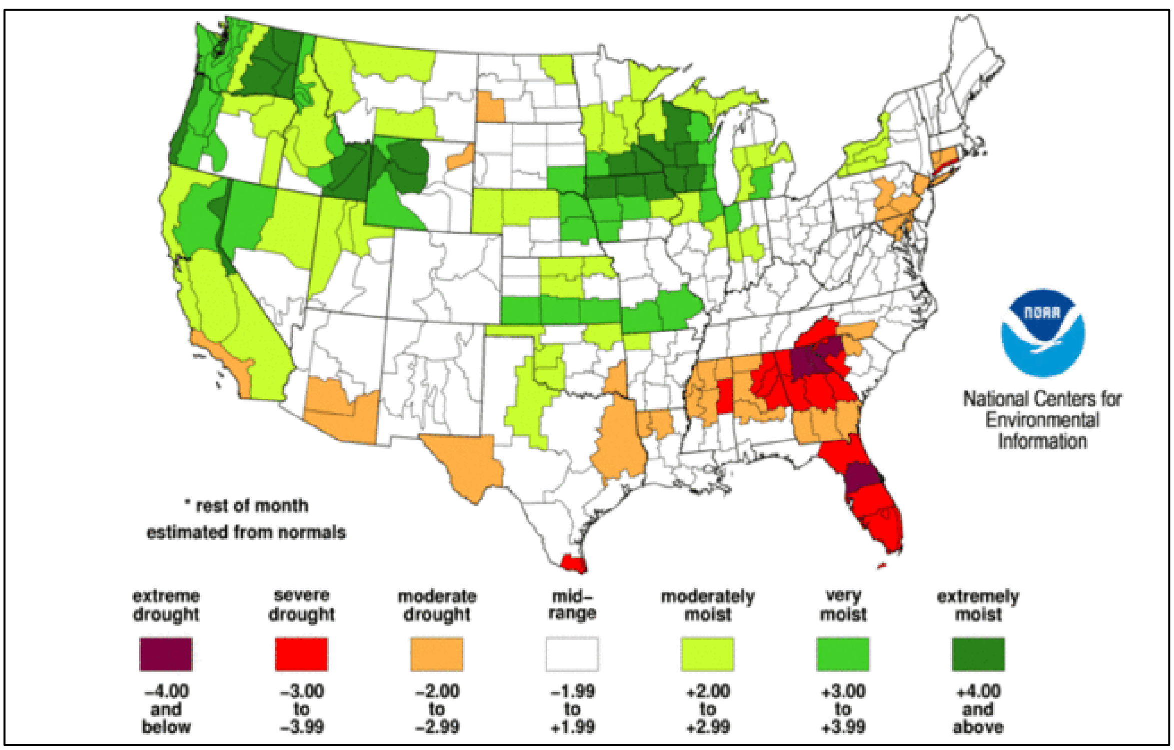


Figure 7-4. Palmer Hydrological Drought Index through May 20, 2017

Source: NOAA, NWS, 2017d

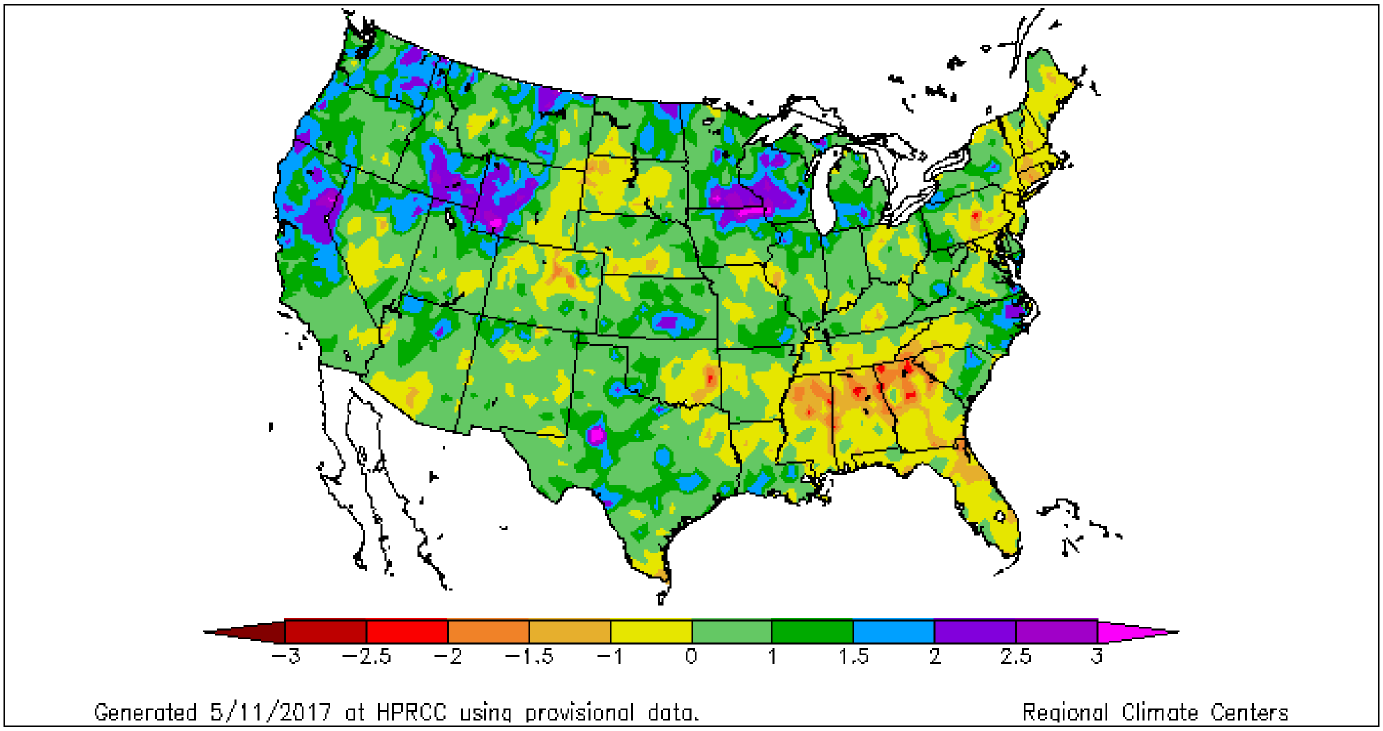


Figure 7-5. 12-Month Standardized Precipitation Index (May 1, 2016 – April 30, 2017)

7.1.3 Water Demand

Drought produces a complex web of impacts that span many sectors of the economy and reach 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.

California's 2005 Water Plan (DWR, 2005) and subsequent updates indicate that water demand in the state will increase through 2030. Although the Department of Water Resources predicts a modest decrease in agricultural water use, the agency anticipates that urban water use will increase by 1.5 to 5.8 million acre-feet per year (DWR, 2005). The 2013 update to the Water Plan explores measures, benchmarks, and successes in increasing agricultural and urban water use efficiency. Between 1996 and 2005, the average amount of water use in the San Francisco Bay area (including the planning area for this hazard mitigation plan) was 155 gallons per capita per day (gpcd); the statewide average was 198 gpcd. The state established a 20-percent water use reduction goal to be achieved by 2020. Although regional estimates were not available, the state average for water use reduction by 2010 was 16 percent (or 166 gpcd) (DWR, 2013).

7.1.4 Local Water Supply

Water Supply System

The Zone 7 Water Agency (Zone 7), a water wholesaler, provides treated drinking water to four major retailers in the planning area that serve approximately 240,000 people and businesses. The wholesale water has three sources (Figure 7-6): South Bay Aqueduct that originates from the California State Water Project; Lake Del Valle storage reservoir that is approximately 10 miles from Livermore; and groundwater from local wells (Zone 7, 2017).

Source: Zone 7, 2015

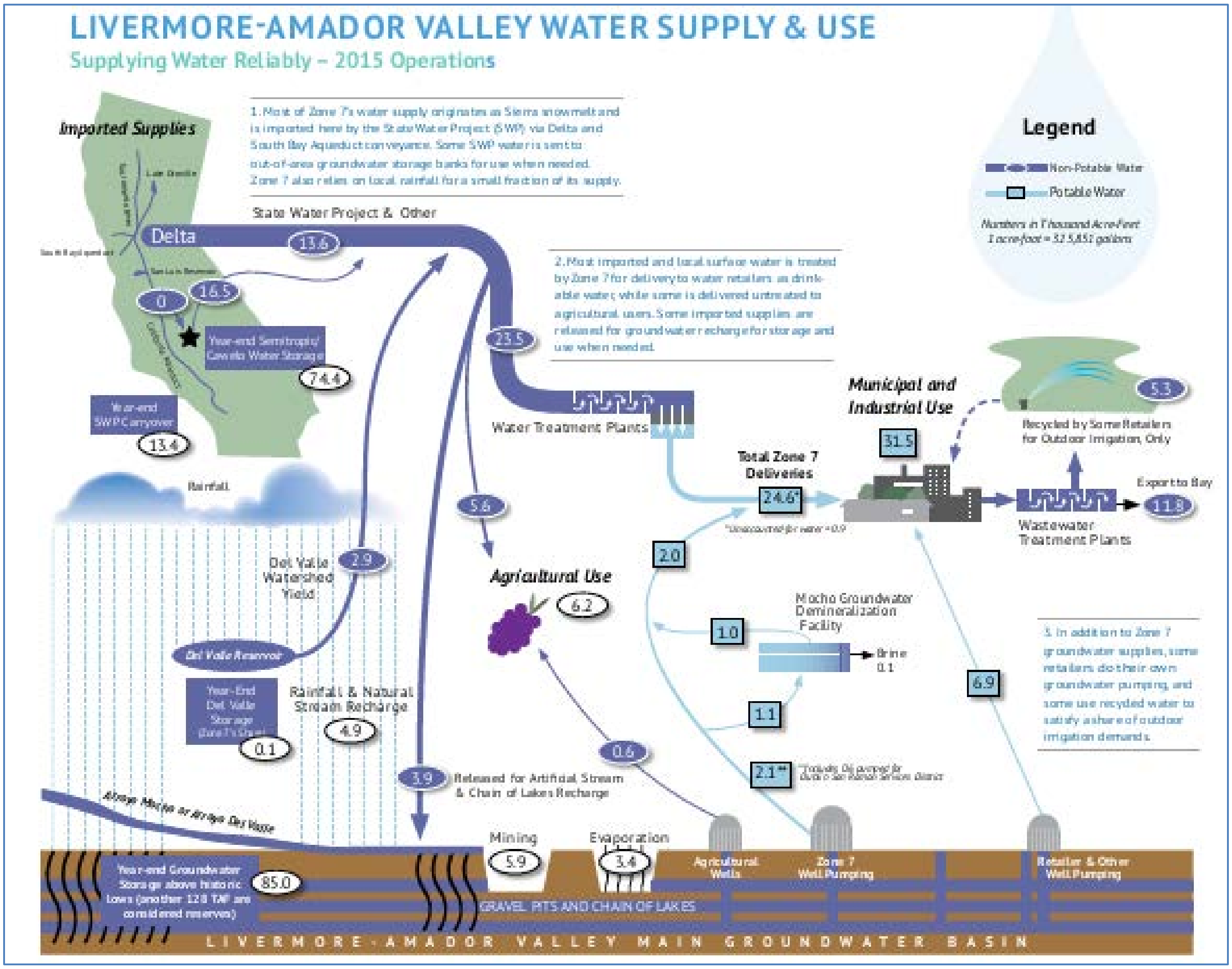


Figure 7-6. Zone 7 Water Agency Supply and Use

The following retail water purveyors in the Tri-Valley planning purchase water from Zone 7:

- **City of Dublin—**Dublin San Ramon Services District is a public agency that distributes water and recycled water, and collects, treats and disposes of wastewater for 173,000 people in Dublin, southern San Ramon, Dougherty Valley, and Pleasanton. It provides water services only to Dougherty Valley and Dublin (Dublin San Ramon Services District, 2017).
- **City of Livermore—** Livermore Municipal Water purchases potable water from Zone 7 Water agency and provides water to more than 28,800 Livermore residents in addition to significant industrial and commercial areas. The balance of residents are served by the California Water Service Company (Cal Water) and with 18,600 customers (including residential and commercial) are within their Livermore system (City of Livermore, 2017).
- **City of Pleasanton—**The City of Pleasanton Utilities Division provides potable water to Pleasanton residents and businesses. The City purchases approximately 80 percent of the water from the Zone 7 Water Agency; the remaining 20 percent comes from local groundwater pumped from City-owned and operated wells (City of Pleasanton, 2017).

Water Supply Strategy

Zone 7 includes a water supply strategy in its 2015 *Urban Water Management Plan* to meet its planning objectives for water supply reliability, cost, water quality, environmental protection and risk. It evaluates a range of water supply and water conservation options and recommended a strategy that includes desalination, recycled water, conservation, groundwater management and off-site banking/transfers.

Zone 7 has projected water supply and demand through 2035 for normal-year, single-dry-year, and multiple-dry-year conditions. Table 7-1 and Table 7-2 show the normal-year and single-dry-year projections. Under normal-year conditions, the agency will have sufficient supply to meet the projected demand and to increase groundwater storage for later use in the service area (Zone 7, 2015).

Table 7-1. Projected Normal Year Water Supply and Demand Comparison

Supply/Demand	Supply Projections by Year (acre-feet per year)			
	2020	2025	2030	2035
Supply Component				
State Water Project (Existing Conveyance-Early Long-Term)	50,000	50,000	50,000	50,000
Yuba Accord	145	145		
Byron Bethany Irrigation District	2,000	2,000	2,000	2,000
Arroyo Valle	7,300	7,300	10,300	10,300
California Water Fix			8,000	8,000
Possible desalination and/or potable reuse[a]		10,000	10,000	10,000
Groundwater	9,200	9,200	9,200	9,200
State Water Project - Carryover	10,000	10,000	10,000	10,000
TOTAL SUPPLY	78,645	88,645	99,500	99,500
Demand Component				
Retail Demand	41,300	44,700	46,600	47,600
Untreated Water Demand	6,200	6,600	7,800	8,300
Direct Retail Demand	300	300	300	300
Local Groundwater Basin	9,200	9,200	9,200	9,200
Kern County Groundwater Banking Program	0	300	7,300	9,000
Surface Water Storage – SWP Carryover or Other Storage	10,000	10,000	10,000	10,000
Transmission System	2,100	2,200	2,300	2,400
Storage Losses	3,000	4,000	6,000	6,000
TOTAL DEMAND	72,100	77,300	89,500	92,800
Supply & Demand Comparison				
Supply Totals	78,645	88,645	99,500	99,500
Demand Totals	72,100	77,300	89,500	92,800
Difference	6,545	11,345	10,000	6,700
Difference as % of Supply	8%	13%	10%	6%
Difference as % of Demand	9%	15%	11%	7%

a. Per Water Supply Evaluation Update

Table 7-2. Projected Single-Dry-Year Water Supply and Demand Comparison

Supply/Demand	Supply Projections (by year) (acre-feet per year)			
	2018	2023	2028	2033
Supply Component				
State Water Project (Existing Conveyance-Early Long-Term)	21,800	21,800	21,800	21,800
State Water Project - Carryover	10,000	10,000	10,000	10,000
Yuba Accord	676	676		
Byron Bethany Irrigation District	2,000	2,000	2,000	2,000
Arroyo Valle	350	350	350	350
California Water Fix			0	0
Possible desalination and/or potable reuse[a]		10,000	10,000	10,000
Groundwater	12,400	12,400	12,400	12,400
Semitropic	10,400	10,400	10,400	10,400
Cawelo	10,000	10,000	10,000	10,000
TOTAL SUPPLY	67,626	77,626	76,950	76,950
Demand Component				
Retail Demand	39,500	43,400	46,100	47,300
Untreated Water Demand	6,200	6,200	7,300	8,300
Direct Retail Demand	300	300	300	300
Local Groundwater Basin	0	0	0	0
Kern County Groundwater Banking Program	0	0	0	0
Surface Water Storage – SWP Carryover or Other Storage	0	0	0	0
Transmission System Losses	2,000	2,200	2,300	2,400
Storage Losses	0	0	0	0
TOTAL DEMAND	48,000	52,100	56,000	58,300
Supply & Demand Comparison				
Supply Totals	67,626	77,626	76,950	76,950
Demand Totals	48,000	52,100	56,000	58,300
Difference	19,626	25,526	20,950	18,650
Difference as % of Supply	29%	33%	27%	24%
Difference as % of Demand	40%	49%	37%	32%

a. Per Water Supply Evaluation Update
Source: Zone 7, 2015

7.1.5 Drought Response Planning

California Drought Contingency Plan

The *California Drought Contingency Plan* defines the following drought levels, which can serve as a reference for determining the need for response (DWR, 2010):

- When the state's precipitation, snowpack, or runoff is lower than normal, or reservoir levels are below average, conservation measures should be increased voluntarily, to help manage the state's current water supply. General response types are as follows:
    - Level 1, Abnormally Dry—Actions to raise awareness of drought

    - ➢ Level 2, First-Stage Drought—Voluntary conservation, heightened awareness, increased preparation

- When reservoirs are low; precipitation, snowpack, and runoff are all well below normal and forecasted to remain so, mandatory conservation may need to be enacted in communities that do not have adequate water supplies. General response types are as follows:
    - Level 3, Severe Drought—Mandatory conservation, emergency actions
    - Level 4, Extreme Drought—Maximum mandatory conservation
- When extremely dry conditions persist across the state, water safety, supply, and quality are all at risk due to shortages, and all sectors of water usage are facing hardship as a result of inadequate supply and dry conditions, general response types are as follows:
    - Level 5, Exceptional Drought—Water supplies cut off, maximum response.

Drought recovery begins when water conditions throughout the state are at normal levels. No drastic water conservation measures are necessary in this period, although water conservation should always be practiced. The state's reservoirs are full or nearly full and runoff across the state is at normal levels.

Zone 7 Water Management Plan

Zone 7's *2015 Urban Water Management Plan* will be enacted at the appropriate level to address a water supply shortage up to 50 percent (Chapter 8, Water Shortage Contingency Plan). Zone 7 Water District has sufficient water supply to meet demand in most years, but shortages can occur as a result of dry weather or an extended interruption of imported supplies. Voluntary water restrictions may also be initiated by an executive order from the governor due to state-level water conditions. The water shortage stages and associated actions Zone 7 will take to implement a water shortage contingency plan in response to a water supply shortfall are as follows (Zone 7, 2015):

- Stage 1, Minimal Shortage
    - Zone 7 Board declaration based on findings from the Annual Sustainability Report to determine voluntary vs. mandatory reductions (Stage 1 vs. Stage 2).
    - Public outreach to support voluntary conservation.
    - Retailers asked to voluntarily reduce demand up to 20 percent.
- Stage 2, Moderate Shortage
    - Zone 7 Board declaration based on findings from the Annual Sustainability Report to determine voluntary vs. mandatory reductions (Stage 1 vs. Stage 2), and retailers required to reduce demand accordingly up to 20 percent.
    - Water shortage surcharge may be implemented as determined by the board.
    - Expanded public outreach to support conservation.
    - Specific practices may be prohibited as determined by the board.
- Stage 3, Severe Shortage
    - Zone 7 Board declaration based on findings from the Annual Sustainability Report with mandatory demand reduction between 20 and 35 percent and retailers asked to reduce demand accordingly.
    - Water shortage surcharge may be implemented as determined by the board.
    - Intensified public outreach to support conservation.
    - Specific practices are prohibited as determined by the board.

- Stage 4, Critical Shortage
  - Zone 7 Board declaration based on findings from the Annual Sustainability Report with mandatory demand reduction greater than 35 percent and retailers asked to reduce demand accordingly.
  - Water shortage surcharge may be implemented as determined by the board.
  - Intensified public outreach to support conservation.
  - Specific practices are prohibited as determined by the board.

Since Zone 7 is a wholesale water agency, it has not adopted ordinances that set or enforce consumption limits at the customer level.

Local Retail Water Purveyors

Local retail water purveyors in the Tri-Valley planning area (Dublin San Ramon Services District, Livermore Municipal Water, California Water Service Company, and City of Pleasanton Utilities Division) have prepared for water supply interruptions with water shortage contingency plans. The plans consist of four stages of water conservation and give guidelines to residential and commercial users' conservation action ideas. These plans also include per capita allotment, penalties and customer incentives for conservation.

7.2 HAZARD PROFILE

7.2.1 Past Events

In California, droughts typically occur after two or three years of below-average rainfall for the period from November to March, when about 75 percent of the State's average annual precipitation falls. December, January, and February are when approximately 50 percent of the rainfall occurs in California.

Drought has affected nearly every county in California at one time, causing more than $2.6 million in damages. They are a cyclic part of the climate of the State and occur at any time of the year, with an average recurrence interval between three and 10 years (Cal OES, 2013a; Alameda County, 2016a). This section provides information regarding drought events that occurred in California and Alameda County.

State of California

The California Department of Water Resources has state hydrologic data back to the early 1900s. The hydrologic data show multi-year droughts from 1912 to 1913, 1918 to 1920 and 1922 to 1924, and 1928 to 1934 (DWR, 2013a). Since then, four prolonged periods of drought occurred in California:

- **2012 to 2016 Drought**—California's drought has set several records for the state. The period from 2012 to 2014 ranked as the driest three consecutive years for statewide precipitation. Calendar year 2014 set new climate records for statewide average temperatures and for record-low water allocations from State Water Project and federal Central Valley Project contractors. Calendar year 2013 set minimum annual precipitation records for many communities. The state has detailed executive orders and regulations concerning water conservation and management. Total impacts of the drought cannot be determined until after its conclusion. Based on a wet winter, Governor Brown declared an end to the drought emergency on April 7, 2017 in Executive Order B-40-17, except in four counties (Fresno, Kings Tulare, and Tuolumne) (CA.gov, 2017).
- **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 low snowmelt runoff. 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).

- **1987 to 1992 Drought** —California received precipitation well below average levels for four consecutive years. While the Central Coast was most affected, the Sierra Nevadas in Northern California and the Central Valley counties were also affected. During this drought, only 56 percent of average runoff for the Sacramento Valley was received, totaling just 10 million acre-feet. In 1991, the State Water Project sharply decreased deliveries to water suppliers including the San Francisco Bay Area. By February 1991, all 58 counties in California were suffering from drought conditions, and urban areas as well as rural and agricultural areas were impacted.
- **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, with the previous winter recorded as the fourth driest in California's hydrological history. 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. Over $2.6 billion in crop damage was recorded in 31 counties. Alameda County was included in FEMA-3023-EM-CA declaration on January 20, 1977.

Alameda County

The 2010 ABAG Annex to Local Hazard Mitigation Plan (ABAG, 2010) identified the following drought events that impacted Alameda County:

- **2007 to 2009**—This event affected the entire state, particularly the central coast. It was a three year drought due to below average rainfall, low snowmelt runoff, and the largest court ordered water restriction in state history. The dry conditions damaged crops, deteriorated water quality, and caused extreme fire danger. California proclaimed a state disaster in 2008 and 2009. Damages included $300 million in agricultural revenue loss and potential $3 billion in economic losses over time.
- **1987 to 1992**—This event affected the entire state.
- **1976 to 1977**—This event affected the entire state with the exception of southwestern deserts. These were the two driest years in California's history. The drought was most severe in the northern two-thirds of the State. California proclaimed a statewide disaster that did not include Alameda County, but the federal disaster declaration in 1977 did include Alameda County. Damage totaled $2.664 billion ($888.5 million in 1976 and $1.775 billion in 1977).
- **1959 to 1962**—This event affected the entire state.
- **1943 to 1951**—This event affected the entire state.
- **1928 to 1937**—This event affected the entire state.
- **1922 to 1926**—This event affected the entire state with the exception of central Sierra Nevada.
- **1917 to 1921**—This event affected the entire state with the exception of central Sierra Nevada and the north coast.

The National Drought Mitigation Center (NDMC) 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 database is being populated beginning with the most recent impacts and working backward in time. The Drought Impact Reporter contains information on 173 impacts from droughts that specifically affected Alameda County from 2006 through May 1, 2017 (NDMC Drought Impact Reporter, 2017). The following are the categories and reported number of impacts (some impacts are assigned to more than one category):

- Agriculture—38

- Business and Industry—8
- Energy—4
- Fire—14
- Plants and Wildlife—33
- Relief, Response, and Restrictions—96
- Society and Public Health—65
- Tourism and Recreation—7
- Water Supply and Quality—109

Between 1954 and 2016, the State of California experienced one FEMA declared drought-related major disaster (DR) or emergency (EM) classified as a drought. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Alameda County was included in the declaration (FEMA 2017a) (see Table 7-3).

Table 7-3. FEMA Declarations for Drought Events in Alameda County

FEMA Declaration Number	Event Date	Event Type	Location
EM-3023	1977	Drought	58 counties including Alameda County

Agriculture-related disasters and disaster declarations are common in the United States. The U.S. Department of Agriculture (USDA) Farm Service Agency provides assistance for natural disaster losses resulting from drought, flood, fire, freeze, tornadoes, pest infestation, and other natural disasters. The Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses. Between 2012 and 2016, California has been included in 61 drought-related USDA disaster declarations and Alameda County has been included in 11 (USDA, 2017):

- S3952 in 2016
- S3784 and S3943 in 2015
- S3626, S3637, and S3743 in 2014
- S3547, S3558 and S3569 in 2013
- S3248 and S3930 in 2012.

7.2.2 Location

Droughts can occur anywhere in California and are typically regional in nature. If a drought is occurring in Alameda County, then the planning area is most likely being impacted as well. The entire planning area is susceptible to droughts and impacts brought on by such events.

7.2.3 Frequency

Historical drought data for the Alameda County region indicate there have been four significant droughts in the last 40 years (1976 to 2016). The Tri-Valley planning area has been included in various drought stages during 12 of the last 40 years. This equates to a drought about 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.

7.2.4 Severity

General Drought Impacts

Drought can have a widespread impact on the environment and the economy, although it typically does not result in direct loss of life or damage to property, as do other natural disasters. Nationwide, the impacts of drought occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Economic Impacts—Drought can cost people and businesses money: farmers' crops are destroyed; low water supply requires spending money on irrigation or to drill new wells; water-related businesses see drops in sales; water companies must spend money on new or additional water supplies.
- 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 groups 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. 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 steam flows are lowest.

Local Impacts of the 2012-2016 Drought

The Cities of Dublin, Livermore and Pleasanton all initiated water shortage contingency plans during the most recent drought. Each city carried out public education campaigns about water conservation and took steps to conserve water. Zone 7 and its retailers developed a website for Tri-Valley residents with information on water-wise gardening www.trivalleywaterwise.com (Water-Wise Gardening Tri-Valley, 2017). The following are examples of how local proprietors dealt with the drought.

Zone 7

In 2014, Zone 7 had to establish mandatory minimum guidelines for its service area to achieve a needed 25-percent reduction in water use over the course of the year by cutting back on outdoor watering by 50 to 60 percent. During this time, Zone 7 only received a 5 percent allocation from the State Water Project, but Zone 7 was able to fulfill 75 percent of retail requests. Zone 7 relied on its out-of-valley storage, groundwater banking programs, and its local groundwater basin management operations (Zone 7 Water Agency, 2014).

Dublin San Ramon Services District and City of Dublin

On May 19, 2015, the Dublin San Ramon Services District declared that a State of Community Drought Emergency existed since February 2014 as there was insufficient water to meet ordinary demand of water consumers in the service area. An updated Drought Response Act Plan adopted on May 19, 2015 was to run through February 2, 2016 and was later revised to continue until October 31, 2016.

In May 2015, Dublin San Ramon Services District issued Water Use Limitations Urgency Ordinance No. 336, which adopted water use limitations during the drought Emergency, and Water Shortage Enforcement Ordinance No. 337, which adopted penalties and provisions for the enforcement of water use limitations. In March 2016, the Board adopted Urgency Ordinance No. 338 to revise the water use limitations during the Community Drought Emergency.

Customers responded positively to Dublin San Ramon Services District's water conservation program and the ongoing drought statewide by saving water that exceeded water use reduction goals. From June 2015 through January 2016, Dublin San Ramon Services District's cumulative water savings was 37 percent compared to 2013 water use, exceeding Dublin San Ramon Services District's conservation standard of 12 percent.

The City of Dublin has taken steps to reduce its consumption of potable water. Nearly all of its parks and landscaped medians now use recycled water; recycled water use is approximately 90 percent of total usage for municipal operations. The City instituted several water-saving practices for businesses, residents, and City departments (City of Dublin, 2017).

City of Livermore

The City of Livermore first adopted a Water Shortage Contingency Plan in 1991 and updated the plan in 1996, 2005 and 2011. The Plan includes water conservation strategies in response to shortages. In response to the drought emergency declared by Governor Brown in January 17, 2014, the Livermore City Council declared a water shortage emergency on February 24, 2014 and enacted Stage 1 Voluntary Water Conservation Measures to achieve a 20% reduction in water consumption. On April 28, 2014, the City Council enacted Stage 2 mandatory conservation measures at a 35% level. Due to the community's positive response in achieving conservation targets and updated evaluation of water availability, the City Council on June 27, 2016 was able to repeal the mandated Stage 3 conservation measures and enacted Stage 1 voluntary conservation of 10%. On May 22, 2017, the City Council repealed the Stage 1 conservations measures following Governor Brown's declaration of the end of the drought emergency. During the drought, Livermore Municipal Water customers were able to achieve conservation of 25% in 2014, 32% in 2015 and 28% in 2016 as compared to 2013 water use. (City of Livermore, 2017a).

City of Pleasanton

In April 2014, the City moved into Stage 3 water restrictions, mandating a 25-percent reduction in use by all water customers. This continued into 2015. City staff organized a public education program to inform residents and businesses on ways to conserve water with more efficient and reduced landscape irrigation, repairing leaks, and eliminating non-necessary water usage from their routines. In under 6 months, Pleasanton water users reduced their water consumptions by 27 percent from the previous year.

In 2015, the City secured almost $17 million in low-interest loans and incentive grants from the state to build infrastructure to deliver more recycled water. As a result, approximately 450 million gallons a year of recycled water was projected to be delivered to commercial users. In 2016, 10 miles of purple lines (recycled water infrastructure) were installed, saving the City 10 percent of potable water (City of Pleasanton, 2017a).

7.2.5 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.

Empirical studies conducted over the past century have shown that meteorological 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.

Scientists at this time 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; California is currently experiencing a several-year-long drought, while other areas in the United States may experience droughts as short as one or two months. How long droughts 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.

7.3 SECONDARY HAZARDS

The secondary hazard 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. Millions of board feet of timber have been lost, and in many cases erosion occurred, which caused serious damage to aquatic life, irrigation, and power production by heavy silting of streams, reservoirs, and rivers.

Drought also is often accompanied by extreme heat, exposing people to the risk of sunstroke, heat cramps and heat exhaustion. Pets and livestock are also vulnerable to heat-related injuries. Crops can be vulnerable as well.

Environmental losses are the result of damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity.

Drought-induced subsidence is a potential secondary hazard, although it is not as common as wildfire or extreme heat. If subsidence does occur, it can significantly impact the local environment, floodplain/wetlands, and water supply.

7.4 EXPOSURE

All people, property and environments within the Tri-Valley planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions.

7.5 VULNERABILITY

7.5.1 Population

The entire population of the planning area is vulnerable to drought events. Drought conditions can affect people's health and safety, including health problems related to low water flows and poor water quality, and health problems related to dust. Droughts can also lead to the loss of human life (NDMC, 2017a). Other possible impacts on health from drought include increased recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and sanitation and hygiene; compromised food and nutrition; and increased incidence of illness and disease. Health implications of drought—both short-term and long-term—are numerous (Centers for Disease Control and Prevention, 2012). Drought conditions can cause shortages of water for human consumption. Droughts can also lead to reduced local firefighting capabilities.

Alameda County, the Cities of Dublin, Livermore and Pleasanton, regional water purveyors, and other regional stakeholders have spent considerable effort to protect life, safety, and health during times of consecutive dry years, such as the current drought. Provisions and measures have been taken to analyze and account for anticipated water shortages. With the actions implemented by the Cities of Dublin, Livermore and Pleasanton and the coordination with Alameda County, the planning area has the ability to minimize and reduce impacts on residents and water consumers in the planning area. No significant life or health impacts as a result of drought are anticipated in the planning area.

7.5.2 Property

No structures will be directly affected by drought conditions in the Tri-Valley planning area, though some structures may become vulnerable to wildfires, which are more likely following years of drought. Risk to life and property is greatest in the wildland-urban interface, where forested areas adjoin urbanized areas (high density residential, commercial and industrial). All assets in and adjacent to the wildland-urban interface zone, including population, structures, critical facilities, lifelines, and businesses are considered vulnerable to wildfire. Specific vulnerability regarding wildfire is described in Chapter 12.

7.5.3 Critical Facilities

Critical facilities as defined for this plan will continue to be operational during a drought. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic impacts that are not considered significant.

7.5.4 Environment

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes and vegetation. However, many species will eventually recover from this temporary condition. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Environmental losses are difficult to quantify, but growing public awareness and concern for environmental quality have forced public officials to focus greater attention on these effects.

7.5.5 Economic Impact

A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages and higher costs for these resources. Industries that rely on water for business may be impacted the most (e.g., landscaping businesses). Although most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant within the recreation and tourism industry. Moreover, droughts in another area could impact the food supply/price of food for residents of the planning area. While the planning area is not considered highly agricultural, it is important to note that ranching, vineyards and the winery business are an important part of the Tri-Valley economy.

7.6 FUTURE TRENDS IN DEVELOPMENT

Land use planning is directed by general plans adopted under California's General Planning Law. Municipal planning partners are encouraged to establish general plans with policies directing land use and dealing with issues of water supply and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. Dublin, Livermore and Pleasanton reviewed their general plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation actions to increase the capability to deal with future trends in development.

7.7 SCENARIO

Continuation or exacerbation of the current drought across California—an extreme, multiyear drought with record-breaking rates of low precipitation and high temperatures—is the worst-case scenario for the planning area. Low precipitation and high temperatures intensify the possibility of wildfires throughout the planning area, increasing the need for water, when water is already in limited supply. Surrounding regions, also in drought conditions, could increase their demand for the water supplies also relied upon in the planning area, causing social and political conflicts. The high-density population of the Bay Area increases the likelihood of such conflicts, despite the existence of the Bay Area Water Supply and Conservation Agency *Water Conservation Implementation Plan*. The longer drought conditions last in the planning area, the more impacted the local economy becomes; water-dependent industries especially will experience setbacks.

7.8 ISSUES

The planning team has identified the following drought-related issues:

- Identification of the availability and reliability of new water supplies
- Monitoring of the implementation and benefits of the long-term reliable water supply strategy projects, Bay Area Water Supply and Conservation Agency *Water Conservation Implementation Plan* projects, and water system upgrades
- Application of alternative techniques (groundwater recharge, water recycle, local capture and reuse, desalination, and transfer) to stabilize and offset Sierra Nevada snowpack water supply shortfalls
- Regular occurrence of drought or multiyear droughts that may limit the planning area's ability to successfully recover from or prepare for more occurrences-particularly noteworthy due to longevity of the current ongoing drought.
- The probability of increased drought frequencies and durations due to climate change
- The promotion of active water conservation even during non-drought periods.

8. EARTHQUAKE

8.1 GENERAL BACKGROUND

An earthquake is the vibration of the earth's surface that follows a release of energy in the earth's crust. 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. Vibrations called "seismic waves" are generated in the process of breaking. These waves travel outward from the source of the earthquake along the surface and through the earth at varying speeds, depending on the material they move through.

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 movement of the tectonic plates creates stress released as energy that moves through the earth as waves called earthquakes.

DEFINITIONS

Earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Hypocenter—The region underground where an earthquake's energy originates

Liquefaction—Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

8.1.1 Earthquake Classifications

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

Magnitude

An earthquake's magnitude is a measure of the energy released at the source of the earthquake. It is commonly expressed by ratings on either of two scales (USGS, 1989):

- The **Richter scale** measures magnitude of earthquakes based on the amplitude of the largest energy wave released by the earthquake. Richter scale readings are suitable for smaller earthquakes; however, because it is a logarithmic scale, the scale does not distinguish clearly the magnitude of large earthquakes above a certain level. Richter scale magnitudes and corresponding earthquake effects are as follows:
  - 2.5 or less—Usually not felt, but can be recorded by seismograph
  - 2.5 to 5.4—Often felt, but causes only minor damage
  - 5.5 to 6.0—Slight damage to buildings and other structures
  - 6.1 to 6.—May cause a lot of damage in very populated areas
  - 7.0 to 7.9—Major earthquake; serious damage
  - 8.0 or greater—Great earthquake; can totally destroy communities near the epicenter
- A more commonly used magnitude scale today is the **moment magnitude (M_W) scale**. The moment magnitude 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). Moment magnitude roughly matches the Richter scale but provides more accuracy for larger magnitude earthquakes. The scale is as follows:

- Great—$M_W \geq 8$
- Major—M_W = 7.0 - 7.9
- Strong—M_W = 6.0 - 6.9
- Moderate—M_W = 5.0 - 5.9
- Light—M_W = 4.0 - 4.9
- Minor—M_W = 3.0 - 3.9
- Micro—$M_W < 3$

Intensity

Currently the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows (USGS, 2014):

- I (Not Felt). Not felt except by a very few under especially favorable conditions
- II (Weak). Felt only by a few persons at rest, especially on upper floors of buildings.
- III (Weak). Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
- IV (Light). Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
- V (Moderate). Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
- VI (Strong). Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
- VII (Very Strong). Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
- VIII (Severe). Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
- IX (Violent). Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
- X (Extreme). Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

8.1.2 Ground Motion

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

The most commonly mapped ground motion parameters are horizontal and vertical peak ground accelerations (PGA) for a given soil type. PGA is a measure of how hard the earth shakes, or accelerates, in a given geographic area. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. PGA is measured in 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). Table 8-1 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

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

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

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

8.1.3 USGS Earthquake Mapping Programs

ShakeMaps

The USGS Earthquake Hazards Program produces maps called ShakeMaps that provide near-real-time mapping of ground motion and shaking intensity following significant earthquakes. ShakeMaps focus on the ground shaking resulting from 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 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.

National Seismic Hazard Map

National maps of earthquake shaking hazards have been produced since 1948. They 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).

The USGS updated its National Seismic Hazard Map in 2014, incorporating the best available seismic, geologic, and geodetic information on earthquake rates and associated ground shaking. Figure 8-1 shows the peak ground acceleration with 10 percent probability of exceedance in 50 years. For Dublin, Livermore and Pleasanton, this PGA is 0.4 or greater.

Source: USGS, 2014a

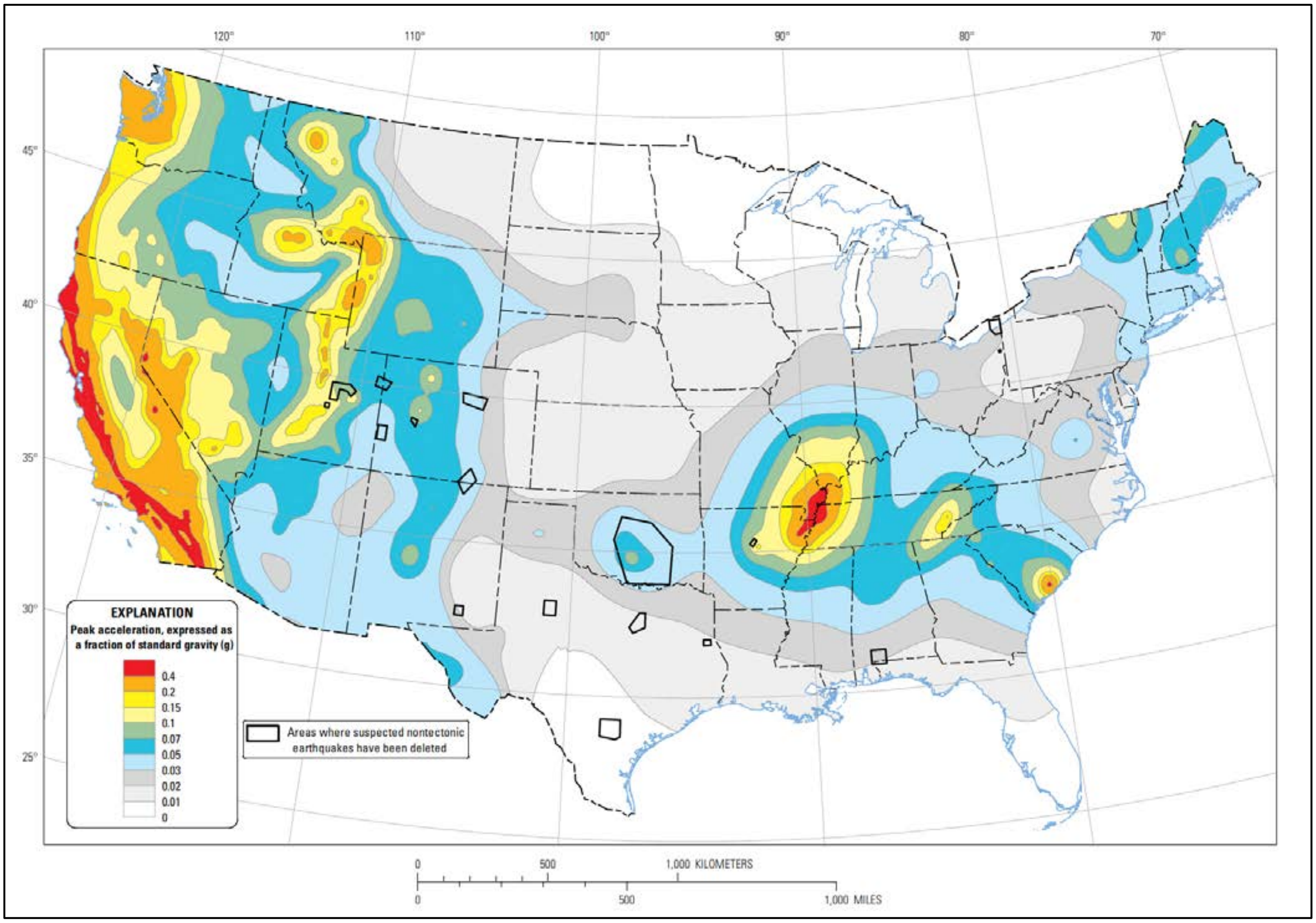


Figure 8-1. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years

8.1.4 Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the quake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 8-2 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

Table 8-2. NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (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 m thick)	

The USGS has created a soil type map for the San Francisco Bay area that provides rough estimates of site effects based on surface geology. NEHRP soil types were assigned to a geologic unit based on the average velocity of that unit; USGS notes that this approach can lead to some inaccuracy. For instance, a widespread unit consisting of Quaternary sand, gravel, silt, and mud has been assigned as Class C soil types; however, some of the slower soil types in this unit fall under Class D. USGS does not have any way of differentiating units for slower-velocity soils in its digital geologic dataset (USGS, 2017).

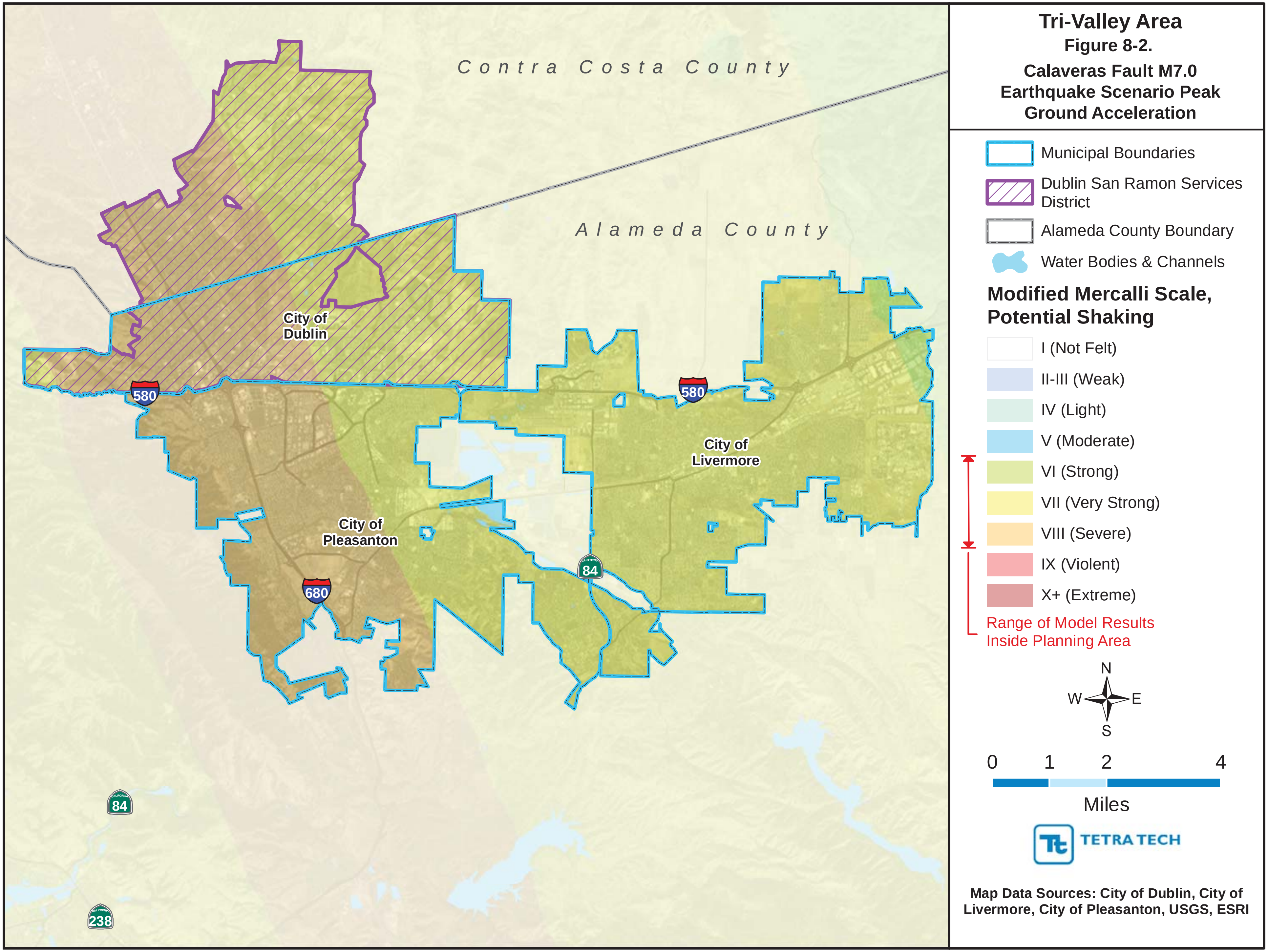
8.1.5 Earthquake Scenarios for Risk Assessment

The USGS Earthquake Hazards Program creates scenarios of potential earthquakes for use in earthquake hazard planning. Hypothetical ShakeMaps of these scenarios depict the expected ground motions and effects of the scenario across the surrounding region. The following USGS scenarios were used in the risk assessment for this plan:

- Calaveras (North + Central + South) Fault Scenario—A Magnitude-7.0 event with a depth of 7 km and epicenter one mile west of the City of Dublin. (See Figure 8-2)
- Greenville Fault Scenario—A Magnitude-7.0 event with a depth of 12 km and epicenter 24 miles southeast of the City of Pleasanton. (See Figure 8-3)
- Haywired Fault Scenario—A Magnitude-7.05 event with a depth of 8 km epicenter 9 miles northwest of the City of Dublin. (See Figure 8-4)
- Mount Diablo Fault Scenario—A Magnitude-6.7 event with a depth of 14 km and epicenter 9 miles north of the City of Livermore. (See Figure 8-5).
- North San Andreas (North Coast + Peninsula + Santa Cruz Mountain) Fault Scenario—A Magnitude-7.8 event with a depth of 9.8 km and epicenter 140 miles northwest of the City of Dublin. (See Figure 8-6).

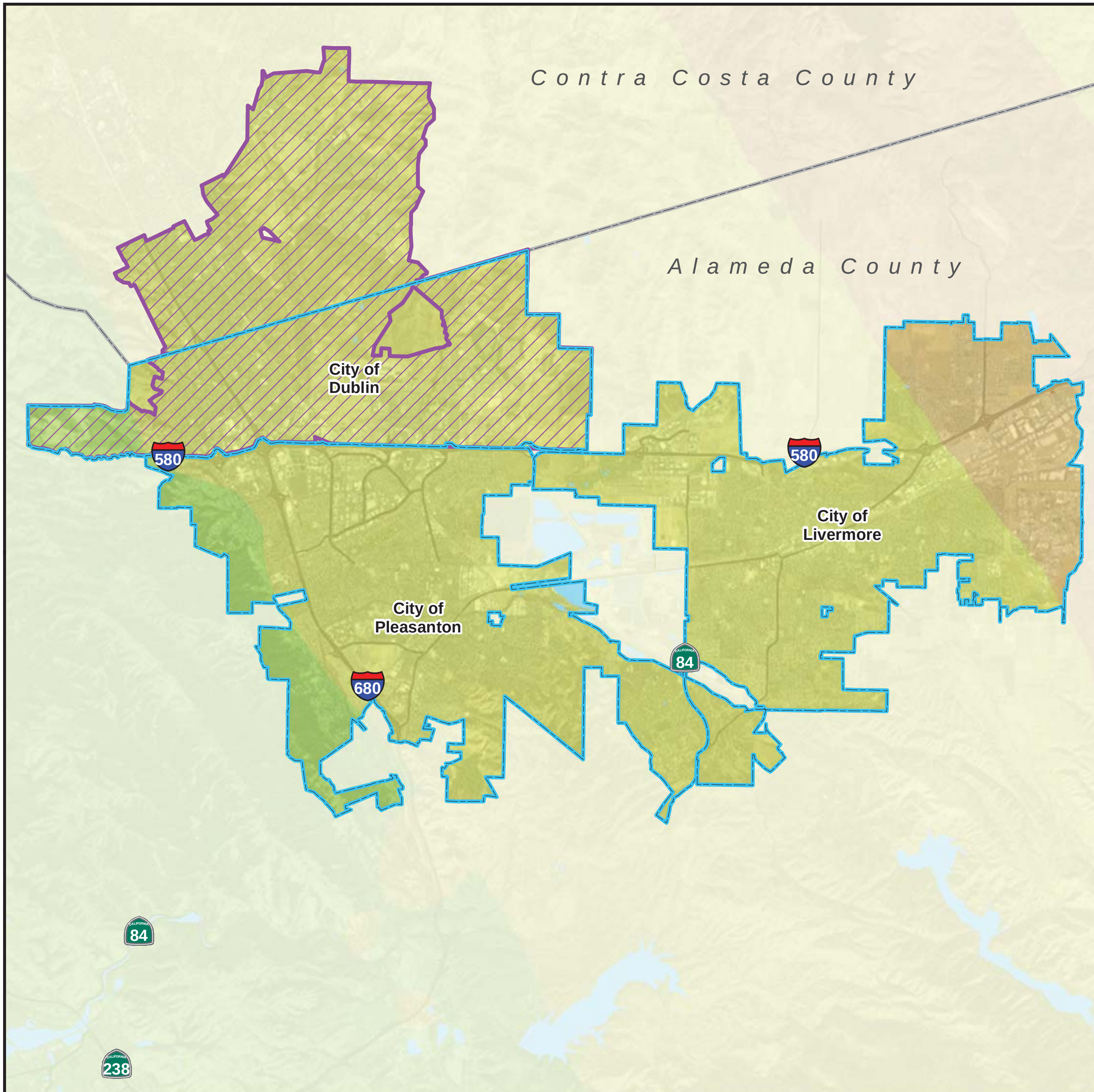
8.2 HAZARD PROFILE

California is seismically active because it sits on the boundary between two of the earth's tectonic plates. Most of the state—everything east of the San Andreas Fault—is on the North American Plate. Coastal cities from Monterey to San Diego are on the Pacific Plate, which is constantly moving northwest past the North American Plate. The relative rate of movement is about 2 inches (50 millimeters) per year (Cal OES, 2013b). Earthquakes in the San Francisco Bay region result from strain energy constantly accumulating across the region because of the northwestward motion of the Pacific Plate relative to the North American Plate.



Tri-Valley Area
Figure 8-2.
Calaveras Fault M7.0 Earthquake Scenario Peak Ground Acceleration

Tri-Valley Area
Figure 8-3.
Greenville Fault M7.0 Earthquake Scenario Peak Ground Acceleration



Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels

Modified Mercalli Scale, Potential Shaking

I (Not Felt)
II-III (Weak)
IV (Light)
V (Moderate)
VI (Strong)
VII (Very Strong)
VIII (Severe)
IX (Violent)
X+ (Extreme)

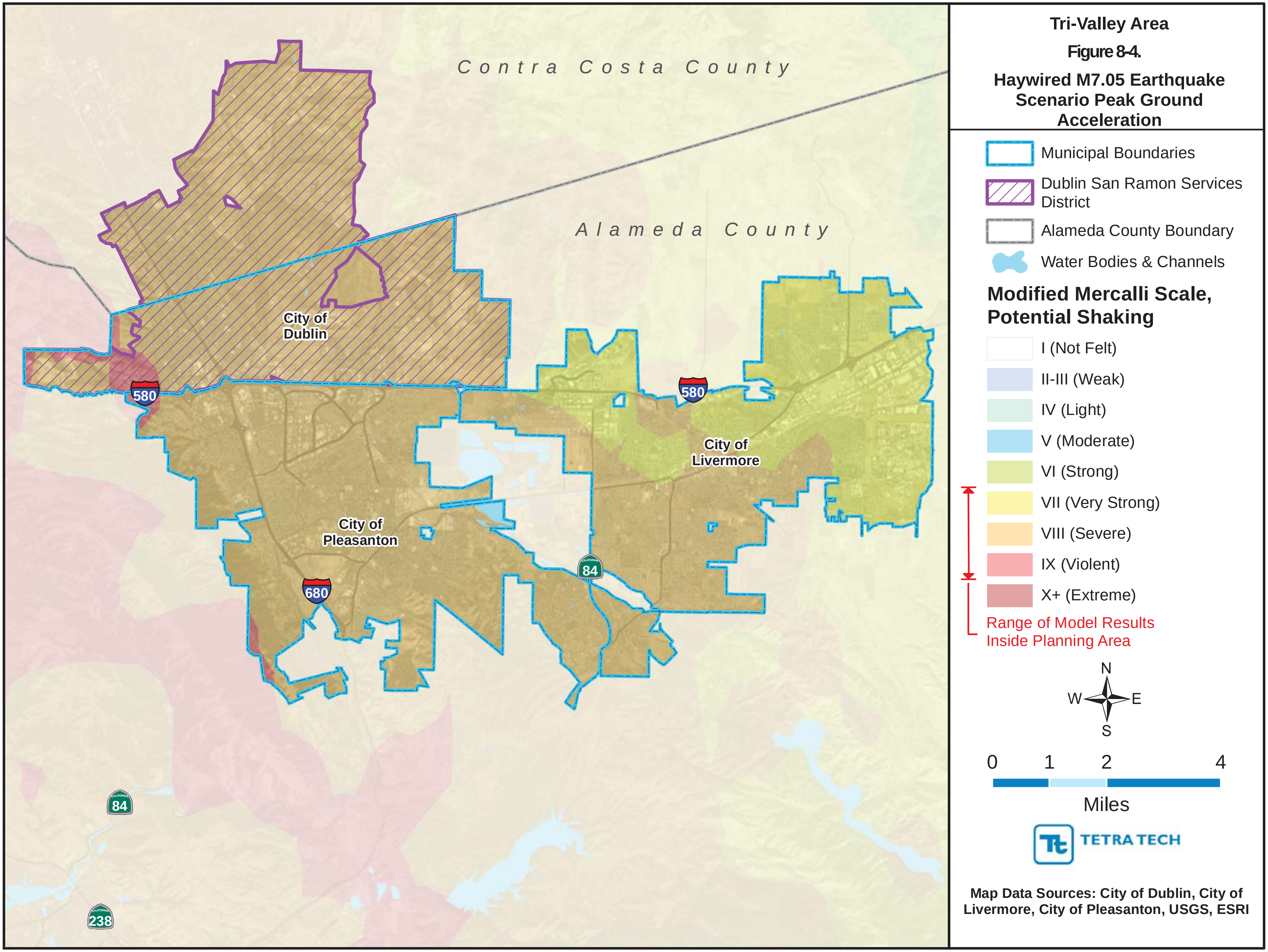
Range of Model Results Inside Planning Area

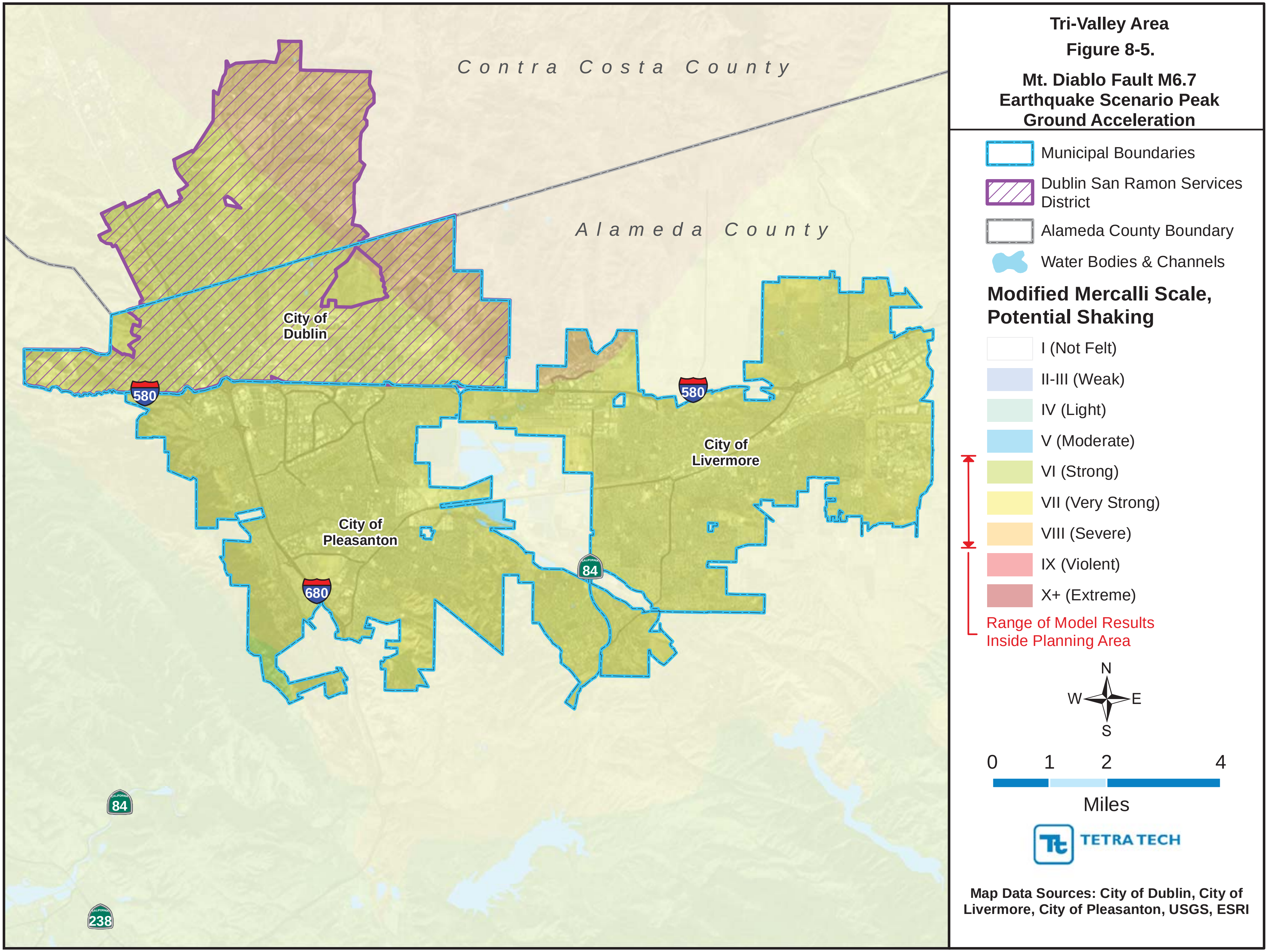
N W E S

0 1 2 4
Miles

TETRA TECH

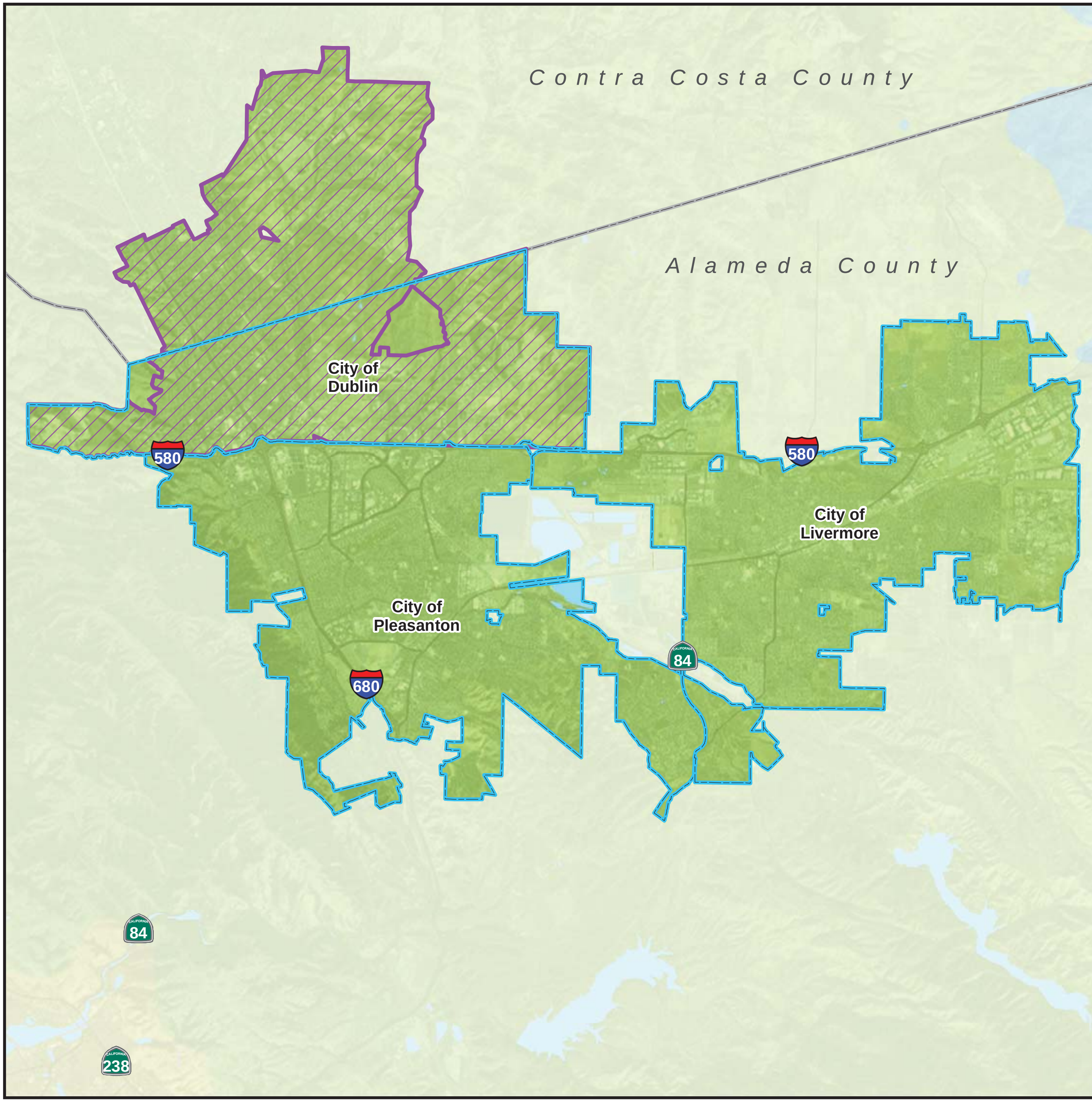
Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, USGS, ESRI


Tri-Valley Area
Figure 8-4.
Haywired M7.05 Earthquake Scenario Peak Ground Acceleration
Contra Costa County
Alameda County
City of Dublin
City of Pleasanton
City of Livermore
580
680
84
238
Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels
Modified Mercalli Scale, Potential Shaking
I (Not Felt)
II-III (Weak)
IV (Light)
V (Moderate)
VI (Strong)
VII (Very Strong)
VIII (Severe)
IX (Violent)
X+ (Extreme)
Range of Model Results Inside Planning Area
N
W
E
S
0 1 2 4
Miles
TETRA TECH
Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, USGS, ESRI



Tri-Valley Area
Figure 8-5.
Mt. Diablo Fault M6.7 Earthquake Scenario Peak Ground Acceleration
Contra Costa County
Alameda County
City of Dublin
City of Pleasanton
City of Livermore
580
680
84
238
Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels
Modified Mercalli Scale, Potential Shaking
I (Not Felt)
II-III (Weak)
IV (Light)
V (Moderate)
VI (Strong)
VII (Very Strong)
VIII (Severe)
IX (Violent)
X+ (Extreme)
Range of Model Results Inside Planning Area
N
W
E
S
0
1
2
4
Miles
TETRA TECH
Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, USGS, ESRI

Tri-Valley Area
Figure 8-6.
N San Andreas Fault M7.8 Earthquake Scenario Peak Ground Acceleration



Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels

Modified Mercalli Scale, Potential Shaking

I (Not Felt)
II-III (Weak)
IV (Light)
V (Moderate)
VI (Strong)
VII (Very Strong)
VIII (Severe)
IX (Violent)
X+ (Extreme)

Range of Model Results Inside Planning Area

N
W E
S

0 1 2 4
Miles

TETRA TECH

Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, USGS, ESRI

8.2.1 Past Events

The last significant (> 6.0 M) seismic event in the Tri-Valley vicinity was the 2014 Magnitude-6.0 earthquake that originated 6 miles southwest of Napa. The previous large event was the 1989 M-7.1 Loma Prieta Earthquake that originated 10 miles northeast of Santa Cruz. No significant seismic events in the planning area vicinity have been recorded since these two events. Other significant earthquakes in California include the 1906 earthquake in San Francisco, the 1971 San Fernando Earthquake, and the 1994 Northridge earthquake. Recent earthquakes of magnitude of 5.0 or greater near the planning area are listed in Table 8-3 and their locations are shown on Figure 8-7.

Table 8-3. Recent Earthquakes Magnitude 5.0 or Larger Near Planning Area

Date	Magnitude	Epicenter Location
8/24/2014, South Napa Earthquake	6.0	South Napa
10/31/2007, Alum Rock Earthquake	5.6	San Francisco Bay area, California
5/14/2002, Gilroy Earthquake	5	Northern California
9/3/2000, Yountville Earthquake	5	Northern California
8/12/1998, San Juan Bautista Earthquake	5.2	Central California
4/18/1990, Northern California	5.4	Near Aromas, Northern California
10/18/1989, Loma Prieta Earthquake	7.1	10 miles northeast of Santa Cruz
8/8/1989, Santa Cruz County Earthquake	5.2	Central California
6/27/1989	5.3	Northern California
6/13/1988	5.3	San Francisco Bay area, California
2/20/1988	5.1	Central California
3/31/1986	5.6	Northern California
1/26/1986	5.4	Central California

Source: USGS, 2017a

The State of California has been included in 12 FEMA major disaster (DR) or emergency (EM) declarations for earthquake events; however, Alameda County was included in only one: DR-845 for the October 17, 1989 Loma Prieta Earthquake; this declaration applied to the Counties of Alameda, Contra Costa, Marin, Monterey, Sacramento, San Benito, San Francisco, San Joaquin, San Mateo, Santa Clara, Santa Cruz, and Solano (FEMA, 2017).

8.2.2 Location

Faults

Geologists have found that earthquakes tend to reoccur along faults, which are zones of weakness in the earth's crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur. In fact, relieving stress along one part of a fault may increase it in another part.

Active faults have experienced displacement in historical time. 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. The State Division of Mines and Geology indicates that increased earthquake activity throughout California may cause tectonic movement along currently inactive fault systems. An example of a fault zone that has been reactivated is the Foothills Fault Zone in the Sierra Nevada, which was considered inactive until evidence was found near Spenceville, California, of an earthquake 1.6 million years ago. Then, in 1975, an earthquake occurred on another branch of the zone near Oroville, California.

Source: USGS, 2016a

Figure 8-7. Recent Earthquakes Near Planning Area

A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

The Cities of Dublin, Livermore and Pleasanton are located in a seismically active region in California, with exposure to major regional faults: Calaveras, Greenville, Hayward, Mount Diablo, and San Andreas. The primary seismic hazard for the planning area is potential ground shaking from these five large faults. Figure 8-8 shows the location of these fault lines and the probability of a major earthquake on each.

Calaveras Fault

The Calaveras Fault is a major branch of the San Andreas Fault, located east of the Hayward Fault. It extends 76 miles from the San Andreas Fault near Hollister to Danville at its northern end. The Calaveras Fault is one of the most geologically active and complex faults in the San Francisco Bay Area (USGS, 2017b). The probability of a M-6.7 or greater earthquake along the Calaveras Fault within the next 30 years is 26 percent.

Greenville

The Greenville Fault is in the eastern Bay Area in Contra Costa and Alameda Counties. This dextral strike-slip fault zone borders the eastern side of Livermore Valley and is considered to be part of the larger San Andreas fault system in the central Coast Ranges. The fault zone extends from northwest of Livermore Valley along the Marsh Creek and Clayton Faults toward Clayton Valley.

Hayward Fault

The Hayward Fault is a 45-mile-long, right lateral slip fault that runs parallel to the San Andreas Fault through densely populated areas on the East Bay. The Hayward Fault is increasingly becoming a hazard priority in the Bay Area because of its increased chance for activity and its proximity to critical infrastructure and multiple highly populated areas. The probability of a M-6.7 or greater earthquake along the Hayward Fault within the next 30 years is 33 percent (USGS, 2016b).

Mount Diablo

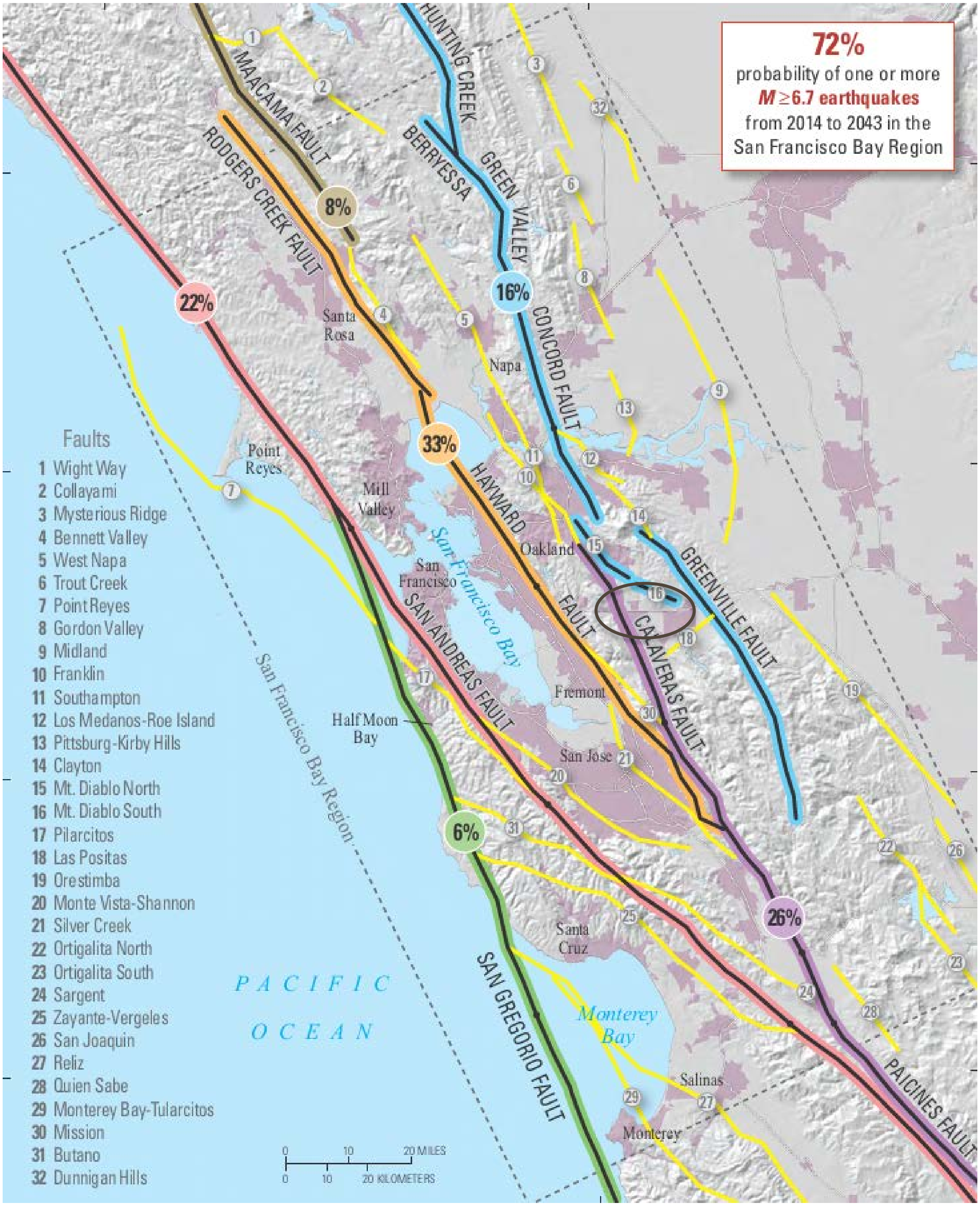
The Mount Diablo thrust fault is in the vicinity of Mount Diablo in Contra Costa County. The fault lies between the Calaveras Fault, the Greenville Fault, and the Concord Fault, all right-lateral strike slip faults, and appears to transfer movement from the Calaveras and Greenville Faults to the Concord Fault, while continuing to uplift Mount Diablo.

San Andreas Fault

The San Andreas Fault extends 810 miles from the East Pacific rise in the Gulf of California through the Mendocino fracture zone off the shore of northern California. The fault is estimated to be 28 million years old. It is an example of a transform boundary exposed on a continent. The fault forms the tectonic boundary between the Pacific Plate and the North American Plate, and its motion is right-lateral strike-slip.

The San Andreas Fault is typically referenced in three segments. The southern segment extends from its origin at the East Pacific Rise to Parkfield, California, in Monterey County. The central segment extends from Parkfield to Hollister, California. The northern segment extends northwest from Hollister, through the Bay Area, to its ultimate junction with the Mendocino fracture zone and the Cascadia subduction zone in the Pacific Ocean. The probability of a M-6.7 or greater earthquake along the San Andreas Fault within the next 30 years is 22 percent (USGS, 2016d).

Source: USGS, 2016c



Note: Oval shows the approximate location of Tri-Valley planning area.

Figure 8-8. Significant Known Faults in the Bay Area

Maps of Earthquake Impact in the Planning Area

Identifying the extent and location of an earthquake is not as simple as it is for other hazards such as flood, landslide or wildfire. The impact of an earthquake is largely a function of the following components:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically).

Mapping that shows the impacts of these components was used to assess the risk of earthquakes in the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. The mapping used in this assessment is described below.

National Earthquake Hazard Reduction Program (NEHRP) Soil Maps

NEHRP soil types define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F. Figure 8-9 shows NEHRP soil classifications in the planning area.

Liquefaction Maps

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. 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. Figure 8-10 shows the liquefaction susceptibility in the planning area.

Alquist-Priolo Zone Maps

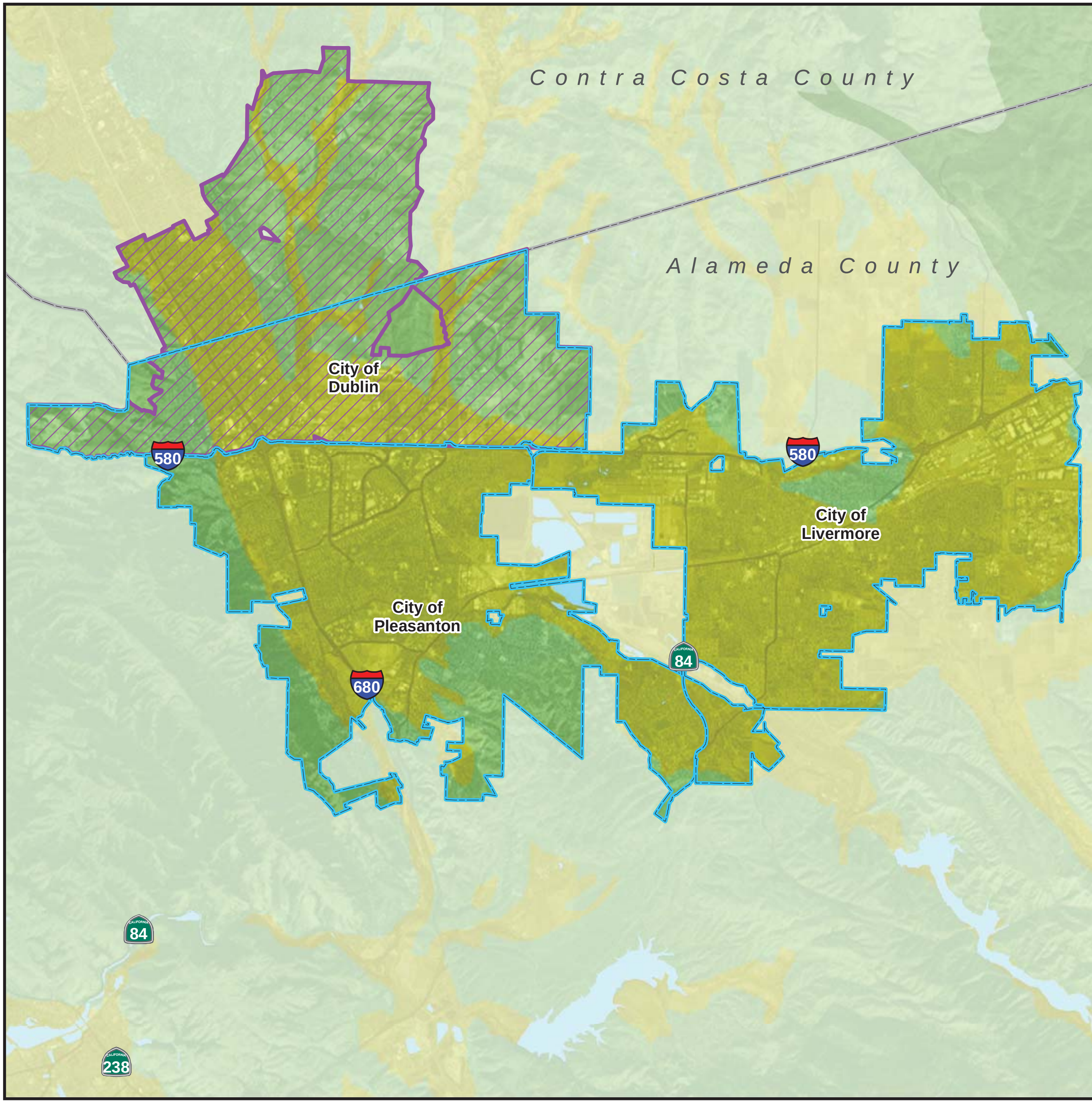
The sudden sliding of one part of the earth's crust past another releases the vast store of elastic energy in the rocks as an earthquake. The resulting fracture is a fault, and the sliding movement of earth on either side of a fault is called fault rupture. Fault rupture begins below the ground surface at the earthquake hypocenter, typically between 3 and 10 miles below the ground surface in California. If an earthquake is large enough, the fault rupture will travel to the ground surface, potentially destroying structures built across its path (Cal OES, 2013).

California's Alquist-Priolo Zone Maps provide regulatory zones for potential surface fault rupture where fault lines intersect with future development and populated areas. The purpose of these maps is to assist in the geologic investigation before construction begins to ensure that the resulting structure will not be located on an active fault. The Tri-Valley planning area is located in a designated Alquist-Priolo Zone (California DOC, 2010a).

Alquist-Priolo maps were referenced, but not specifically used, in the assessment of risk for this plan. This plan assumes that the studies conducted and information provided by the State of California are the best available data for surface rupture risk and could not be improved through a separate assessment for this plan. Alquist-Priolo maps are available to the public on the California Department of Conservation website.

8.2.3 Frequency

California experiences hundreds of earthquakes each year, most with minimal damage and magnitudes below 3.0 on the Richter Scale. 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 2 to 3 years and major earthquakes of more than 7.0 occur once a decade.



Tri-Valley Area

Figure 8-9.

National Earthquake Hazards Reduction Program (NEHRP) Soil Classification

Municipal Boundaries

Dublin San Ramon Services District

Alameda County Boundary

Water Bodies & Channels

NEHRP Site Class / Soil Profile

B / Rock

C / Very Dense Soil - Soft Rock

D / Stiff Soil

Soil classification data provided by the California Department of Conservation. The data is based on surficial geology published at a scale of 1:250,000. The surficial geologic units were grouped into composite units with similar average shear wave velocity to 30 meters depth (Vs30) values. This data was prepared as part of the Probabilistic Seismic Hazard Map of California (Petersen, M., D. Beeby, W. Bryant, T. Cao, C. Cramer, J. Davis, M. Reichle, G. Saucedo, S. Tan G., Taylor, T. Toppozada, J. Treiman, and C. Wills (1999) Seismic Shaking Hazard Maps of California: California Division of Mines and Geology Map Sheet 48).

N
W E
S

0 1 2 4

Miles

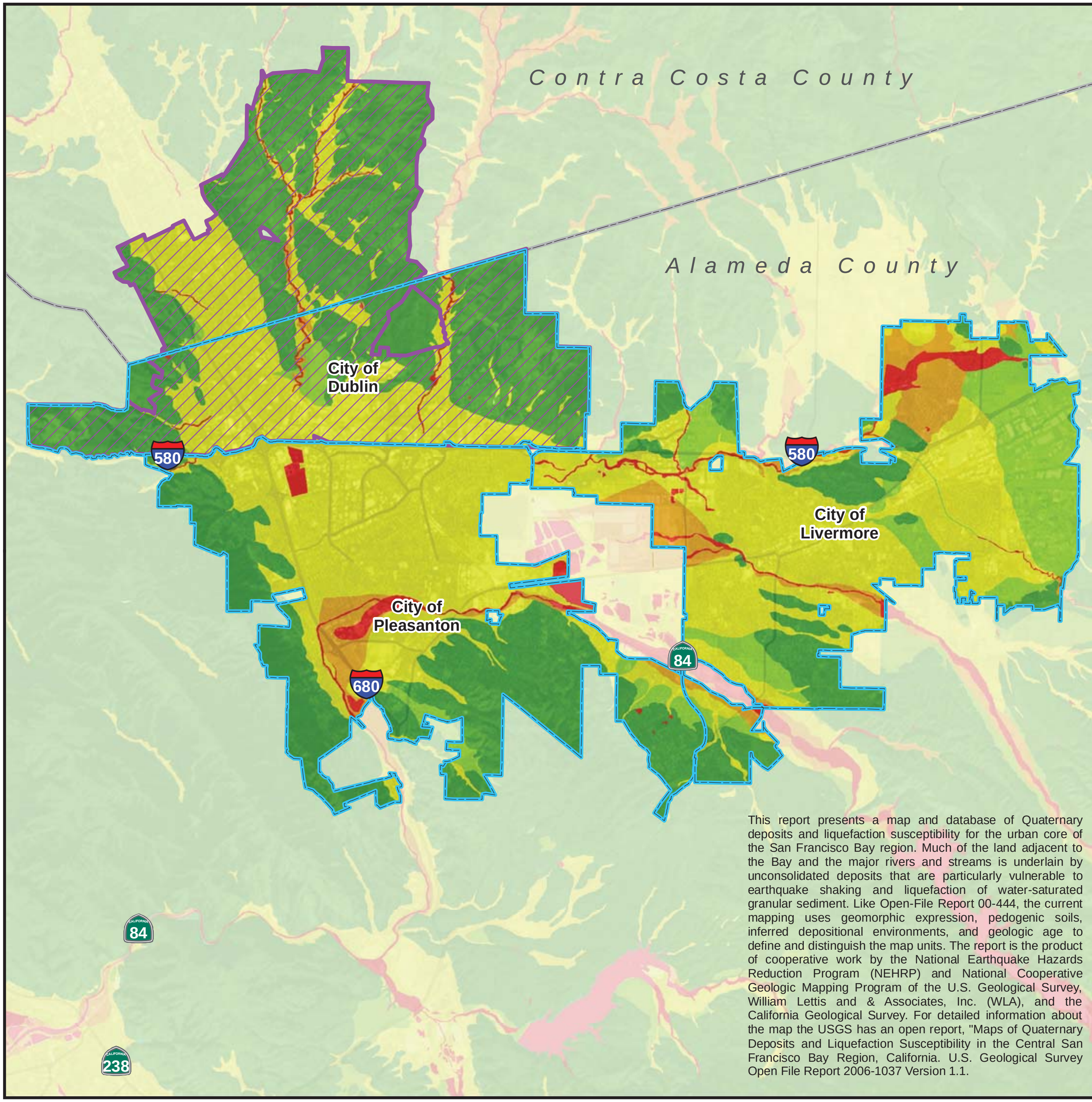
TETRA TECH

Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, California Dept of Conservation, CGS, USGS, ESRI

Tri-Valley Area

Figure 8-10.

Liquefaction Susceptibility



This report presents a map and database of Quaternary deposits and liquefaction susceptibility for the urban core of the San Francisco Bay region. Much of the land adjacent to the Bay and the major rivers and streams is underlain by unconsolidated deposits that are particularly vulnerable to earthquake shaking and liquefaction of water-saturated granular sediment. Like Open-File Report 00-444, the current mapping uses geomorphic expression, pedogenic soils, inferred depositional environments, and geologic age to define and distinguish the map units. The report is the product of cooperative work by the National Earthquake Hazards Reduction Program (NEHRP) and National Cooperative Geologic Mapping Program of the U.S. Geological Survey, William Lettis and & Associates, Inc. (WLA), and the California Geological Survey. For detailed information about the map the USGS has an open report, "Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California. U.S. Geological Survey Open File Report 2006-1037 Version 1.1.

Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels
No Liquefaction Data Available

Susceptibility to Liquefaction

Very Low
Low
Medium
High
Very High

N
W E
S

0 1 2 4
Miles

TETRA TECH

Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, California Geological Survey, USGS, ESRI

Both the San Andreas and the Hayward Faults have the potential for major to great events. The USGS estimated in 2016 that there is a 72 percent probability of at least one 6.7 or greater magnitude earthquake before 2043 that could cause widespread damage in the San Francisco Bay area (USGS, 2016e). The 2013 *State of California Multi-Hazard Mitigation Plan* cites projections that there is more than a 99-percent probability of a Magnitude-6.7 earthquake in California in the next 30 years and a 94-percent probability of a Magnitude-7.0 earthquake in California in the next 30 years. Probabilities for earthquakes on major fault lines in the San Francisco Bay Area were estimated by the USGS in a 2016 report, as summarized in Table 8-4.

Table 8-4. Earthquake Probabilities for the San Francisco Bay Area, 2014-2043

Fault	Probability of One or More ≥6.7 Quake, 2014-2043	Fault	Probability of One or More ≥6.7 Quake, 2014-2043
Hunting Creek	16%	Maacama	8%
Green Valley	16%	Rodgers Creek Fault	33%
Concord	16%	Hayward	33%
Greenville	16%	San Andreas	22%
Berryessa	16%	San Gregorio	6%
Calaveras	26%		

Source: USGS, 2016e

8.2.4 Severity

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over a period of 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, because the shocks shake, damage or demolish buildings and other structures. 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.

The USGS has created ground motion maps based on current information about several fault zones. These maps show the PGA that has a certain probability (2 percent or 10 percent) of being exceeded in a 50-year period. The PGA is measured in numbers of g's (the acceleration associated with gravity). Figure 8-11 shows the PGAs with a 2-percent exceedance chance in 50 years in the planning area. The planning area is located within a high risk area.

8.2.5 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.

8.3 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 quicksand-like into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

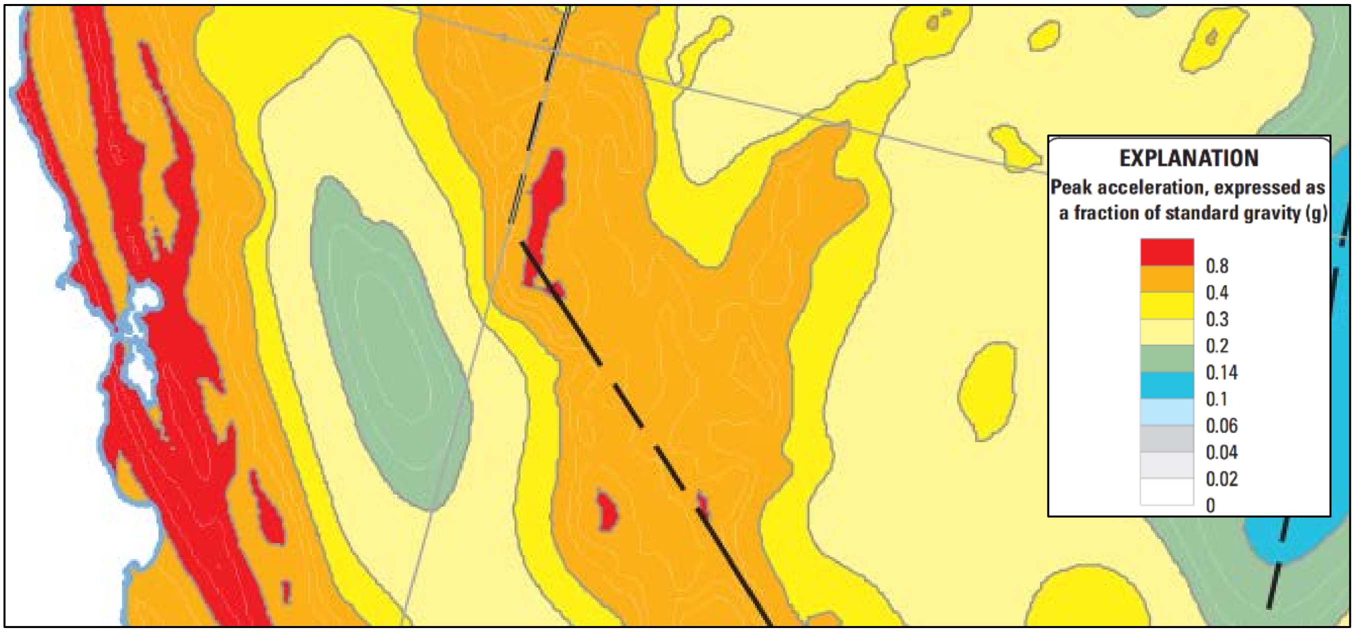


Figure 8-11. PGA with 2-Percent Probability of Exceedance in 50 Years

Earthen dams and levees are highly susceptible to seismic events, and the impacts of their eventual failures can be considered secondary hazards of earthquakes. Additionally, fires can result from gas lines or power lines that are broken or downed during the earthquake. It may be difficult to control a fire, particularly if the water lines feeding fire hydrants are also broken.

8.4 EXPOSURE

8.4.1 Population

The entire population of the planning area is potentially exposed to direct and indirect impacts from earthquakes. Whether directly impacted or indirectly impact, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

8.4.2 Property

According to Alameda County Assessor records, there are 66,760 buildings in the planning area, with a total replacement value of $53 billion. Since all structures in the planning area are susceptible to earthquake impacts to varying degrees, this total represents the property exposure to seismic events. Most of the buildings (96 percent) are residential. Table 8-5 shows the exposure value breakdown by municipality.

Table 8-5. Earthquake Exposure by Municipality

Jurisdiction	Total # of Buildings	Total Building Value—Structure and Contents
Dublin	16,588	$12,164,354,419
Livermore	27,539	$20,508,103,666
Pleasanton	22,633	$21,028,153,157
Total	66,760	$53,700,611,242

8.4.3 Critical Facilities and Infrastructure

All critical facilities and infrastructure in the planning area (see Table 4-4) are exposed to the earthquake hazard. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding hazardous materials are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

8.4.4 Environment

Environmental problems as a result of an earthquake can be numerous. Secondary hazards will likely have some of the most damaging effects on the environment. Earthquake-induced landslides in landslide-prone areas can significantly damage surrounding habitat. It is also possible for streams to be rerouted after an earthquake. Rerouting can change the water quality, possibly damaging habitat and feeding areas. There is a possibility that streams fed by groundwater wells will dry up because of changes in underlying geology.

8.5 VULNERABILITY

Earthquake vulnerability data was generated using a Hazus analysis. Once the location and size of a hypothetical earthquake are identified, Hazus estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up.

8.5.1 Population

Residents of High Risk Areas

The degree of vulnerability is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, and their proximity to fault locations. There are estimated to be 146,510 people in over 53,075 households living on soils with moderate to very high liquefaction potential in the planning area. This is about 74 percent of the total population.

Susceptible Population Groups

Two groups are particularly vulnerable to earthquake hazards:

- **Population Below Poverty Level**—An estimated 11,500 households in areas with moderate to very high liquefaction potential soils have household incomes less than $50,000 per year. This is about 22 percent of all households located on moderate to very high liquefaction potential soils. These households may lack the financial resources to improve their homes to prevent or mitigate earthquake damage. Economically disadvantaged residents are also less likely to have insurance to compensate for losses in earthquakes.
- **Population Over 65 Years Old**—An estimated 14,611 residents in areas with moderate to very high liquefaction potential soils are over 65 years old. This is about 28 percent of all residents in those areas. This population group is vulnerable because they are more likely to need special medical attention, which may not be available due to isolation caused by earthquakes. Elderly residents also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations.

Estimated Impacts on Persons and Households

Impacts on persons and households in the planning area were estimated for the five selected earthquake scenarios through the Hazus analysis. Table 8-6 summarizes the results.

Table 8-6. Estimated Earthquake Impact on Persons and Households

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter
Calaveras	758	375
Greenville	89	49
Haywired	2,071	1,039
Mount Diablo	292	143
North San Andreas	4	2

8.5.2 Property

Liquefaction Potential

Table 8-7 shows the estimated number of buildings on moderate to very high liquefiable soils. There are estimated to be 45,568 buildings, or 70 percent of the total building stock, on these soils.

Table 8-7. Number of Buildings on Moderate to Very High Liquefiable Soils

Jurisdiction	Number of Buildings
Dublin	9,696
Livermore	19,542
Pleasanton	16,330
Total	45,568

Building Age

Table 8-8 identifies significant milestones in building and seismic code requirements that directly affect the structural integrity of development. Using these time periods, the planning team used Hazus to identify the number of structures in the planning area by date of construction.

Table 8-8. Age of Structures in Planning Area

Time Period	Number of Current Structures Built in Period	Significance of Time Frame
Pre-1933	618	Before 1933, there were no explicit earthquake requirements in building codes. State law did not require local governments to have building officials or issue building permits.
1933-1940	169	In 1940, the first strong motion recording was made.
1941-1960	3,635	In 1960, the Structural Engineers Association of California published guidelines on recommended earthquake provisions.
1961-1975	20,087	In 1975, significant improvements were made to lateral force requirements.
1976-1994	19,562	In 1994, the Uniform Building Code was amended to include provisions for seismic safety.
1994 – present	22,689	Seismic code is currently enforced.
Total	66,760	

The number of structures does not reflect the number of total housing units, as many multi-family units are reported as one structure. Approximately 34 percent of the planning area's structures were constructed after the Building Code was amended in 1994 to include seismic safety provisions. Approximately 1 percent were built before 1933 when there were no building permits, inspections, or seismic standards.

Loss Potential

Property losses were estimated through the Hazus analysis for the five scenario events. Table 8-9 through Table 8-13 show the results for structural loss, representing damage to building structures, and non-structural loss, representing the value of lost contents and inventory, relocation, income loss, rental loss, and wage loss.

Table 8-9. Loss Estimates for Calaveras Fault Scenario Earthquake

	Estimated Loss Associated with Earthquake			% of Total Replacement Value
	Structure	Contents	Total	
Dublin	$564,146,058	$162,144,441	$726,290,499	6.0%
Livermore	$183,024,116	$77,605,970	$260,630,086	1.3%
Pleasanton	$899,391,183	$289,707,975	$1,189,099,158	5.7%
Total Planning Area	$1,646,561,357	$529,458,386	$2,176,019,743	4.1%

Table 8-10. Loss Estimates for Greenville Fault Scenario Earthquake

	Estimated Loss Associated with Earthquake			% of Total Replacement Value
	Structure	Contents	Total	
Dublin	$83,206,165	$34,160,786	$117,366,951	1.0%
Livermore	$503,487,581	$163,105,087	$666,592,668	3.3%
Pleasanton	$102,370,262	$49,355,172	$151,725,435	0.7%
Total Planning Area	$689,064,008	$246,621,046	$935,685,054	1.7%

Table 8-11. Loss Estimates for Haywired Fault Scenario Earthquake

	Estimated Loss Associated with Earthquake			% of Total Replacement Value
	Structure	Contents	Total	
Dublin	$1,460,638,578	$479,691,784	$1,940,330,362	16.0%
Livermore	$1,370,533,128	$455,789,010	$1,826,322,138	8.9%
Pleasanton	$2,650,641,204	$980,362,472	$3,631,003,677	17.3%
Total Planning Area	$5,481,812,910	$1,915,843,266	$7,397,656,177	13.8%

Table 8-12. Loss Estimates for Mt. Diablo Fault Scenario Earthquake

	Estimated Loss Associated with Earthquake			% of Total Replacement Value
	Structure	Contents	Total	
Dublin	$303,165,849	$86,701,274	$389,867,123	3.2%
Livermore	$373,545,048	$127,640,591	$501,185,639	2.4%
Pleasanton	$274,380,720	$95,288,012	$369,668,732	1.8%
Total Planning Area	$951,091,617	$309,629,877	$1,260,721,494	2.3%

Table 8-13. Loss Estimates for North San Andreas Fault Scenario Earthquake

	Estimated Loss Associated with Earthquake			% of Total Replacement Value
	Structure	Contents	Total	
Dublin	$30,230,952	$14,295,720	$44,526,672	0.4%
Livermore	$34,240,275	$21,438,354	$55,678,629	0.3%
Pleasanton	$51,698,029	$25,378,231	$77,076,260	0.4%
Total Planning Area	$116,169,256	$61,112,305	$177,281,561	0.3%

A summary of the property-related losses is as follows:

- For the Calaveras Scenario, the estimated damage potential is $2.17 billion, or 4.1 percent of the total replacement value for the planning area.
- For the Greenville Scenario, the estimated damage potential is $935 million, or 1.7 percent of the total replacement value for the planning area.
- For the Haywired Scenario, the estimated damage potential is $7.39 billion, or 13.8 percent of the total replacement value for the planning area.
- For the Mount Diablo Scenario, the estimated damage potential is $1.26 billion, or 2.3 percent of the total replacement value for the planning area.
- For the North San Andreas Scenario, the estimated damage potential is $177 million, or 0.3 percent of the total replacement value for the planning area.

Debris Estimates

The Hazus analysis also estimated the amount of earthquake-caused debris in the planning area for the five scenario events, as summarized in Table 8-14.

Table 8-14. Estimated Earthquake-Caused Debris

	Debris to Be Removed (tons)
Calaveras	723.42
Greenville	287.84
Haywired	2,499.41
Mount Diablo	413.29
North San Andreas	26.19

8.5.3 Critical Facilities and Infrastructure

Level of Damage

Hazus classifies the vulnerability of critical facilities 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 critical facility in the planning area, which was then averaged across the facility category. The results for the five fault scenario events are summarized in Table 8-15 through Table 8-19.

Time to Return 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 was performed for the five fault scenarios. Results are summarized in Table 8-20 through Table 8-24.

8.5.4 Environment

The environment vulnerable to earthquake hazard is the same as the environment exposed to the hazard.

Table 8-15. Estimated Damage to Critical Facilities from the Calaveras Fault Scenario Earthquake

Category	Percent of Facilities Experiencing Defined Damage Level				
	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health Services	62.73%	26.71%	0.82%	0.04%	9.68%
Emergency Services	56.62%	32.71%	4.09%	0.04%	6.52%
Educational Facilities	56.18%	30.98%	4.80%	0.17%	7.85%
Government	15.52%	17.46%	38.40%	17.15%	11.44%
Utilities	30.28%	25.41%	27.74%	5.52%	11.03%
Transportation Infrastructure	53.13%	18.57%	7.10%	10.40%	10.79%
Hazardous Materials	47.14%	17.46%	22.80%	8.10%	4.48%
Overall	45.9%	24.2%	15.1%	5.9%	8.8%

Table 8-16. Estimated Damage to Critical Facilities from the Greenville Fault Scenario Earthquake

Category	Percent of Facilities Experiencing Defined Damage Level				
	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health Services	90.76%	3.08%	0.13%	0.44%	5.56%
Emergency Services	79.34%	15.95%	1.00%	0.09%	3.59%
Educational Facilities	77.12%	16.37%	1.11%	0.19%	5.18%
Government	57.32%	23.07%	12.62%	1.58%	5.37%
Utilities	80.56%	11.18%	2.69%	0.64%	4.90%
Transportation Infrastructure	70.88%	14.95%	3.91%	6.09%	4.14%
Hazardous Materials	29.48%	19.36%	35.30%	9.95%	5.89%
Overall	69.4%	14.9%	8.1%	2.7%	4.9%

Table 8-17. Estimated Damage to Critical Facilities from the Haywired Fault Scenario Earthquake

Category	Percent of Facilities Experiencing Defined Damage Level				
	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health Services	39.61%	46.51%	2.46%	0.01%	11.40%
Emergency Services	24.90%	51.46%	15.62%	0.31%	7.68%
Educational Facilities	24.63%	49.03%	15.93%	0.32%	10.06%
Government	0.36%	1.32%	8.16%	25.04%	65.11%
Utilities	4.78%	14.66%	27.08%	24.09%	29.36%
Transportation Infrastructure	20.47%	15.40%	9.56%	15.80%	38.74%
Hazardous Materials	1.01%	3.74%	28.60%	30.86%	35.76%
Overall	16.5%	26.0%	15.3%	13.8%	28.3%

Table 8-18. Estimated Damage to Critical Facilities from the Mt. Diablo Fault Scenario Earthquake

Category	Percent of Facilities Experiencing Defined Damage Level				
	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health Services	82.95%	9.37%	0.09%	0.16%	7.40%
Emergency Services	64.18%	28.76%	2.01%	0.07%	4.95%
Educational Facilities	66.51%	25.49%	1.49%	0.07%	6.42%
Government	22.96%	33.88%	32.02%	3.78%	7.33%
Utilities	64.53%	21.43%	6.53%	0.71%	6.76%
Transportation Infrastructure	61.92%	19.26%	5.16%	8.63%	5.01%
Hazardous Materials	41.53%	26.33%	25.77%	2.98%	3.36%
Overall	57.8%	23.5%	10.4%	2.3%	5.9%

Table 8-19. Estimated Damage to Critical Facilities from the San Andreas Fault Scenario Earthquake

Category	Percent of Facilities Experiencing Defined Damage Level				
	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health Services	96.90%	0.37%	0.47%	0.80%	1.43%
Emergency Services	97.89%	1.46%	0.11%	0.12%	0.40%
Educational Facilities	97.51%	1.67%	0.10%	0.11%	0.59%
Government	90.39%	8.13%	1.07%	0.18%	0.21%
Utilities	94.76%	1.94%	0.54%	0.62%	2.11%
Transportation Infrastructure	91.11%	5.80%	0.81%	1.97%	0.28%
Hazardous Materials	91.62%	6.33%	1.90%	0.07%	0.05%
Overall	94.3%	3.7%	0.7%	0.6%	0.7%

Table 8-20. Functionality of Critical Facilities for Calaveras Fault Scenario Earthquake

Planning Unit	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health Services	20	62.7	63.3	88.8	89.4	90.2	90.2
Emergency Services	24	56.6	57.3	88.5	89.3	93.4	93.4
Educational Facilities	62	56.1	56.8	86.4	87.1	91.9	92.0
Government	23	15.5	16.3	32.9	33.0	71.4	88.5
Utilities	120	53.9	72.8	84.1	86.9	90.9	97.5
Transportation Infrastructure	147	70.1	76.7	79.3	79.8	80.7	86.6
Hazardous Materials	27	47.1	47.9	64.5	64.5	87.4	95.4
Total/Average	423	51.7	55.9	74.9	75.7	86.5	91.9

Table 8-21. Functionality of Critical Facilities the Greenville Fault Scenario Earthquake

Planning Unit	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health Services	20	90.7	90.7	93.7	93.8	93.9	94.2
Emergency Services	24	79.3	79.6	94.9	95.3	96.3	96.3
Educational Facilities	62	77.1	77.4	93.1	93.5	94.6	94.7
Government	23	57.3	58.4	80.3	80.3	93.0	94.6
Utilities	120	88.3	93.5	94.7	95.3	96.3	98.8
Transportation Infrastructure	147	83.8	88.5	90.0	90.3	90.8	94.1
Hazardous Materials	27	29.4	30.4	48.7	48.8	84.1	94.0
Overall	423	72.3	74.1	85.1	85.3	92.7	95.2

Table 8-22. Functionality of Critical Facilities for the Haywired Fault Scenario Earthquake

Planning Unit	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health Services	20	39.6	40.6	85.0	86.1	88.5	88.5
Emergency Services	24	24.9	26.0	75.1	76.3	92.0	92.1
Educational Facilities	62	24.6	25.7	72.5	73.6	89.5	89.7
Government	23	0.3	0.4	1.6	1.6	9.8	34.8
Utilities	120	27.4	41.8	52.3	59.0	71.6	91.7
Transportation Infrastructure	147	36.9	43.4	46.8	47.7	49.2	59.7
Hazardous Materials	27	1.0	1.2	4.7	4.7	33.3	64.2
Total/Average	423	22.1	25.6	48.3	49.9	62.0	74.4

Table 8-23. Functionality of Critical Facilities from the Mt. Diablo Fault Scenario Earthquake

Planning Unit	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health Services	20	82.9	83.1	92.1	92.3	92.4	92.4
Emergency Services	24	64.2	64.8	92.2	92.9	94.9	94.9
Educational Facilities	62	66.5	67.0	91.4	92.0	93.4	93.4
Government	23	22.9	24.5	56.7	56.8	88.8	92.6
Utilities	120	80.0	90.2	92.9	93.6	95.0	98.5
Transportation Infrastructure	147	78.8	84.7	86.7	87.1	87.8	92.4
Hazardous Materials	27	41.5	42.7	67.7	67.8	93.6	96.6
Total/Average	423	62.4	65.3	82.8	83.2	92.3	94.4

Table 8-24. Functionality of Critical Facilities from the San Andreas Fault Scenario Earthquake

Planning Unit	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health Services	20	96.9	96.9	97.2	97.2	97.7	98.1
Emergency Services	24	97.8	97.9	99.3	99.3	99.4	99.5
Educational Facilities	62	97.5	97.5	99.1	99.1	99.2	99.3
Government	23	90.3	90.7	98.4	98.4	99.6	99.7
Utilities	120	96.2	97.2	97.4	97.7	98.2	99.3
Transportation Infrastructure	147	95.7	97.4	97.7	97.8	98.0	99.0
Hazardous Materials	27	91.5	91.9	97.9	97.9	99.8	99.9
Total/Average	423	95.1	95.6	98.2	98.2	98.8	99.2

8.6 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans adopted under California's General Planning Law. The safety elements of the general plans establish standards and plans for the protection of the cities from hazards. The information in this plan provides a tool to ensure that there is no increase in exposure in areas of high seismic risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced. The geologic hazard portions of the planning area are heavily regulated under California's General Planning Law. The International Building Code establishes provisions to address seismic risk. Table 8-25 summarizes developable land by land use in areas with high and very high susceptibility to liquefaction.

8.7 SCENARIO

With the abundance of fault exposure in the Bay Area, 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. Dams and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. Soil liquefaction would occur in water-saturated sands, silts or gravelly soils.

Table 8-25. Developable Land in High and Very High Liquefaction Susceptibility Areas

	High Liquefaction Susceptibility Areas		Very High Liquefaction Susceptibility Areas	
	Area (acres)	% of total	Area (acres)	% of total
Residential	919	38.9%	329	25.1%
Commercial	141	6.0%	37	2.8%
Industrial	200	8.5%	45	3.4%
Agriculture	41	1.7%	40	3.1%
Religion / Assembly	247	10.5%	243	18.6%
Government / Institutional	0	0.0%	0	0.0%
Education	812	34.4%	616	47.0%
Vacant / Rights-of-Way / Water / Open Space	2,361	100.0%	1,310	100.0%
Total	919	38.9%	329	25.1%

Source: Alameda County, 2016

8.8 ISSUES

Important issues associated with an earthquake include the following:

- More information is needed on the exposure and performance of soft-story construction within the planning area.
- 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.
- Critical facility owner should be encouraged to create or enhance 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 few dams that could affect a portion of 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.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Dam failures would happen at multiple locations, increasing the impacts of the individual events.
- Citizens are expected to be self-sufficient for up to three days after a major earthquake without government response agencies, utilities, private-sector services, and infrastructure components. Education programs are currently in place to facilitate development of individual, family, neighborhood, and business earthquake preparedness. Government alone can never make this region fully prepared. It takes individuals, families, and communities working in concert with one another to be fully prepared for disaster.
- After a major seismic event, the Tri-Valley planning area is likely to experience disruptions in the flow of goods and services resulting from the destruction of major transportation infrastructure across the broader region.

9. FLOOD

9.1 GENERAL BACKGROUND

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.

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

1-percent annual chance (1oo-Year) floodplain—The area flooded by the flood that has a 1-percent chance of being equaled or exceeded each year. The 1-percent annual chance flood is the standard used by most federal and state agencies.

0.2-Percent-Annual-Chance (500-Year) Floodplain—The area flooded by the flood that has a 0.2-percent chance of being equaled or exceeded in a given year.

Regulatory Floodway—Channel of a river or other water course and adjacent land areas that must be reserved for discharge of the base flood without cumulatively increasing water surface elevation more than a designated height. Communities must regulate development in these floodways to ensure no increases in upstream flood elevations.

Return Period—The average number of years between occurrences of a hazard (equal to the inverse of the annual likelihood of occurrence).

9.1.1 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1-percent annual change flood (also called the base flood) is used as a regulatory boundary by many agencies. The area flooded by the base flood is called the special flood hazard area (SFHA). 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.

9.1.2 Floodplain Ecosystems and the Effects of Human Activities

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.

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

9.1.3 Federal Flood Programs

National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. For most participating communities, FEMA has prepared a detailed Flood Insurance Study (FIS). 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 (the 500-year flood). Base flood elevations and the boundaries of the 1-percent annual chance and 0.2-percent annual chance floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their floodplain management program. In recent years, FIRMs have been digitized as Digital Flood Insurance Rate Maps (DFIRMs), which are more accessible to residents, local governments and stakeholders.

Table 9-1 lists each municipal jurisdiction's date of entrance into the NFIP and the effective date of its current FIRM. As participants in the NFIP, the cities must, at a minimum, regulate development in their floodplain areas in accordance with NFIP criteria. Before a permit to build in a floodplain area is issued, the cities must ensure that two basic criteria are met:

- All new construction, substantial improvements, and repairs of substantial damage will be protected from damage by the base flood.
- New floodplain development will 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.

Table 9-1. Jurisdictions and Date Joined NFIP

Jurisdiction	NFIP Community #	NFIP Entry Date	Current Effective FIRM
Dublin	060705	April 14, 1981	August 3, 2009
Livermore	060008	July 5, 1977	August 3, 2009
Pleasanton	060012	December 16, 1980	August 3, 2009

Source: FEMA, 2017c

In participating communities, structures permitted or built in the planning area before NFIP and related building code regulations went into effect are called "pre-FIRM" structures, and structures built afterwards are called "post-FIRM." The insurance rate is different for the two types of structures. Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built before the FIRM was adopted may be more vulnerable to flooding and related damage because they do not meet code or are located in hazardous areas. The first FIRMs in the planning area were available in 1977 to 1983. The date of the current effective FIRM for all three cities is August 3, 2009. FEMA has developed a preliminary new DFIRM for these three cities dated April 16, 2015. Although the preliminary data is the most recent data available, until is it officially approved and adopted, it can only be used for review and guidance purposes. Preliminary data is subject to change until that point, and as such, it is not used to rate flood insurance policies or enforce the federal mandatory purchase requirement.

The Cities of Dublin, Livermore and Pleasanton are all in good standing with the NFIP. In California, the Department of Water Resources is the coordinating agency for floodplain management. 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 DWR. Maintaining compliance under the NFIP is an important component of flood risk reduction.

FEMA Regulatory Flood Zones

FEMA defines flood hazard areas as areas expected to be inundated by a flood of a given magnitude. These areas are determined via statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on DFIRMs, which provide the following information:

- Locations of specific properties in relation to SFHAs
- Base flood elevations (1-percent annual chance) at specific sites
- Magnitudes of flood in specific areas
- Undeveloped coastal barriers where flood insurance is not available
- Regulatory floodways and floodplain boundaries (1-percent and 0.2-percent annual chance floodplain boundaries).

On a DFIRM, the SFHA is the land area covered by floodwaters of the base flood—an area where NFIP floodplain management regulations must be enforced, and where mandatory purchase of flood insurance applies. This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities, because many communities have maps showing the extent of the base flood and likely depths that will occur.

The base flood elevation (the water elevation of a flood that has a 1-percent chance of occurring in any given year) is one of the most important factors in estimating potential damage from flooding. A structure within a

1-percent annual chance floodplain has a 26-percent chance of undergoing flood damage during the term of a 30-year mortgage. The 1-percent annual chance flood is used by the NFIP as the basis for insurance requirements nationwide. DFIRMs also depict 0.2-percent annual chance flood designations (500-year events).

DFIRM, FIRMs, and other flood hazard information can be used to identify the expected extent of flooding from a 1-percent and 0.2-percent annual chance event. DFIRMS and FIRMS depict SFHAs, defined as follows:

- **Zones A1-30 and AE—**SFHAs that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base flood elevations are shown within these zones. There are mandatory flood insurance purchase requirements, and floodplain management standards apply.
- **Zone A (also known as Unnumbered A-zones**)**—**SFHAs where no base flood elevations or depths are shown because detailed hydraulic analyses have not been performed. There are mandatory flood insurance purchase requirements, and floodplain management standards apply.
- **Zone AH—**Areas subject to inundation by the base flood (shallow flooding), usually areas of ponding, where average depths are between 1 and 3 feet. Base flood elevations derived from detailed hydraulic analyses are shown in this zone. There are mandatory flood insurance purchase requirements, and floodplain management standards apply.
- **Zone AO—**SFHAs subject to inundation by types of shallow flooding (usually sheet flow or sloping terrain) where average depths are between 1 and 3 feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. There are mandatory flood insurance purchase requirements, and floodplain management standards apply.
- **Zone VE, V1-30—**Areas subject to inundation by the base flood event, with additional hazards due to storm-induced velocity wave action. Base flood elevations derived from detailed hydraulic analyses are shown. There are mandatory flood insurance purchase requirements, and floodplain management standards apply.
- **Zone V—**SFHAs along the coast that are subject to inundation by the base flood event with additional hazards associated with storm-induced waves. No base flood elevations or flood depths are shown because detailed hydraulic analyses have not been performed. There are mandatory flood insurance purchase requirements, and floodplain management standards apply.
- **Zone B and X (shaded)—**Areas of moderate flood hazard and areas between the limits of the base flood and 0.2 percent annual change flood. These zones are not SFHAs.
- **Zones C and X (unshaded)—**Areas of minimal flood hazard located outside the SFHA and higher than the elevation of the 0.2-percent annual chance flood.

On the current DFIRM for Dublin, most of the city is shown as Zone X (unshaded). There are small areas of the 1-percent annual chance floodplain and 0.2-percent annual chance floodplain. On the current DFIRM for Livermore, there are large portions of Zone X (unshaded) and only small portions within the 1- percent annual chance floodplain and 0.2-percent annual chance floodplain. For Pleasanton, most of the city is shown as Zone X (unshaded). The 1-percent annual chance floodplain covers only minor areas in Pleasanton; Pleasanton has more 0.2-percent annual chance floodplain than Dublin and Livermore

The 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 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.

Figure 9-1 shows the nationwide number of CRS communities by class as of October 2016, when there were 1,391 communities receiving flood insurance premium discounts under the CRS program.

Source: FEMA, 2016

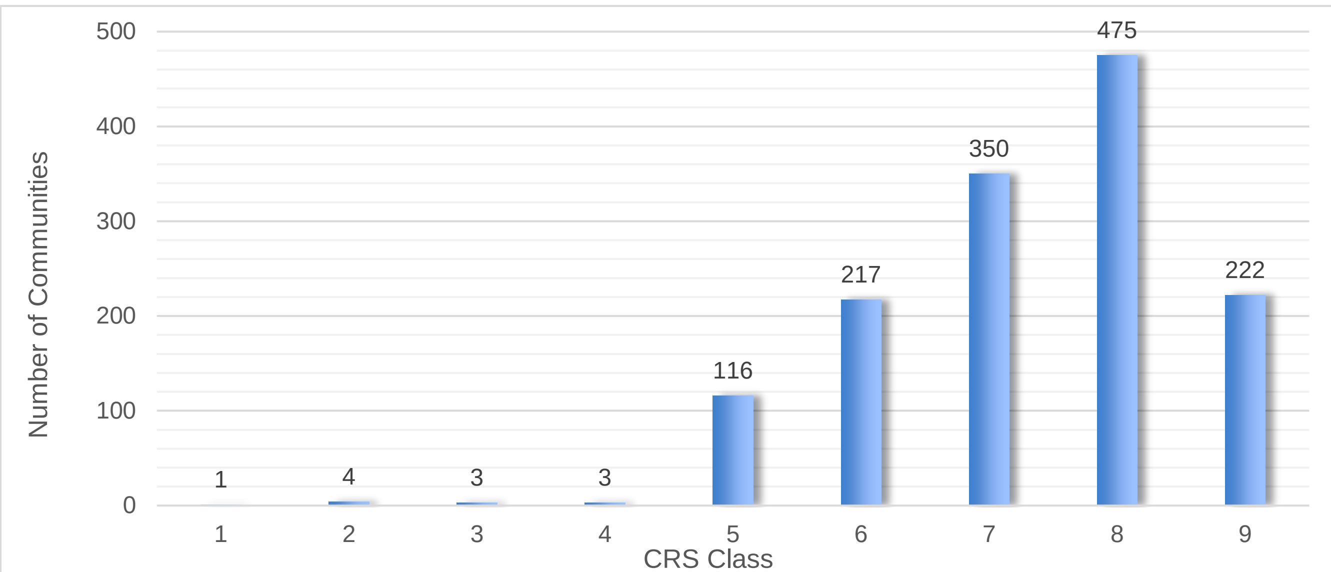


Figure 9-1. CRS Communities by Class Nationwide as of October 2016

Although insurance premiums are one benefit of participation in the CRS, more important benefits result from activities that save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk, as evidenced by the fact that over 68 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.

The Cities of Livermore and Pleasanton currently participate in the CRS program. Their CRS status is summarized in Table 9-2. The total annual savings on flood insurance premiums within the planning area is over $20,000. Many of the mitigation actions identified in Volume 2 of this plan are creditable activities under the CRS program. Therefore, successful implementation of this plan offers the potential for these communities to enhance their CRS classifications and for currently non-participating communities to join the program.

Table 9-2. CRS Community Status in the Planning Area

Community	NFIP Community #	CRS Entry Date	Current CRS Classification	% Premium Discount, SFHA/non-SFHA	Total Premium Savings
Livermore	060008	05/01/2015	9	5/5	$5,112
Pleasanton	060012	10/1/1992	7	15/5	$15,423
Total					$20,535

Source: FEMA, 2017

9.2 HAZARD PROFILE

9.2.1 Types of Flooding Affecting the Planning Area

Flooding in the planning area typically occurs during the rainy season, between November and April. Three types of flooding primarily affect the planning area: stormwater flooding, riverine flooding and flash floods.

Stormwater Runoff Flooding

Urban drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent flooding on streets and in other urban areas. These closed conveyance systems channel water away from an urban area to surrounding streams, bypassing natural processes of water filtration through the ground, containment, and evaporation of excess water. Urban drainage systems can play a role in flooding in two ways:

- Because drainage systems reduce the amount of time surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in the area (FEMA, 2008).
- If stormwater runoff exceeds the capacity of the drainage system, then stormwater runoff flooding can result throughout the system's service area.

Stormwater runoff flooding can occur in areas other than delineated floodplains or along recognizable channels. It generally occurs in flat areas, and generally increases with urbanization, which speeds accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA, 1997).

Riverine Flooding

Riverine flooding is the overbank flooding of rivers and streams. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into major rivers. Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards as areas that are inundated by the 1-percent annual chance flood with flood depths of only 1 to 3 feet. These areas are generally flooded by low velocity sheet flows of water. Two types of flood hazards are generally associated with riverine flooding:

- **Inundation**—Inundation occurs when there is floodwater and debris flowing through an area that is not normally covered by water. Such events cause minor to severe damage, depending on the velocity and depth of flows, the duration of the flood event, the quantity of logs and other debris carried by the flows, and the amount and type of development and personal property along the floodwater's path.
- **Channel Migration**—Channel migration is erosion that results from the wearing away of banks and soils due to flowing water. This erosion, combined with sediment deposition, causes the migration or lateral movement of a river channel across a floodplain. A channel can also move by abrupt change in location, called avulsion, which can shift the channel location a large distance in as short a time as one flood event.

Flash Flooding

The National Weather Service defines flash flooding as follows (NWS, 2009):

> "[A] rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within 6 hours of the causative event (e.g., intense rainfall, dam failure). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters."

Flash floods are capable of tearing out trees, undermining buildings and bridges, and scouring new channels. In urban areas, flash flooding is an increasingly serious problem due to the removal of vegetation and replacement of ground cover with impermeable surfaces such as roads, driveways, and parking lots. The greatest risk from flash floods is that they occur with little to no warning. The major factors in predicting potential damage are the intensity and duration of rainfall and watershed and stream steepness.

9.2.2 Past Events

Sources that provide historical information regarding previous occurrences and losses associated with flooding events in Alameda County and the planning area include FEMA, NWS, and NOAA's National Centers for Environmental Information (NCEI). Between 1954 and April 2017, FEMA issued disaster (DR) declarations for the State of California for 48 flood-related events, classified as one or a combination of the following: winter storms, debris and mud flows, severe winter storms, severe storms, mudslides, landslides, heavy rains, and high tides. Alameda County was included in 13 declarations, as listed in Table 9-3. Little recorded information is available regarding previous flooding occurrences in the Cities of Dublin, Livermore and Pleasanton. Table 9-4 lists known flood events that impacted the planning area between 1970 and April 2017.

Table 9-3. FEMA Disaster Declarations for Flood Events in Alameda County

FEMA Declaration Number	Event Date	Event Type	Location
DR-4308	February 1 – February 23, 2017	Severe Winter Storms, Flooding, Mudslides	43 counties including Alameda County
DR-4305	January 18 – January 23, 2017	Severe Winter Storms, Flooding, Mudslides	23 counties including Alameda County
DR-4301	January 3 – January 12, 2017	Severe Winter Storms, Flooding, Mudslides	34 counties including Alameda County
DR-1646	March 29 – April 16, 2006	Severe Storms, Flooding, Landslides, and Mudslides	17 counties including Alameda County
DR-1628	December 17 – January 3, 2006	Severe Storms, Flooding, Mudslides, and Landslides	31 counties including Alameda County
DR-1155	December 28, 1996 – April 1, 1997	Severe Storms, Flooding, Mud and Landslides	48 counties including Alameda County
DR-1046	February 13 – April 19, 1995	Severe Winter Storms, Flooding, Landslides, Mud Flows	57 counties including Alameda County
DR-1044	January 3 – February 10, 1995	Severe Winter Storms, Flooding, Landslides, Mud Flows	42 counties including Alameda County
DR-758	February 12-March 10, 1986	Severe Storms & Flooding	39 counties including Alameda County
DR-677	January 21 – March 30, 1983	Coastal Storms, Floods, Slides & Tornadoes	40 counties including Alameda County
DR-1203	February 2 – April 30, 1998	Severe Winter Storms and Flooding	41 counties including Alameda County
DR-651	December 19, 1981 – January 8, 1983	Severe Storms, Flood, Mudslides & High Tide	10 counties including Alameda County
DR-283	February 16, 1970	Severe Storms & Flooding	17 counties including Alameda County

Source: FEMA, 2017d

Table 9-4. Flood Events in the Tri-Valley Planning Area

Event Date	Event Type	FEMA Declaration Number	Location	Description
February 21, 2017	Atmospheric River	DR-4308	Countywide	Widespread rain caused flooding, debris flow, accidents, and overtopping of reservoir spillways. In Livermore and Pleasanton, there were multiple road closures including westbound 580, westbound Stanley Blvd, Happy Valley Road. Ten people were stranded by flash flood in Livermore along Collier Canyon Road.
February 9, 2017	Atmospheric River	DR-4308	Countywide	Strong wind and heavy rain produced road flooding and debris flows.
November 30,2014	Rain and wind	N/A	Tri-Valley area	Rain and wind brought a few downed trees and minor urban flooding. Heavy rain produced flooding on Interstate 580 onramp in Dublin and two westbound lanes were flooded in Livermore.
October 13, 2009	Heavy Rain and wind	N/A	Northern and Central CA	Heavy rain and wind downed numerous trees and power lines. Heavy rain caused major flooding on Bernal Avenue at Valley Avenue
March 29 – April 16, 2006	Severe Storms, Flooding, Landslides, and Mudslides	DR-1646	Countywide	Strong storms brought heavy rain to most of Alameda County causing landslides, eroding hillsides and cracked pavement. Oversaturated earth also caused landslide and/or erosion problems to private properties, which spilled over onto public rights-of-way.
December 17, 2005 – January 12, 2006	Winter Storms (Severe Storms, Flood, Mudslides, Landslides)	DR-1628	Bay Area including Alameda County	Storms were blamed for two deaths from falling trees, around 50 businesses were declared damaged, and three homes were nearly wiped out by mudslides. The event included severe storms, flooding, mudslides, and landslides. Estimated damage was over $100 million.
February 3, 1998	Flash Flood	N/A	Tri-Valley area	A levee breach along Arroyo Mocha damage roads and property in Dublin and Livermore. Estimated damage was $100,000.
December 28, 1996 – April 1, 1997	Severe Storms, Flooding, Mud and Landslides	DR-1155	48 counties including Alameda County	300 square miles in northern California were flooded and over 12,000 people were evacuated. Levee breaks were reported across the Sacramento and San Joaquin Valleys. Over 23,000 homes, business, agricultural lands, bridges, and roads were damaged. Eight deaths resulted from this event. Overall, the state had $1.8 billion in damage.
January 3 – February 10, 1995; and February 13 – April 19, 1995	Severe Winter Storms, Flooding, Landslides, Mud Flows	DR-1044 and DR-1046	42 counties including Alameda County	Winter storms, flooding and landslides impacted a large area of the state. Storms in the Sacramento River Basin resulted in small stream flooding due to drainage system failures. Over 100 stations recorded their greatest one-day rainfall in history. Overall, there were 38 deaths, damage to homes and over $1.7 billion in damage.
February 12 – March 10, 1986	Severe Storms & Flooding	DR-758	Bay Area including Alameda County	The event damaged over 12,000 homes, destroyed over 1,300 homes, and caused 13 deaths and 67 injuries in California. Damage totaled over $407.5 million.
January 21 – March 30, 1983	Coastal Storms, Floods, Slides & Tornadoes	DR-677	40 counties including Alameda County	The state had over $500 million in damage from this event due to heavy rains, high winds, flooding, and levee breaks.
February 10, 1970	Severe Storms & Flooding	DR-283	Bay Area including Alameda County	Heavy winds, storms and flooding impacted the Bay Area, including Alameda County. Impacted areas had over $27 million in damage.

Sources: NOAA NCEI, 2017; SPC 2016; ABAG Regional Hazard Mitigation Plan 2011; State of California 2013

9.2.3 Location

Primary Flood Sources

The factors that induce flooding in Alameda County are winter storms with heavy rainfall, steep topography, and constricted floodways. Storms of wide-area distribution originate over the Pacific Ocean in winter and develop with the frontal lifting of air masses along the hills of the coastal range.

City of Dublin

According to the effective 2009 FEMA Flood Insurance Study for Alameda County, the City of Dublin has flood problems similar to those of Alameda County, with heavy winter rainfall, a steep topography, and constricted floodways.

City of Livermore

According to the effective 2009 FEMA Flood Insurance Study for Alameda County, the principal flooding problems in the City occur during winter. Storm runoff is concentrated rapidly by the network of tributaries that discharge through the hills into the major streams. The tributaries have carved well-defined courses through the hills, but upon reaching the flat Livermore Valley, the channels become shallow and inadequate for lower return-frequency flows. Constriction of Arroyo Seco flows at the Western Pacific and Southern Pacific Railroad crossing of the creek forces lower-frequency flood flows to spread out from these points. Another constricting hydraulic factor is a length of channel along Arroyo Las Positas upstream from Airway Boulevard. Rapid runoff rates, inadequate channels, and constricting structures combined with the development of some floodplain areas, make Livermore susceptible to damage when large rainstorms occur.

City of Pleasanton

According to the effective 2009 FEMA Flood Insurance Study for Alameda County, the main flooding problem is caused by the low capacity of the lower reaches of Arroyo De La Laguna, which causes backwater flooding in its tributary channels.

According to the City of Pleasanton’s annex in the 2010 ABAG Local Hazard Mitigation Plan, when above-normal rain falls over a short duration, the increased runoff and flooding is at Arroyo Las Positas, Arroyo Mocho, Altamont Creek, and in areas with poor drainage.

Regulatory Floodplain

Flooding in the planning area has been documented by gage records, high water marks, damage surveys, and personal accounts. This documentation was the basis for the FEMA’s Alameda County FIRM. Less than 5 percent of the planning area is within the FIRM’s mapped 1-percent annual chance floodplain, as shown on Figure 9-2 and listed in Table 9-5.

All principal flooding sources are incorporated in the currently effective FIRMs. The FIRMs are the most detailed and consistent data source available for determining flood extent. The effective 2009 Flood Insurance Study was used in this risk assessment to map the extent and location of the flood hazard, along with map revisions prepared through July 2016.

9.2.4 Frequency

According to NOAA NCEI, Alameda County has experienced 33 flood and flash flood events since 1996. Table 9-6 shows these statistics, as well as the annual average number of events and the percent chance of each flood hazard occurring in Alameda County in any given year.

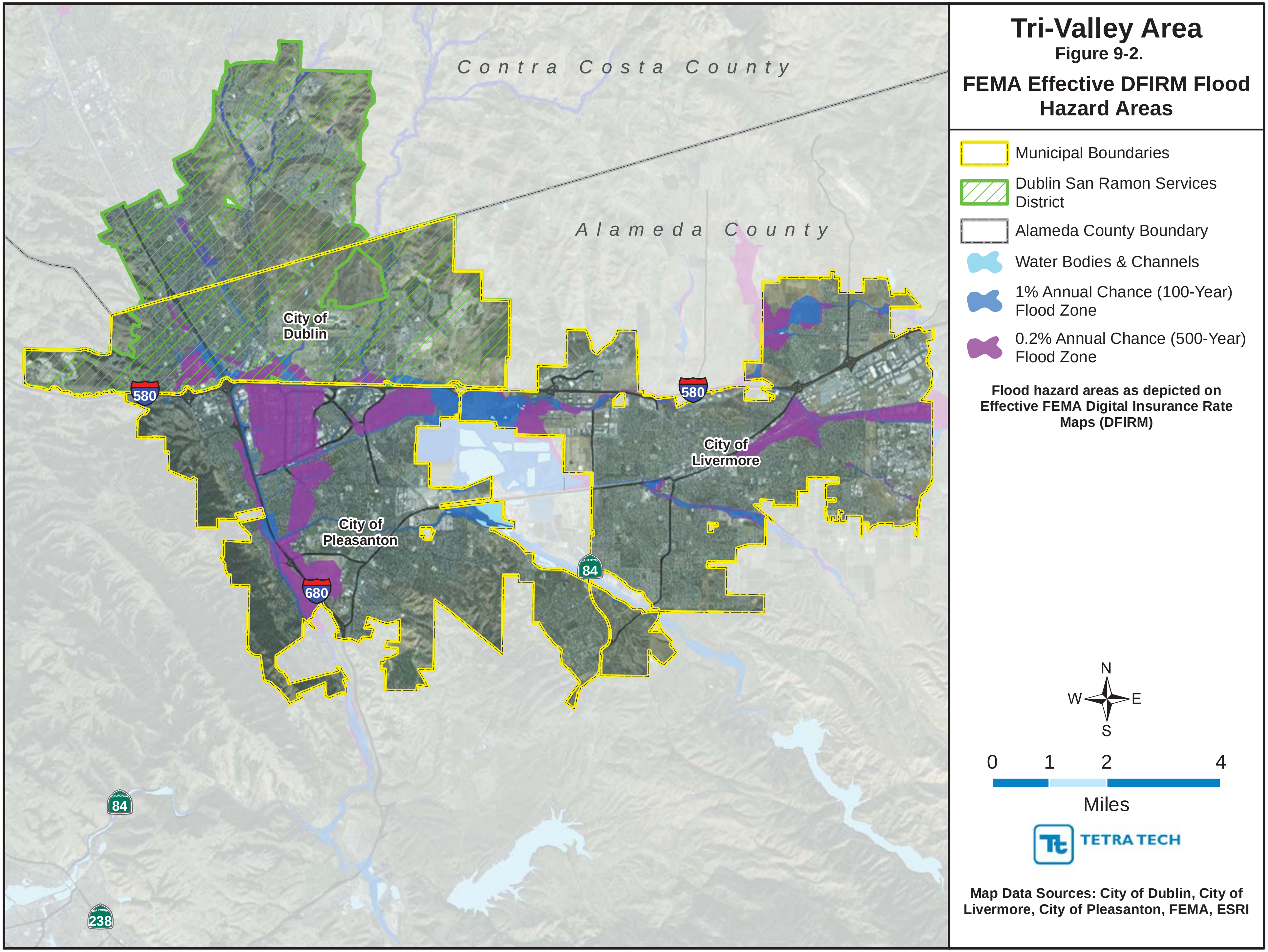

Contra Costa County
Alameda County
City of Dublin
City of Pleasanton
City of Livermore
580
680
84
238
Tri-Valley Area
Figure 9-2.
FEMA Effective DFIRM Flood Hazard Areas
Municipal Boundaries
Dublin San Ramon Services District
Alameda County Boundary
Water Bodies & Channels
1% Annual Chance (100-Year) Flood Zone
0.2% Annual Chance (500-Year) Flood Zone
Flood hazard areas as depicted on Effective FEMA Digital Insurance Rate Maps (DFIRM)
N
W
E
S
0
1
2
4
Miles
TETRA TECH
Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, FEMA, ESRI

Table 9-5. Area in the 1-Percent Annual Chance Flood Floodplain

	1-Percent Annual Chance Floodplain	
	Area (acres)	% of total acreage
Dublin	368	3.70
Livermore	922	5.45
Pleasanton	557	3.59
Total	1,847	4.36

Table 9-6. Probability of Future Occurrences of Flood Events

Hazard Type	Number of Occurrences Between 1996 and April 2017	Rate of Occurrence	Recurrence Interval (in years)	% Chance of Occurrence in Any Given Year
Flash Flood	15	0.70	2.5	70%
Flood	18	0.84	2.14	84%
TOTAL	33			Over 100%

Source: NOAA NCEI, 2017a

Smaller floods may occur on a more frequent basis and be categorized under a different hazard event type, most typically severe weather or severe storms. It is estimated that the planning area will experience the direct and indirect impacts of flooding each year, including urban flooding and smaller floods in identified flood-prone areas. These events may induce secondary hazards such as erosion, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

Statistically, a structure within a 1-percent annual chance flood area has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage.

9.2.5 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak flow; Table 9-7 lists peak flows used by FEMA to map the floodplains of the planning area.

9.2.6 Warning Time

The potential warning time a community has to respond to a flooding threat is a function of the time between the first measurable rainfall and the first occurrence of flooding. The time it takes to recognize a flooding threat reduces the potential warning time for a community that has to take actions to protect lives and property. Another element that characterizes a community’s flood threat is the length of time floodwaters remain above flood stage.

Due to the sequential pattern of weather conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. The NWS issues watches and warnings when forecasts indicate rivers may approach bank-full levels.

Table 9-7. Summary of Peak Discharges within the Planning Area

Source/Location	Peak Flow (cubic feet/second)			
	10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
ARROYO DE LA LAGUNA				
Downstream of Arroyo Del Valle	7,000	13,500	17,000	28,000
Downstream of Arroyo Mocho	6,000	12,000	15,000	25,000
ARROYO DEL VALLE				
Upstream of Arroyo De La Laguna	1,860	4,150	7,000	9,080
ARROYO LAS POSITAS				
Upstream of confluence with Arroyo Mocho'	1,800	1,800	1,800	1,800
At Gage (USGS No. 11176145)	2,000	4,200	5,000	6,700
ARROYO MOCHO				
Upstream of Arroyo De La Laguna	4,520	11,500	13,700	20,600
Upstream of Chabot Canal	4,450	11,450	13,600	20,300
Upstream of Tassajara Creek	5,300	10,300	12,400	16,700
Downstream of Arroyo Las Positas	5,200	10,200	12,300	16,500
At USGS Gage No. 11176000	2,100	3,800	4,500	5,900
Upstream of Arroyo	1,900	1,900	1,900	1,900
Las Positas Near Garden Circlet	5,000	7,800	9,100[a]	11,900
Upstream of Tassajara Creeks	5,100	7,900	9,200[a]	12,100
CHABOT CANAL				
At confluence with Arroyo Mocho	730	1,260	1,560	2,430
COLLIER CANYON CREEK				
Near North Canyon Parkway	470	990	1,200	1,600
Downstream of Tributary	470	990	1,200	1,600
Upstream of Tributary	390	810	980	1,300
COLLIER CANYON TRIBUTARY	180	410	500	680
HEWLETT CANAL				
At confluence with Chabot Canal	186	331	400	614
LINE B-2-1				
At Interstate Highway 680	830	1,500	1,840	2,850
Upstream of Western Pacific RR	680	1,210	1,500	2,060
Upstream of confluence with Line B-2-3	230	420	520	800
LINE G-3				
At confluence with Arroyo Mocho	540	970	1,190	1,800
LINE J (ZONE 6) (CANADA DEL ALISO)				
At confluence with Line E (Zone 6) (Laguna Creek)	160	380	550	1,000
PLEASANTON CANAL				
At confluence with Arroyo Del La Laguna	280	480	580	850
TASSAJARA CREEK				
At confluence with Arroyo Mocho	1,540	3,200	4,140	6,900

a. Base flood elevations in the improved reach of Arroyo Mocho between Santa Rita and El Charro Roads are based on peak flows of 12,400 cubic feet per second at Santa Rita Road and 12,300 cubic feet per second at Garden Circle. These flows do not reflect overbank losses. The design flow for this reach of Arroyo Mocho is 12,500 cubic feet per second.

Source: FEMA FIS, 2009

The flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat (NWS, 2009a):

- **Minor Flooding**—Minimal or no property damage, but possibly some public threat or inconvenience.
- **Moderate Flooding**—Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- **Major Flooding**—Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

9.3 SECONDARY HAZARDS

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

9.4 EXPOSURE

Hazus was used to assess the risk and vulnerability to flooding in the planning area. The model used census data at the block level and FEMA floodplain data, which has a level of accuracy acceptable for planning purposes. Where possible, the Hazus default data was enhanced using local GIS data from local, state and federal sources.

9.4.1 Population

Population counts of those living in the floodplain in the planning area were generated by estimating percent of residential buildings in each jurisdiction within the 10-percent, 1-percent and 0.2-percent annual chance floodplains and multiplying this by total population in the planning area. Table 9-8 shows the results of this analysis.

9.4.2 Property

Structures in the Floodplain

Table 9-9, Table 9-10 and Table 9-11 summarize the total area of the 10-, 1-, and 0.2-percent-annual-chance flood hazard areas and the number of structures in each. The Hazus model determined that there are 300 structures within the 10-percent-annual-chance flood hazard area, 830 structures within the 1-percent-annual-chance flood hazard area, and 8,077 structures within the 0.2-percent-annual-chance flood hazard area. In the 1-percent-annual-chance flood hazard area, about 90 percent are residential, and 9 percent are commercial and industrial.

Exposed Value

Table 9-12, Table 9-13 and Table 9-14 summarize the estimated value of exposed buildings in the planning area. This methodology estimated $717 million worth of building-and-contents exposure to the 10-percent-annual-chance flood, representing 1.3 percent of the total replacement value of the planning area, $1.169 billion worth of exposure to the 1-percent-annual-chance flood, representing 2.2 percent of the total replacement value of the planning area, and $10.2 billion worth of exposure to the 0.2-percent-annual-chance flood, representing 19.1 percent of the total.

Table 9-8. Population Within the 10-Percent, 1-Percent and 0.2-Percent Annual Chance Flood Hazard Areas

	10-Percent Annual Chance Flood Hazard Area		1-Percent Annual Chance Flood Hazard Area		0.2-Percent Annual Chance Flood Hazard Area	
	Population Exposed[a]	% of Total Population	Population Exposed[a]	% of Total Population	Population Exposed[a]	% of Total Population
Dublin	254	0.4%	1,183	2.0%	3,804	6.4%
Livermore	212	0.2%	212	0.2%	5,340	6.0%
Pleasanton	409	0.5%	1,276	1.7%	17,354	22.9%
Total	875	0.4%	2,671	1.2%	26,498	11.8%

a. Represents percent of residential buildings exposed multiplied by estimated January 1, 2017 population from California Department of Finance.

Table 9-9. Area and Structures in the 10-Percent Annual Chance Floodplain

	Area in Floodplain (acres)	Number of Structures in Floodplain							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Dublin	181	69	24	0	1	2	1	0	97
Livermore	839	62	15	0	0	2	1	0	80
Pleasanton	337	116	3	2	0	2	0	0	123
Total	1,357	247	42	2	1	6	2	0	300

Table 9-10. Area and Structures in the 1-Percent Annual Chance Floodplain

	Area in Floodplain (acres)	Number of Structures in Floodplain							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Dublin	368	321	54	1	1	2	1	1	381
Livermore	922	62	15	0	0	2	1	0	80
Pleasanton	557	362	3	2	0	2	0	0	369
Total	1,847	745	72	3	1	6	2	1	830

Table 9-11. Area and Structures in the 0.2-Percent Annual Chance Floodplain

	Area in Floodplain (acres)	Number of Structures in Floodplain							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Dublin	854	1,032	140	6	1	11	1	4	1,195
Livermore	2,088	1,563	60	67	0	7	1	0	1,698
Pleasanton	2,958	4,924	224	18	0	10	2	6	5,184
Total	5,901	7,519	424	91	1	28	4	10	8,077

Table 9-12. Value of Structures in the 10-Percent Annual Chance Floodplain

	Estimated Value within the Floodplain			% of Total Replacement Value
	Structure	Contents	Total	
Dublin	$132,074,724	$125,014,291	$257,089,014	2.1%
Livermore	$176,253,263	$162,236,748	$338,490,011	1.7%
Pleasanton	$68,141,755	$53,967,801	$122,109,556	0.6%
Total	$376,469,741	$341,218,840	$717,688,582	1.3%

Table 9-13. Value of Structures in the 1-Percent Annual Chance Floodplain

	Estimated Value within the Floodplain			
	Structure	Contents	Total	% of Total Replacement Value
Dublin	$319,871,666	$281,906,825	$601,778,490	4.9%
Livermore	$176,253,263	$162,236,748	$338,490,011	1.7%
Pleasanton	$139,691,444	$89,742,646	$229,434,090	1.1%
Total	$635,816,373	$533,886,219	$1,169,702,592	2.2%

Table 9-14. Value of Structures in the 0.2-Percent Annual Chance Floodplain

	Estimated Value within the Floodplain			
	Structure	Contents	Total	% of Total Replacement Value
Dublin	$1,253,666,919	$985,964,915	$2,239,631,834	18.4%
Livermore	$1,005,046,299	$894,841,929	$1,899,888,229	9.3%
Pleasanton	$3,397,453,405	$2,707,341,684	$6,104,795,089	29.0%
Total	$5,656,166,624	$4,588,148,528	$10,244,315,151	19.1%

Land Use in the Floodplain

Some land uses are more vulnerable to flooding, such as single-family homes, while others are less vulnerable, such as agricultural land or parks. Table 9-15 shows the existing land use of all parcels in the 1-percent annual chance and 0.2-percent annual chance floodplain, including those in public/open space uses. About 56 percent of the parcels in the 1-percent annual chance floodplain are zoned for vacant/rights-of-way/water/open space. These are favorable, lower-risk uses for the floodplain. This would be valuable information for gauging the future development potential of the floodplain.

Table 9-15. Land Use Within the Floodplain

	1-Percent Annual Chance Floodplain		0.2-Percent Annual Chance Floodplain	
	Area (acres)	% of total	Area (acres)	% of total
Residential	404	20.7%	1,122	27.6%
Commercial	321	16.4%	972	23.9%
Industrial	7	0.4%	155	3.8%
Agriculture	1	0.0%	0	0.0%
Religion / Assembly	43	2.2%	55	1.4%
Government / Institutional	58	3.0%	68	1.7%
Education	11	0.6%	80	2.0%
Vacant / Rights-of-Way / Water / Open Space	1,106	56.7%	1,620	39.8%
Total	1,950	100.0%	4,070	100.0%

9.4.3 Critical Facilities and Infrastructure

Table 9-16, Table 9-17 and Table 9-18 summarize the critical facilities and infrastructure in the 10-, 1-, and 0.2-percent annual chance flood hazard areas. Details are provided in the following sections.

Table 9-16. Critical Facilities/Infrastructure in the 10-Percent Annual Chance Floodplain

	Medical and Health Services	Emergency Services	Educational Facilities	Government / City Facilities	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	0	0	0	1	0	10	0	0	11
Livermore	0	0	0	1	1	13	0	0	15
Pleasanton	0	1	0	0	1	20	1	0	23
Total	0	1	0	2	2	43	1	0	49

Table 9-17. Critical Facilities/Infrastructure in the 1-Percent Annual Chance Floodplain

	Medical and Health Services	Emergency Services	Educational Facilities	Government / City Facilities	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	1	0	0	1	1	12	0	0	15
Livermore	0	0	0	1	1	14	0	0	16
Pleasanton	0	1	0	0	2	21	2	0	26
Total	1	1	0	2	4	47	2	0	57

Table 9-18. Critical Facilities/Infrastructure in the 0.2-Percent Annual Chance Floodplain

	Medical and Health Services	Emergency Services	Educational Facilities	Government / City Facilities	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	1	2	0	5	1	16	0	0	25
Livermore	2	1	0	1	1	26	4	0	35
Pleasanton	4	3	6	0	19	31	2	0	65
Total	7	6	6	6	21	73	6	0	125

Toxic Release Inventory Facilities

Toxic Release Inventory facilities are known to manufacture, process, store, or otherwise use certain chemicals above minimum thresholds. If damaged by a flood, these facilities could release chemicals that cause cancer or other human health effects, significant adverse acute human health effects, or significant adverse environmental effects (U.S. Environmental Protection Agency, 2015). Two businesses in the 1-percent annual chance floodplain and six businesses in the 0.2-percent annual chance floodplain report having Toxic Release Inventory hazardous materials. During a flood event, containers holding these materials can rupture and leak into the surrounding area, having a disastrous effect on the environment as well as residents.

Utilities and Infrastructure

Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the planning area, including for emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Underground utilities can be damaged. Dikes can fail or be overtopped, inundating the land that they protect. The following sections describe specific types of critical infrastructure.

Roads

The following major roads in the planning area pass through the 1-percent annual chance floodplain:

- Interstate 580
- Interstate 680

- State Highway 84 / Isabel Ave (Livermore)
- West Las Positas Blvd (Pleasanton)
- East Stanley Blvd (Livermore)
- Santa Rita Road (Pleasanton)
- 1st Street (Pleasanton)
- First Street (Livermore)
- Hopyard Road (Pleasanton)
- Murietta Blvd (Livermore)
- Livermore Ave (Livermore)
- Holmes Street (Livermore)
- P Street (Livermore)
- East Avenue (Livermore)
- Vasco Road (Livermore)
- Jack Londond Blvd (Livermore)

Some of these roads are built above the flood level, and others function as levees to prevent flooding. Still, in severe flood events these roads can be blocked or damaged, preventing access to some areas.

Bridges

Flooding events can significantly impact road bridges. These are important because often they provide the only ingress and egress to some neighborhoods. An analysis showed that there are 73 bridges that are in or cross over the 1-percent annual chance and 0.2-percent annual chance floodplain.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers and streams.

9.4.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

9.5 VULNERABILITY

Many of the areas exposed to flooding may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, infrastructure and environment.

9.5.1 Population

Estimated Impacts on Persons and Households

Impacts on persons and households in the planning area were estimated for the 10-, 1-, and 2-percent annual chance flood events through a Hazus analysis. Table 9-19 summarizes the results.

Table 9-19. Estimated Flood Impact on Persons and Households

	Displaced Population[a]	People Requiring Short-Term Shelter[a]
10-Percent Annual Chance Flood	109	79
1-Percent Annual Chance Flood	386	309
0.2-Percent Annual Chance Flood	11,531	10,770

a. Calculated using a Census-block level, general building stock analysis in Hazus, adjusted to reflect the estimated population.

Public Health and Safety

Floods and their aftermath present numerous threats to public health and safety:

- **Unsafe food—**Floodwaters contain disease-causing bacteria, dirt, oil, human and animal waste, and farm and industrial chemicals. Their contact with food items, including food crops in agricultural lands, can make that food unsafe to eat. Refrigerated and frozen foods are affected during power outages caused by flooding. Foods in cardboard, plastic bags, jars, bottles, and paper packaging may be unhygienic with mold contamination.
- **Contaminated drinking and washing water and poor sanitation—**Flooding impairs clean water sources with pollutants. The pollutants also saturate into the groundwater. Flooded wastewater treatment plants can be overloaded, resulting in backflows of raw sewage. Private wells can be contaminated by floodwaters. Private sewage disposal systems can become a cause of infection if they or overflow.
- **Mosquitoes and animals—**Floods provide new breeding grounds for mosquitoes in wet areas and stagnant pools. The public should dispose of dead animals that can carry viruses and diseases only in accordance with guidelines issued by local animal control authorities. Leptospirosis—a bacterial disease associated predominantly with rats—often accompanies floods in developing countries, although the risk is low in industrialized regions unless cuts or wounds have direct contact with disease-contaminated floodwaters or animals.
- **Mold and mildew—**Excessive exposure to mold and mildew can cause flood victims—especially those with allergies and asthma—to contract upper respiratory diseases, triggering cold-like symptoms. Molds grow in as short a period as 24 to 48 hours in wet and damp areas of buildings and homes that have not been cleaned after flooding, such as water-infiltrated walls, floors, carpets, toilets and bathrooms. Very small mold spores can be easily inhaled by human bodies and, in large enough quantities, cause allergic reactions, asthma episodes, and other respiratory problems. Infants, children, elderly people and pregnant women are considered most vulnerable to mold-induced health problems.
- **Carbon monoxide poisoning—**In the event of power outages following floods, some people use alternative fuels for heating or cooking in enclosed or partly enclosed spaces, such as small gasoline engines, stoves, generators, lanterns, gas ranges, charcoal or wood. Built-up carbon monoxide from these sources can poison people and animals.
- **Hazards when reentering and cleaning flooded homes and buildings—**Flooded buildings can pose significant health hazards to people entering them. Electrical power systems can become hazardous. Gas leaks can trigger fire and explosion. Flood debris—such as broken bottles, wood, stones and walls—may cause injuries to those cleaning damaged buildings. Containers of hazardous chemicals may be buried under flood debris. Hazardous dust and mold can circulate through a building and be inhaled by those engaged in cleanup and restoration.
- **Mental stress and fatigue—**People who live through a devastating flood can experience long-term psychological impact. The expense and effort required to repair flood-damaged homes places severe financial and psychological burdens on the people affected. Post-flood recovery can cause, anxiety, anger, depression, lethargy, hyperactivity, and sleeplessness. There is also a long-term concern among the affected that their homes can be flooded again in the future.

Current loss estimation models such as Hazus are not equipped to measure public health impacts such as these. The best preparation for these effects includes awareness that they can occur, education of the public on prevention, and planning to deal with them during responses to flood events.

9.5.2 Property

Structures and Contents

Hazus calculates losses to structures from flooding by looking at depth of flooding and type of structure. Impacted structures are those with finished floor elevations below the flood event water surface elevation. These structures are the most likely to receive significant damage in a flood event. Using historical flood insurance claim data, Hazus estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. For this analysis, local data on facilities was used instead of the default inventory data provided with Hazus. The analysis is summarized in Table 9-20, Table 9-21, and Table 9-22 for the 10-, 1-, and 0.2-percent-annual-chance flood events, respectively.

Table 9-20. Loss Estimates for 10-Percent Annual Chance Floodplain

	Buildings Impacted	Estimated Loss Associated with Flood			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	32	$590,797	$2,169,503	$2,760,300	0.02%
Livermore	9	$1,869,180	$5,121,677	$6,990,857	0.03%
Pleasanton	4	$101,385	$292,115	$393,500	0.002%
Total	45	$2,561,361	$7,583,295	$10,144,656	0.02%

Note: Values shown are accurate for comparison of results in this plan. See Section 5.5 for discussion of data limitations.

Table 9-21. Loss Estimates for 1-percent Annual Chance Flood

	Buildings Impacted	Estimated Loss Associated with Flood			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	103	$2,918,583	$4,516,967	$7,435,549	0.06%
Livermore	9	$1,869,180	$5,121,677	$6,990,857	0.03%
Pleasanton	202	$5,563,985	$2,250,544	$7,814,529	0.04%
Total	314	$10,351,747	$11,889,188	$22,240,935	0.04%

Note: Values shown are accurate for comparison of results in this plan. See Section 5.5 for discussion of data limitations.

Table 9-22. Loss Estimates for 0.2-percent Annual Chance Flood

	Buildings Impacted	Estimated Loss Associated with Flood			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	381	$219,729,360	$284,954,257	$504,683,618	4.1%
Livermore	80	$95,941,930	$205,932,827	$301,874,756	1.5%
Pleasanton	369	$167,384,587	$200,293,920	$367,678,508	1.7%
Total	830	$483,055,877	$691,181,005	$1,174,236,882	2.2%

Note: Values shown are accurate for comparison of results in this plan. See Section 5.5 for discussion of data limitations.

Key results are as follows:

- There would be up to $10 million of flood loss from a 10-percent-annual-chance flood event in the planning area. This represents 1.4 percent of the total exposure to that level of flood and less than 0.1 percent of the total replacement value for the planning area.
- There would be up to $22 million of flood loss from a 1-percent-annual-chance flood event in the planning area. This represents 1.9 percent of the total exposure to that level of flood and less than 0.1 percent of the total replacement value for the planning area.
- There would be $1.2 billion of flood loss from a 0.2-percent-annual-chance flood event in the planning area. This represents 11.5 percent of the total exposure to that level of flood and 2.2 percent of the total replacement value.

Flood-Caused Debris

The Hazus analysis estimated the amount of flood-caused debris within the planning area generated by flooding, as summarized in Table 9-23.

Table 9-23. Estimated Flood-Caused Debris

Jurisdiction	10% Annual-Chance Flood		1% Annual-Chance Flood		0.2% Annual-Chance Flood	
	Debris to Be Removed (tons)a	Estimated Number of Truckloadsb	Debris to Be Removed (tons)a	Estimated Number of Truckloadsb	Debris to Be Removed (tons)a	Estimated Number of Truckloadsb
Dublin	87	3	539	22	15,997	640
Livermore	538	22	538	22	11,914	477
Pleasanton	133	5	6,722	269	26,476	1,059
Total	758	30	7,799	312	54,387	2,175

a. Debris generation estimates were based on updated general building stock dataset at a Census Block analysis level.
b. Hazus assumes 25 tons/trucks.
Note: Values shown are accurate for comparison of results in this plan. See Section 5.5 for discussion of data limitations.

National Flood Insurance Program

Table 9-24 lists flood insurance statistics that help identify vulnerability in the planning area. Dublin, Livermore and Pleasanton participate in the NFIP, with a combined 368 flood insurance policies providing $125.7 million in insurance coverage. According to FEMA statistics, only 8 flood insurance claims were paid between January 1, 1978 and March 31, 2017, for a total of $154 thousand, an average of $19,250 per claim.

Table 9-24. Flood Insurance Statistics

	Date of Entry Initial FIRM Effective Date	# of Flood Insurance Policies as of 3/31/2017	Insurance In Force	Total Annual Premium	Claims Closed 11/1978 to 3/31/2017	
					Number	Value
Dublin	08/18/1983	121	$39,537,400	$210,497	0	0
Livermore	07/05/1977	107	$35,273,900	$104,078	0	0
Pleasanton	12/16/1980	140	$50,932,000	$104,558	8	$154,583.37
Total		368	$125,743,300	$419,133	8	$154,583.37

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses in excess of $1,000

- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property.

Repetitive loss properties make up only 2 percent of flood insurance policies in force nationally, yet they account for 40 percent of the nation's flood insurance claim payments. A report on repetitive losses by the National Wildlife Federation found that 20 percent of these properties are outside any mapped 1-percent annual chance floodplain.

The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. FEMA-sponsored programs, such as the CRS, require participating communities to identify repetitive loss areas. The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by the policies. A repetitive loss area is the portion of a floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss.

Based on information provided by FEMA Region IX, there are no repetitive loss structures within the city limits of Dublin, Livermore, or Pleasanton as of July 2017.

9.5.3 Critical Facilities and Infrastructure

Hazus was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves to estimate the percent of damage to the building and contents of critical facilities, Hazus correlates these estimates into an estimate of functional down-time (the estimated time it will take to restore a facility to 100 percent of its functionality). This helps to gauge how long the planning area could have limited usage of facilities deemed critical to flood response and recovery. The Hazus critical facility results for 10-, 1-, and 0.2-percent-annual-chance flood events are as follows (see: Table 9-25, Table 9-26, and Table 9-27).

- **10-percent annual chance flood event**—12 facilities would be affected and on average the facilities would receive 4.12 percent damage to the structure and 27.03 percent damage to the contents.
- **1-percent annual chance flood event**—21 facilities would be affected an on average, critical facilities would receive 7.33-percent damage to the structure and 27.78-percent damage to the contents during a 1-percent annual chance flood event.
- **0.2-percent annual chance flood event**—66 facilities would be affected an on average, critical facilities would receive 15.18-percent damage to the structure and 39.94-percent damage to the contents during a 1 percent annual chance flood event..

Table 9-25. Estimated Damage to Critical Facilities and Infrastructure from 10-Percent-Annual-Chance Flood

Types of Critical Facilities and Infrastructure	Number of Facilities Affected	Average % of Total Value Damaged	
		Structure	Content
Medical and Health Services	0	N/A	N/A
Emergency Services	0	N/A	N/A
Educational Facilities	0	N/A	N/A
Government / City Facilities	1	3.86	23.16
Utilities	1	11.26	57.35
Transportation Infrastructure	9	0.03	N/A
Hazardous Materials	1	1.35	0.58
Total/Average	12	4.12	27.03

Table 9-26. Estimated Damage to Critical Facilities and Infrastructure from 1-Percent-Annual-Chance Flood

Types of Critical Facilities and Infrastructure	Number of Facilities Affected	Average % of Total Value Damaged	
		Structure	Content
Medical and Health Services	0	N/A	N/A
Emergency Services	0	N/A	N/A
Educational Facilities	0	N/A	N/A
Government / City Facilities	1	4.24	25.44
Utilities	3	23.20	57.17
Transportation Infrastructure	16	0.43	N/A
Hazardous Materials	1	1.43	0.72
Total/Average	21	7.33	27.78

Table 9-27. Estimated Damage to Critical Facilities and Infrastructure from 0.2-Percent-Annual-Chance Flood

Types of Critical Facilities and Infrastructure	Number of Facilities Affected	Average % of Total Value Damaged	
		Structure	Content
Medical and Health Services	1	22.53	15.06
Emergency Services	1	5.21	5.96
Educational Facilities	3	11.39	57.56
Government / City Facilities	4	11.82	71.03
Utilities	7	28.79	52.95
Transportation Infrastructure	47	0.82	N/A
Hazardous Materials	3	25.67	37.07
Total/Average	66	15.18	39.94

9.5.4 Environment

The environment vulnerable to flood hazard is the same as the environment exposed to the hazard. Loss estimation platforms such as Hazus are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment was not available at the time of this plan. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

While the vulnerability assessment focuses on human vulnerability to flood events, the impact of human activities on flooding is also worth noting. Due to negative impacts of floods, many structural and other measures have been devised to limit how far a floodplain can extend. However, floodplains have many natural and beneficial functions, and disruption of natural systems can have long-term consequences for entire regions. Some well-known, water-related functions of floodplains (noted by FEMA) include:

- Natural flood and erosion control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce flood peaks
- Reduce sedimentation
- Surface water quality maintenance
- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperatures of water
- Groundwater recharge
- Promote infiltration and aquifer recharge
- Reduce frequency and duration of low surface flows.

Areas in the floodplain that typically provide these natural functions are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species.

9.6 FUTURE TRENDS IN DEVELOPMENT

The planning partners are equipped to handle future growth within flood hazard areas. All three cities have general plans that address frequently flooded areas in their safety elements and have committed to linking their general plans to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts flood hazard areas. Additionally, the three cities participant in the NFIP and have adopted flood damage prevention ordinances in response to its requirements. They have committed to maintaining their good standing under the NFIP through actions identified in this plan. Table 9-28 shows the future land use within the 1-percent and 0.2-percent annual chance floodplain.

Table 9-28. Future Land Use Within the Floodplain

	1-Percent Annual Chance Floodplain		0.2-Percent Annual Chance Floodplain	
	Area (acres)	% of total	Area (acres)	% of total
Residential	251	12.9%	1,429	35.1%
Commercial	170	8.7%	581	14.3%
Industrial	145	7.5%	274	6.7%
Agriculture	16	0.8%	3	0.1%
Religion / Assembly	88	4.5%	454	11.2%
Government / Institutional	62	3.2%	510	12.5%
Education	1,217	62.4%	818	20.1%
Vacant / Rights-of-Way / Water / Open Space	1,950	100.0%	4,070	100.0%
Total	251	12.9%	1,429	35.1%

9.7 SCENARIO

The primary water courses in the planning area have the potential to flood at irregular intervals, generally in response to a succession of intense winter rainstorms. Storm patterns of warm, moist air usually occur between early November and late March. A series of such weather events can cause severe flooding in the planning area. The worst-case scenario is a series of storms that flood numerous drainage basins in a short time. This could overwhelm the response and floodplain management capability within the planning area. Major roads could be blocked, preventing critical access for many residents and critical functions. High in-channel flows could cause water courses to scour, possibly washing out roads and creating more isolation problems.

9.8 ISSUES

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

- The accuracy of the existing flood hazard mapping produced by FEMA in reflecting the true flood risk within the planning area is questionable. This is most prevalent in areas protected by privately owned levees and levees not accredited by the FEMA mapping process.
- The extent of the flood-protection currently provided by flood control facilities (dams, dikes and levees) is not known due to the lack of an established national policy on flood protection standards.
- Older levees are subject to failure or do not meet current building practices for flood protection.

- The risk associated with the flood hazard overlaps the risk associated with other hazards such as earthquake, landslide and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- More information is needed on flood risk to support the concept of risk-based analysis of capital projects.
- 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 within and outside of the planning area.
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.
- The concept of residual risk should be considered in the design of future capital flood control projects and should be communicated with residents living in the floodplain.
- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.
- Existing floodplain-compatible uses such as agricultural and open space need to be maintained. There is constant pressure to convert these existing uses to more intense uses within the planning area during times of moderate to high growth.

10. LANDSLIDE

10.1 GENERAL BACKGROUND

Landslides and mudslides can be initiated by storms, earthquakes, fires, volcanic eruptions 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.

According to the USGS, the term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over-steepened slope is the primary reason for a landslide, there are other contributing factors. Landslide hazard areas exist where characteristics such as the following indicate a risk of downhill movement of material (USGS, 2017c):

- A slope greater than 33 percent
- A history of landslide activity during the last 10,000 years
- Stream or wave activity that has caused erosion or cut into a bank to cause the surrounding land to be unstable
- The presence or potential for snow avalanches
- The presence of an alluvial fan, which indicates vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, mixed with granular soils such as sand and gravel.

DEFINITIONS

Landslide—The movement of masses of loosened rock and soil down a hillside or slope. Slope failures occur when the strength of the soils forming the slope is exceeded by the pressure, such as weight or saturation, acting upon them.

Mass movement—A collective term for landslides, debris flows, falls and sinkholes.

Mudslide (or debris flow)—A river of rock, earth, organic matter and other materials saturated with water. Mudslides 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 or "slurry."

USGS scientists also monitor stream flow, noting changes in sediment load in rivers and streams that may result from landslides. All of these types of landslides are considered aggregately in USGS landslide mapping.

10.1.1 Landslide Types

Landslides are commonly categorized by the type of initial ground failure. Common types of slides are shown on Figure 10-1 through Figure 10-4 (WDOE, 2014). The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

Mudslides (or debris flows) are rivers of rock, earth, organic matter and other soil materials saturated with water. They 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.

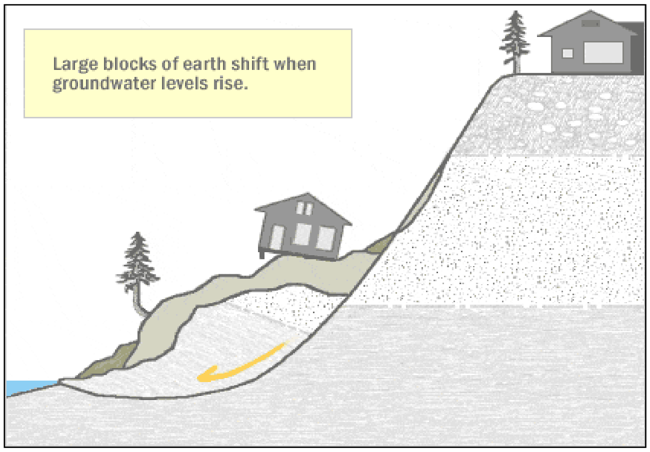


Figure 10-1. Deep Seated Slide

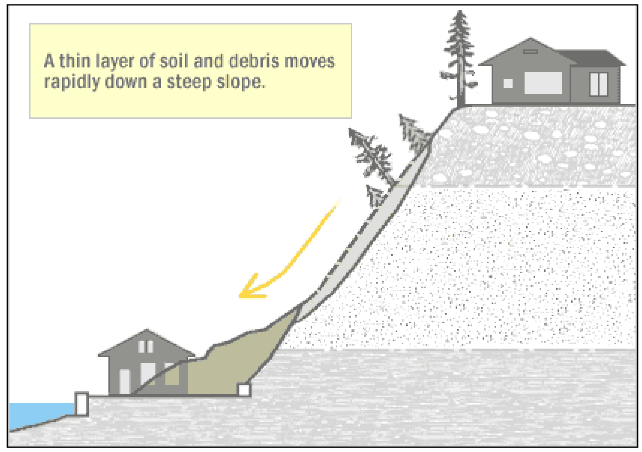


Figure 10-2. Shallow Colluvial Slide

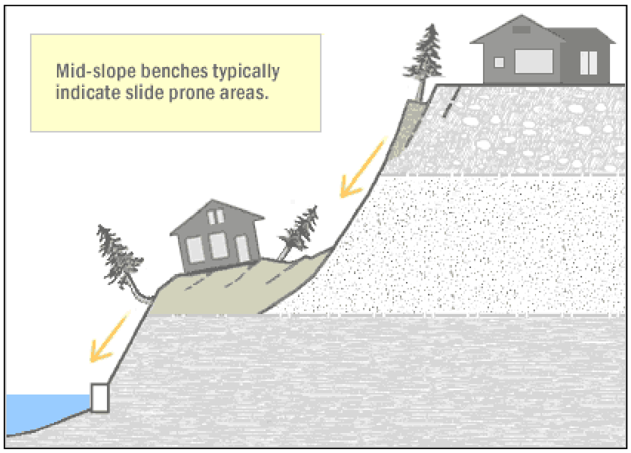


Figure 10-3. Bench Slide

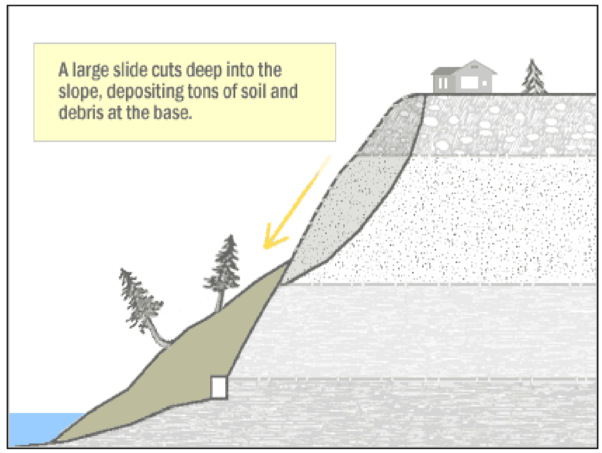


Figure 10-4. Large Slide

A debris avalanche (Figure 10-5) 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. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars, and anything else in its path. Although these slides behave as fluids, they pack 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: (Smith, n.d.)

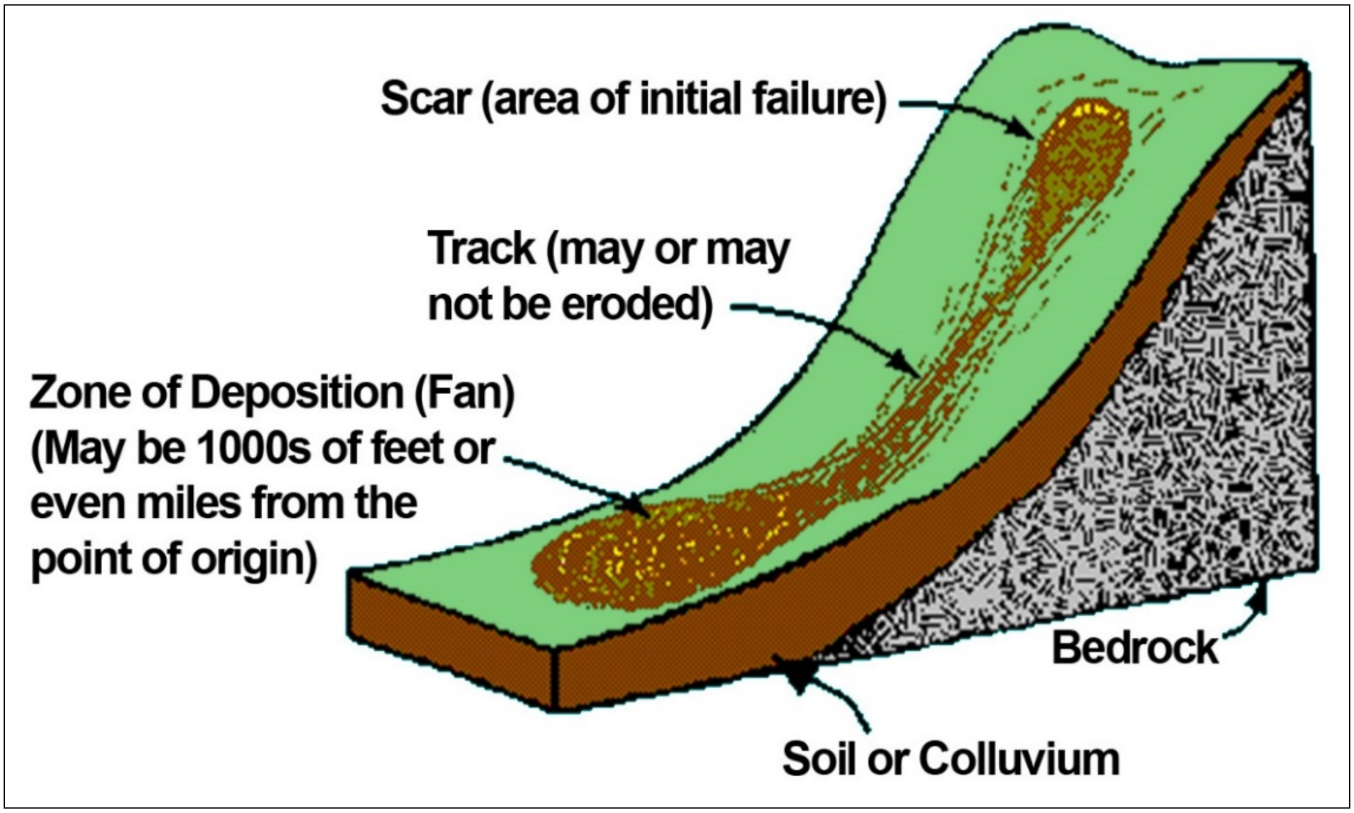


Figure 10-5. Typical Debris Avalanche Scar and Track

10.1.2 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 mass movement 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 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.

10.1.3 Landslide Causes

Mass movements are caused by a combination of geological and climate conditions, as well as encroaching urbanization. Vulnerable natural conditions are affected by human residential, agricultural, commercial and industrial development and the infrastructure that supports it. The following 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
- 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

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. However, even lawn irrigation and minor alterations to small streams in landslide prone locations can result in damaging landslides. Ineffective stormwater management and excess runoff can also cause erosion and increase the risk of landslide hazards. 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

Removing vegetation from very steep slopes can increase landslide hazards. Areas that have experienced wildfire and land clearing for development may have long periods of increased landslide hazard. In addition, woody debris in stream channels (both natural and man-made from logging) may cause the impacts from debris flows to be more severe.

10.1.4 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 adjacent to large active landslides are often extremely or prohibitively 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 the cities' codes and ordinances and Alameda County code.
- Preparation for emergency response to landslides to facilitate rapid, coordinated action among Alameda County, the planning area, and state and federal agencies, and to provide emergency assistance to affected or at-risk citizens
- Evaluation of options including landslide stabilization or structure relocation where landslides are identified as a threat to critical public structures or infrastructure

10.2 HAZARD PROFILE

10.2.1 Past Events

Landslides in the Bay Area typically occur either as a result of an earthquake or during heavy and sustained rainfall events. Urbanized areas, like the Cities of Dublin, Livermore and Pleasanton, and especially hilly areas of Alameda County, have sustained damage from landslides caused by storms. Between 1980 and April 2017, FEMA issued disaster (DR) declarations for the State of California for 10 landslide hazard-related events, classified as one or a combination of the following events: severe winter storms, flooding, debris flow, mud flows, landslides and mudslides, as listed in Table 10-1.

Table 10-1. FEMA Landslide Disaster Declarations in Alameda County

FEMA Declaration	Event Date	Event Type	Location
DR-4308	February 1 – February 23, 2017	Severe Winter Storms, Flooding, Mudslides	43 counties including Alameda County
DR-4305	January 18 – January 23, 2017	Severe Winter Storms, Flooding, Mudslides	23 counties including Alameda County
DR-4301	January 3 – January 12, 2017	Severe Winter Storms, Flooding, Mudslides	34 counties including Alameda County
DR-1646	March 29 – April 16, 2006	Severe Storms, Flooding, Landslides, and Mudslides	17 counties including Alameda County
DR-1628	December 17 – January 3, 2006	Severe Storms, Flooding, Mudslides, and Landslides	31 counties including Alameda County
DR-1155	December 28, 1996 – April 1, 1997	Severe Storms, Flooding, Mud and Landslides	48 counties including Alameda County
DR-1046	February 13 – April 19, 1995	Severe Winter Storms, Flooding, Landslides, Mudslides	57 counties including Alameda County
DR-1044	January 3 – February 10, 1995	Severe Winter Storms, Flooding, Landslides, Mudslides	42 counties including Alameda County
DR-677	January 21 – March 30, 1983	Coastal Storms, Floods, Slides & Tornadoes	40 counties including Alameda County
DR-651	December 19, 1981 – January 8, 1983	Severe Storms, Flood, Mudslides & High Tide	10 counties including Alameda County

Source: FEMA, 2017e

Little recorded information is available regarding previous landslide occurrences in the Cities of Dublin, Livermore and Pleasanton. Table 10-2 lists known landslide events that have impacted the planning area between 1980 and April 2017.

Table 10-2. Landslide Events in the Tri-Valley Planning Area

Event Date	Event Type	FEMA Declaration Number	Location	Description
March 8, 2017	Landslide	N/A	Pleasanton	The backyards of three homes along Foothill Road slid/eroded into Arroyo De La Laguna Creek in Pleasanton.
February 20, 2017	Slide	DR-4308	Livermore	Slide blocked at least one land east bound 84 just west of Vallecitos and Tesla Road closed from mudslide in Livermore.
January 19, 2017	Mudslides	DR-4305	Tri-Valley area/ unincorporated county	Mudslide debris covered Palomares Road, Tesla Road, Mines Road, and Old Altamont Pass Road.
November 2, 2015	Mudslide	N/A	Livermore/ unincorporated county	Heavy rain caused mudslide on Patterson Pass Road, Tesla Road and Corall Hollow Road, east of Livermore
April 6-20, 2006	Heavy Rain and Debris Flows	DR-1646	Alameda County	Heavy rains caused landslides, eroding hillsides and cracked pavement. Landslide or erosion problems on private properties spilled over onto county rights-of-way. Overall, the County had approximately $10 million in damage to county roadways.
December 17, 2005 – January 12, 2006	Winter Storms	DR-1628	Alameda County	Severe storms brought flooding, mudslides, and landslides to most of Alameda County.
February 1995	Late Winter Storms (Severe Winter Storms, Flood, Landslide, Mudflows)	DR-1046	Statewide	All California counties except Del Norte were included in this declaration. In total, the state recorded 17 deaths; $190.6 million in public property damage, $122.4 million in individual damage, $46.9 million in business damage, $79 million in highway damage, and $651.6 million in agricultural damage; with 1,322 homes recording major damage, 267 listed as destroyed, and 2,299 recording minor damage.

Sources: NOAA NCEI, 2017b; FEMA, 2017e; Alameda County Local Hazard Mitigation Plan, 2016b

10.2.2 Location

The best available predictor of where movement of slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most 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 proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they 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.

In 2011, the California Geological Survey conducted a statewide analysis of landslide susceptibility using a combination of regional rock strength and slope data to create classes of susceptibility. The methodology used for the analysis assumed, in general, that landslide susceptibility is low on very low slopes in all rock materials, and that susceptibility increases with slope and in weak rocks. The analysis also factored in locations of past landslides. Figure 10-6 shows the susceptibility classes—low, moderate, high, and very high/existing landslide—in the planning area. Most of the planning area is shown as having low susceptibility, though portions of all the cities' boundaries are shown as having moderate to high susceptibility. The City of Pleasanton has very high susceptibility near its western boundary.

10.2.3 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. In the planning area, landslides typically occur during and after major storms, so the potential for landslides largely coincides with the potential for sequential severe storms that saturate steep, vulnerable soils. As shown in Figure 10-6, the Cities of Dublin and Livermore have a range of low to high susceptibility to deep-seated landslides; therefore, the frequency of landslide events in these areas is considered moderate to high. The western portion of Pleasanton has a high to very high susceptibility to deep-seated landslides; therefore having a high frequency of landslide occurrence.

10.2.4 Severity

Landslides destroy property and infrastructure and can take human lives. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost of about $1.5 billion. Landslides can pose a serious hazard to properties on or below hillsides. When landslides occur — in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support — they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures. In the planning area, landslides and mudslides are a common occurrence and have caused damage to homes, public facilities, roads, parks, and sewer lines in particular.

10.2.5 Warning Time

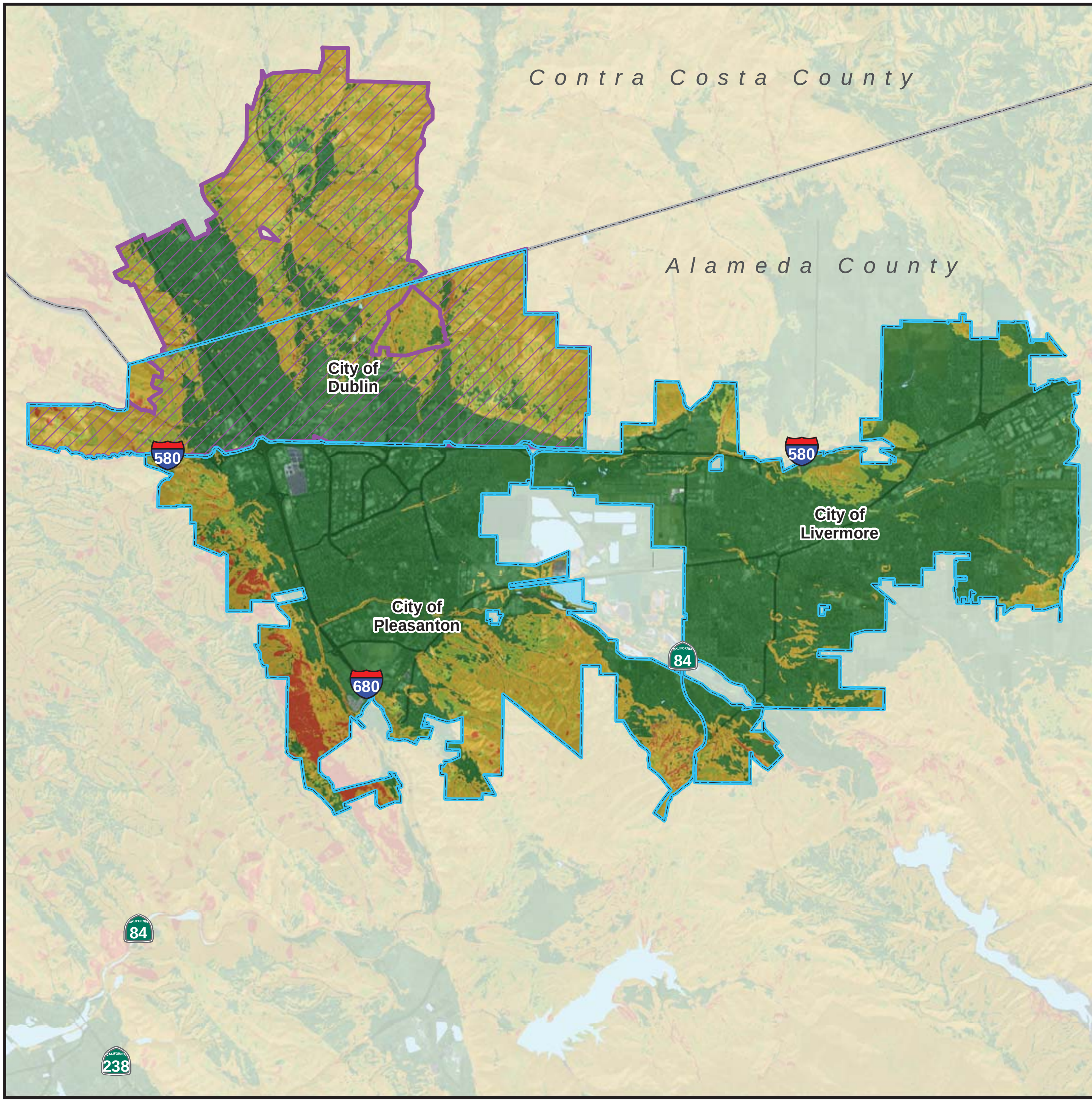
Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Generally accepted warning signs for landslide activity include the following:

- 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 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.

Tri-Valley Area

Figure 10-6.

Susceptibility to Deep-Seated Landslides



- Municipal Boundaries
- Dublin San Ramon Services District
- Alameda County Boundary
- Water Bodies & Channels
- No Landslide Data Available

Susceptibility to Deep-Seated Landslides

- Low
- Moderate
- High
- Very High / Existing

Source dataset created by Wills C.J., Perez, F., Gutierrez, C., 2011, Susceptibility to deep-seated landslides in California: California Geological Survey Map Sheet 58

N
W E
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Miles

TETRA TECH

Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, California Geological Survey, USGS, ESRI

Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. Assessing the geology, vegetation and amount of predicted precipitation for an area can help in predictions of what areas are at risk during general time periods. Currently, there is no practical warning system for individual landslides. The standard operating procedure is to monitor situations on a case-by-case basis and respond after an event has occurred.

10.3 SECONDARY HAZARDS

Landslides can cause several types of secondary effects, such as blocking access to 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.

10.4 EXPOSURE

10.4.1 Population

Population could not be examined by landslide hazard area because census block group areas do not coincide with the hazard areas. Population was estimated using the number of residential buildings in each mapped landslide hazard area multiplied by the 2016 estimated population per household. Using this approach, the estimated population living in each landslide susceptibility zone is as shown in Table 10-3.

Table 10-3. Population Exposure to the Landslide Hazard

	Low Landslide Susceptibility Zone[a]		Moderate Landslide Susceptibility Zone[b]		High Landslide Susceptibility Zone[c]		Very High Landslide Susceptibility Zone[d]	
	Population	% of Total	Population	% of Total	Population	% of Total	Population	% of Total
Dublin	36,175	60.6%	9,343	15.7%	14,072	23.6%	96	0.2%
Livermore	84,093	93.8%	2,911	3.2%	2,641	2.9%	3	0.0%
Pleasanton	61,748	81.3%	5,068	6.7%	8,790	11.6%	310	0.4%
Total	182,016	80.8%	17,322	7.7%	25,503	11.3%	409	0.2%

a. Categories 0 and III zones.
b. Categories V and VI zones.
c. Categories VII, VIII and IX zones.
d. Category X zone; includes existing landslides.
Source: CA DOF, 2017; California Geologic Survey (CGS), 2011

10.4.2 Property

Table 10-4 through Table 10-7 shows the number and replacement value of structures exposed to the landslide risk, based on the California Geological Survey (CGS) definitions of landslide susceptibility. Table 10-8 shows the general land use of planning area parcels exposed to landslides.

10.4.3 Critical Facilities and Infrastructure

Critical facilities exposed to the landslide hazard are summarized in Table 10-9 through Table 10-11.

Table 10-4. Number and Value of Exposed Structures in Very High Landslide Susceptibility Zone

	Buildings Exposed	Estimated Value within the Very High Landslide Risk Area[a]			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	26	$8,128,552	$4,064,276	$12,192,829	0.1%
Livermore	2	$788,088	$691,595	$1,479,683	0.0%
Pleasanton	89	$58,799,278	$29,926,859	$88,726,137	0.4%
Total	117	$67,715,918.52	$34,682,729.95	$102,398,648	0.2%

a. Category X zone; includes existing landslides.
Source: Alameda County, 2016; California Geologic Survey (CGS), 2011

Table 10-5. Number and Value of Exposed Structures in High Landslide Susceptibility Zone

	Buildings Exposed	Estimated Value within the High Landslide Risk Area[a]			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	3,836	$1,489,524,312	$808,744,220	$2,298,268,532	18.9%
Livermore	876	$369,425,486	$272,196,585	$641,622,072	3.1%
Pleasanton	2,547	$1,228,283,787	$704,352,337	$1,932,636,124	9.2%
Total	7,259	$3,087,233,586.22	$1,785,293,141.96	$4,872,526,728	9.1%

a. Categories VII, VIII and IX zones.
Source: Alameda County, 2016; California Geologic Survey (CGS), 2011

Table 10-6. Number and Value of Exposed Structures in Moderate Landslide Susceptibility Zone

	Buildings Exposed	Estimated Value within the Moderate Landslide Risk Area[a]			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	2,546	$1,000,800,694	$541,216,387	$1,542,017,081	12.7%
Livermore	871	$269,402,436	$151,387,931	$420,790,366	2.1%
Pleasanton	1,445	$522,514,587	$292,911,879	$815,426,465	3.9%
Total	4,862	$1,792,717,716.19	$985,516,195.87	$2,778,233,912	5.2%

a. Categories V and VI zones.
Source: Alameda County, 2016; California Geologic Survey (CGS), 2011

Table 10-7. Exposure and Value of Structures in Low Landslide Susceptibility Zone

	Buildings Exposed	Estimated Value within the Low Landslide Risk Area[a, b]			% of Total Replacement Value
		Structure	Contents	Structure & Contents	
Dublin	10,180	$4,916,181,363	$3,395,694,614	$8,311,875,977	68.3%
Livermore	25,790	$11,139,242,238	$8,304,969,307	$19,444,211,545	94.8%
Pleasanton	18,552	$10,412,338,932	$7,779,025,499	$18,191,364,431	86.5%
Total	54,522	$26,467,762,532.92	$19,479,689,420.42	$45,947,451,953	85.6%

a. Categories 0 and III zones.
Source: Alameda County, 2016; California Geologic Survey (CGS), 2011

Table 10-8. Land Use in Landslide Risk Areas

Land Use	Moderate Area		High Area		Very High Area	
	Area (acres)	% of total	Area (acres)	% of total	Area (acres)	% of total
Residential	1,174	34.5%	2,820	30.3%	256	32.4%
Commercial	52	1.5%	150	1.6%	1	0.2%
Industrial	18	0.5%	83	0.9%	1	0.1%
Agriculture	6	0.2%	17	0.2%	0	0.0%
Religion / Assembly	45	1.3%	92	1.0%	2	0.2%
Government / Institutional	263	7.7%	427	4.6%	2	0.2%
Education	96	2.8%	97	1.0%	1	0.1%
Vacant / Rights-of-Way / Water / Open Space	1,746	51.4%	5,624	60.4%	528	66.8%
Total	3,400	100.0%	9,309	100.0%	791	100.0%

Table 10-9. Critical Facilities and Infrastructure in Moderate Landslide Risk Areas

Jurisdiction	Medical and Health Services	Emergency Services	Educational Facilities	Government / City Facilities	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	0	1	3	0	0	0	0	0	4
Livermore	0	0	1	0	1	1	0	0	3
Pleasanton	1	0	0	0	10	2	0	0	13
Total	1	1	4	0	11	3	0	0	20

Table 10-10. Critical Facilities and Infrastructure in High Landslide Risk Areas

Jurisdiction	Medical and Health Services	Emergency Services	Educational Facilities	Government / City Facilities	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	2	0	1	2	0	8	0	0	13
Livermore	0	0	0	0	0	6	0	0	6
Pleasanton	0	0	1	0	24	17	2	0	44
Total	2	0	2	2	24	31	2	0	63

Table 10-11. Critical Facilities and Infrastructure in Very High Landslide Risk Areas

Jurisdiction	Medical and Health Services	Emergency Services	Educational Facilities	Government / City Facilities	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Dublin	0	0	0	0	0	0	0	0	0
Livermore	0	0	0	0	0	0	0	0	0
Pleasanton	0	0	0	0	2	0	0	0	2
Total	0	0	0	0	2	0	0	0	2

A significant amount of infrastructure can be exposed to mass movements:

- **Roads**—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges**—Landslides can significantly impact road bridges. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use.
- **Power Lines**—Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.

10.4.4 Environment

Environmental problems as a result of mass movements can be numerous. Landslides that fall into streams may significantly impact fish and wildlife habitat and affect water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time due to landslides.

10.5 VULNERABILITY

10.5.1 Population

Due to the nature of census block group data, it is difficult to determine demographics of populations vulnerable to mass movements. In general, all of the estimated 24,799 persons exposed to high risk landslide areas are considered to be vulnerable. Increasing population and the fact that many homes are built on view property atop or below bluffs and on steep slopes subject to mass movement, increases the number of lives endangered by this hazard.

10.5.2 Property

Loss estimations for the landslide hazard are not based on damage functions, because none have been generated. Instead, estimates of potential loss were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impacts based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 10-12 shows the general building stock loss estimates in landslide risk areas.

Table 10-12. Loss Potential for Landslide

		Estimated Loss Potential from Landslide		
	Exposed Value[a]	10% Damage	30% Damage	50% Damage
Dublin	$12,164,354,419	$1,216,435,441	$3,649,306,325	$6,082,177,209
Livermore	$20,508,103,666	$2,050,810,366	$6,152,431,099	$10,254,051,833
Pleasanton	$21,028,153,157	$2,102,815,315	$6,308,445,947	$10,514,076,578
Total	$53,700,611,242	$5,370,061,124	$16,110,183,372	$26,850,305,621

a. Exposed value based on cumulative of exposed total value in low, medium, high, and very high susceptibility

10.5.3 Critical Facilities and Infrastructure

There are 85 critical facilities exposed to the landslide hazard to some degree. A more in-depth analysis of the mitigation measures taken by these facilities to prevent damage from mass movements should be done to determine if they could withstand impacts of a mass movement.

Several types of infrastructure are exposed to mass movements, including transportation, water and sewer and power infrastructure. Highly susceptible areas of the planning area include mountain and coastal roads and transportation infrastructure. At this time all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available.

10.5.4 Environment

The environment vulnerable to landslide hazard is the same as the environment exposed to the hazard.

10.6 FUTURE TRENDS IN DEVELOPMENT

The planning partners are equipped to handle future growth within landslide hazard areas. Landslide risk areas are addressed in the safety elements of local general plans. All three cities have committed to linking their general plans to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts landslide hazard areas.

Additionally, the State of California has adopted the International Building Code (IBC) by reference in its California Building Standards Code. The IBC includes provisions for geotechnical analyses in steep slope areas that have soil types considered susceptible to landslide hazards. These provisions assure that new construction is built to standards that reduce the vulnerability to landslide risk. Table 10-13 shows the future land use in the moderate, high, and very high landslide risk areas.

Table 10-13. Future Land Use in Landslide Risk Areas

Land Use	Moderate Area		High Area		Very High Area	
	Area (acres)	% of total	Area (acres)	% of total	Area (acres)	% of total
Residential	1,491	43.8%	3,340	35.9%	257	32.6%
Commercial	36	1.1%	127	1.4%	2	0.2%
Industrial	45	1.3%	121	1.3%	1	0.1%
Agriculture	36	1.1%	352	3.8%	28	3.5%
Religion / Assembly	552	16.2%	832	8.9%	8	1.0%
Government / Institutional	25	0.7%	105	1.1%	2	0.2%
Education	1,216	35.7%	4,440	47.6%	494	62.5%
Vacant / Rights-of-Way / Water / Open Space	3,400	100.0%	9,317	100.0%	791	100.0%
Total	1,491	43.8%	3,340	35.9%	257	32.6%

10.7 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.

Mass movements are becoming more of a concern as development moves outside of city centers into less-developed areas. It is probable that private and public property, including infrastructure, will be affected. Mass movements could affect bridges that pass over landslide-prone ravines and knock out rail service through the planning area. Road obstructions caused by mass movements 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.

10.8 ISSUES

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

- There are existing homes in landslide risk areas throughout the planning area. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available.
- Future development could lead to more homes in landslide risk areas.
- 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.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

11. SEVERE WEATHER

11.1 GENERAL BACKGROUND

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. It includes thunderstorms, downbursts, tornadoes, waterspouts, snowstorms, ice storms, and dust storms. Severe weather can be categorized into two groups: systems that form over wide geographic areas are classified as general severe weather; those with a more limited geographic area are classified as localized severe weather. Severe weather, technically, is not the same as extreme weather, which refers to unusual weather events at the extremes of the historical distribution for a given area.

Severe weather conditions with the greatest potential to impact the planning area are described in the following sections. Flooding and landslides associated with severe weather are discussed as separate hazards in Chapters 9 and 10. In this risk assessment, the "severe weather" hazard refers in aggregate to the various weather conditions profiled—severe storms, extreme heat, damaging winds and space weather. These conditions are treated as a single hazard a for the following reasons:

- Each condition has impacted the planning area, with similar frequencies of occurrence, based on weather records.
- Each condition impacts the entire planning area, with no clearly mapped or defined extent. Without a mapped or defined extent, quantitative, geospatial analysis to assess exposure or vulnerability is not available. Therefore, the risk assessment for severe weather is qualitative and is based on the aggregate exposure and vulnerability to all weather conditions.

11.1.1 Severe Storms

Severe storm conditions in the planning area include heavy rain (atmospheric rivers and thunderstorms), lightning and hail. Heavy rain refers to events where the amount of rain exceeds normal levels. The amount of precipitation needed to qualify as heavy rain varies with location and season. Heavy rain is distinct from climate change analyses on increasing precipitation. It does not mean that the total amount of precipitation at a location has increased, just that the rain is occurring in a more intense event. More frequent heavy rain events,

DEFINITIONS

Atmospheric River—A long, narrow region in the atmosphere that transports most of the water vapor outside of the tropics. These columns of vapor move with the weather, carrying large amounts of water vapor and strong winds. When atmospheric rivers make landfall, they release this vapor in the form of rain or snow, causing flooding and mudslide vents.

Extreme Heat—Temperatures that hover 10ºF or more above the average high temperature for a region and last for several weeks. Humid or muggy conditions occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Extremely dry and hot conditions can provoke dust storms and low visibility.

Thunderstorm—Typically 15 miles in diameter and lasting about 30 minutes, thunderstorms are marked by lightning, heavy rain and strong winds. Lightning, which occurs with all thunderstorms, is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding. Strong winds, hail and tornadoes are also dangers associated with thunderstorms.

Tornado—Funnel clouds of varying sizes that generate winds more than 300 miles per hour. A tornado is formed by the turbulent mixing of layers of air with contrasting temperature, moisture, density and wind flow. Tornadoes can affect an area up to a mile wide, with a path of varying length. They can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale ranging from F0 to F6.

Windstorm—A storm featuring violent winds. Windstorms tend to damage ridgelines that face into the winds.

however, can serve as indicators of changing precipitation levels. Heavy rain is most frequently measured by tracking the frequency of events, analyzing the mean return period, and measuring the amount of precipitation in a certain period (most typically inches of rain within a 24-hour period) (EPA, 2016).

Atmospheric River

An atmospheric river is a common weather pattern that brings southwest winds and heavy rain to California. Atmospheric rivers are long, narrow regions in the atmosphere that transport water vapor carried away from the tropics. These columns of vapor move with the weather, carrying large amounts of water vapor and strong winds. When they make landfall, they often release the water vapor in the form of heavy rain or snow.

Thunderstorms

A thunderstorm is a heavy rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado. Tornadoes are not common in the planning area; only four have been recorded in the County since 1950. All were F0-rated tornadoes except one rated EF1.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder. Thunderstorms have three stages:

- The developing stage of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.
- The thunderstorm enters the mature stage when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front, or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.
- Eventually, a large amount of precipitation is produced and the updraft is overcome by the downdraft beginning the dissipating stage. At the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

There are four types of thunderstorms:

- **Single-Cell Thunderstorms—**Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.

- **Multi-Cell Cluster Storm—**A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line**—A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.
- **Super-Cell Storm—**A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles an hour or more, and strong to violent tornadoes.

NOAA classifies a thunderstorm as a storm with lightning and thunder produced by cumulonimbus clouds, usually producing gusty winds, heavy rain, and sometimes hail. Thunderstorms are usually short in duration (seldom more than two hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry season. According to the American Meteorological Society *Glossary of Meteorology*, thunderstorms are reported as light, medium, or heavy according to the following characteristics:

- Nature of the lightning and thunder
- Type and intensity of the precipitation, if any
- Speed and gustiness of the wind
- Appearance of the clouds
- Effect on surface temperature.

Lightning

Lightning is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt." This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning reaches temperatures approaching 50,000ºF instantaneously. The rapid heating and cooling of air near the lightning causes thunder. Lightning is a major threat during a thunderstorm. In the United States, between 75 and 100 Americans are struck and killed by lightning each year.

Hail Storms

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Super-cooled water may accumulate on frozen particles near the back-side of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

Hailstones grow two ways: by wet growth or dry growth. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super-cooled. When the ice collides with a super-cooled drop, the water does not freeze on the ice immediately. Instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice. Dry-growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are “frozen” in place, leaving cloudy ice.

Hailstones can have layers if they travel up and down in an updraft, or they can have few or no layers if they are “balanced” in an updraft. The number of layers in a hailstone indicates how many it traveled to the top of the storm. Hailstones can begin to melt and then re-freeze together, forming large and very irregularly shaped hail.

11.1.2 Extreme Heat

Extreme heat is unexpected, unusual, or unseasonable hot weather that can create dangerous situations. It is defined as temperatures that hover 10ºF or more above the average high temperatures for the region for several weeks. 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 could take a number of days of oppressive heat for a heat wave to have a significant or quantifiable impact in planning area. Heat waves do not strike victims immediately; rather, their cumulative effects slowly take the lives of vulnerable populations.

The NWS is producing experimental forecasts called Heat Risks to assess the local heat risk in California, Nevada, Utah, and Arizona (see Figure 11-1). The numeric (0-4) and color (green, yellow, orange, red and magenta) scales are similar to the NWS air quality index.

11.1.3 Damaging Winds

Damaging winds are classified as those exceeding 60 mph. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and 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. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- 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.

Source: NWS, 2017e

Numerical Value	Meaning	Who/What is at Risk?	How Common is this Heat?	For those at risk, what actions can be taken?
0	• Level of heat poses **little to no risk**	• No elevated risk	Very Common	• No additional preventative actions should be necessary.
1	• Heat of this type is **tolerated by most**; however there is a **low risk for sensitive groups** to experience health effects	• Primarily those who are extremely sensitive to heat	Very Common	• Increase hydration • Reduce time spent outdoors or stay in the shade when the sun is strongest • Open windows at night and use fans to bring cooler air inside buildings
2	• **Moderate risk for members of heat sensitive groups** to experience health effects • **Some risk for the general population who are exposed to the sun and are active** • For those without air conditioning, **living spaces can become uncomfortable during the day**, but should cool below dangerous levels at night	• Primarily heat sensitive groups, especially those without effective cooling or hydration • Some transportation and utilities sectors	• Fairly common most locations • Very common in southern regions of country	• Reduce time in the sun between 10 a.m. and 4 p.m. • Stay hydrated • Stay in a cool place during the heat of the day • Move outdoor activities to cooler times of the day • Open windows at night and use fans to bring cooler air inside buildings and circulate air
3	• **High Risk for much of the population who are 1) exposed to the sun and active or 2) are in a heat sensitive group** • **Dangerous to anyone without proper hydration or adequate cooling** • **Poor air quality** is possible • **Power interruptions may occur** as electrical demands increase	• Much of the population, especially those who are heat sensitive and anyone without effective cooling or hydration • Most transportation and utilities sectors	• Uncommon most northern locations • Fairly common in southern regions of country	• Try to avoid being outdoors in the sun between 10 a.m. and 4 p.m. • Stay hydrated • Stay in a cool place especially during the heat of the day • If you have access to air conditioning, use it. Fans may not be adequate • Cancel outdoor activities during the heat of the day
4	• **Very High Risk for entire population** • **Very dangerous to anyone without proper hydration or adequate cooling.** • **This is a multi-day excessive heat event.** Prolonged heat is dangerous to anyone not prepared. • **Poor air quality** is likely. • **Power outages are increasingly likely** as electrical demands may reach critical levels.	• Entire population is at risk. • For heat sensitive groups, especially people without effective cooling, **this level of heat can be deadly**. • Most transportation and utilities sectors	• Rare most locations • Occurs up to a few times a year in southern regions of country, especially the Desert Southwest	• Avoid being outdoors in the sun between 10 a.m. and 4 p.m. • Stay hydrated • Stay in a cool place, including overnight • If you have access to air conditioning, use it. Fans will not be adequate • Cancel outdoor activities during the heat of the day

Figure 11-1. NWS Experimental Potential Heat Risks

- 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.

Windstorms are generally short-duration events involving straight-line winds or gusts of over 50 mph, strong enough to cause property damage. Windstorms are especially dangerous in areas with significant tree stands and areas with exposed property, poorly constructed buildings, mobile homes (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.

11.1.4 Space Weather

Space weather refers to variations in the space environment between the sun and earth. It includes phenomena that impact systems and technologies in orbit and on earth. Space weather can occur anywhere from the surface of the sun to the surface of the earth. As a space weather storm leaves the sun, it passes through the sun’s corona and into the solar wind. When it reaches earth, it energizes earth’s magnetosphere and accelerates electrons and protons down to earth’s magnetic field lines where they collide with the atmosphere and ionosphere, particularly at high latitudes. Each component of space weather impacts a different technology (NOAA SWPC, 2017c). Figure 11-2 illustrates several types of space weather phenomena.

Source: NOAA, SWPC; 2017c

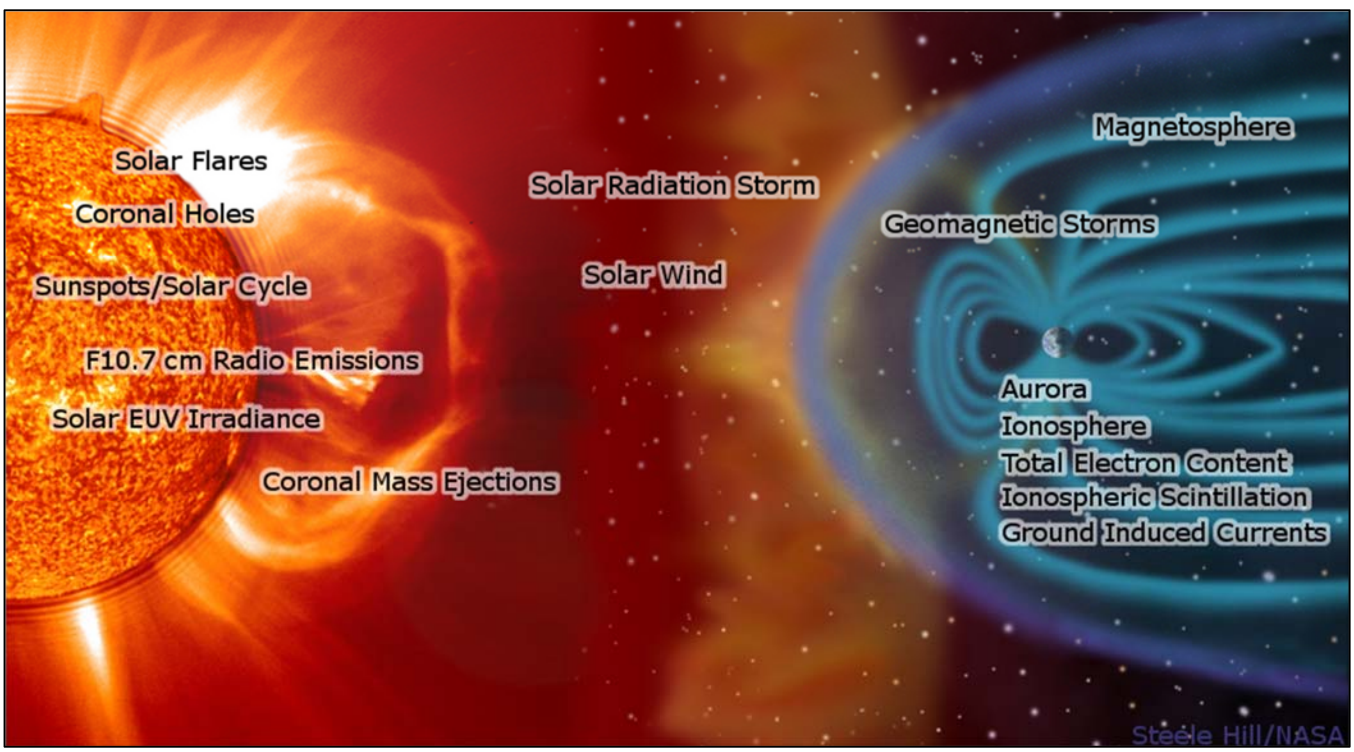


Figure 11-2. Space Weather Phenomena

A solar flare occurs when magnetic energy that has built up in the solar atmosphere is suddenly released. The flare ejects clouds of electrons, ions, and atoms through the corona of the sun into space. These clouds typically reach earth a day or two after the event. Solar flares last from minutes to hours. Radiation is emitted across virtually the entire electromagnetic spectrum, from radio waves at the long wavelength end, through optical emission to X-rays and gamma rays at the short wavelength end (NOAA SWPC, 2017c; NASA, 2016). Solar flares only impact the earth when they occur on the side of the sun that faces the earth (NASA, 2016a). If the energy from a solar flare reaches the earth, it has the potential to affect global positioning system (GPS) signals, television and radio transmissions, and telecommunications.

11.2 HAZARD PROFILE

11.2.1 Past Events

Sources that provide historical information regarding previous occurrences and losses associated with severe weather events in Alameda County and the planning area include FEMA, NWS, and NOAA NCEI. Between 1970 and April 2017, Alameda County was included in 12 FEMA disaster declarations for severe storms, severe winter storms, mudslides, landslides and flooding as listed in Table 11-1. Impacts on the planning area were not identified in the sources reviewed.

Table 11-1. FEMA Disasters for Severe Weather Events in Alameda County

FEMA Declaration	Event Date	Event Type	Location
DR-4308	February 1 – February 23, 2017	Severe Winter Storms, Flooding, Mudslides	43 counties including Alameda County
DR-4305	January 18 – January 23, 2017	Severe Winter Storms, Flooding, Mudslides	23 counties including Alameda County
DR-4301	January 3 – January 12, 2017	Severe Winter Storms, Flooding, Mudslides	39 counties including Alameda County
DR-1646	March 29 – April 16, 2006	Severe Winter Storms, Flooding, Landslides, Mudflows	17 counties including Alameda County
DR-1628	December 17, 2005 to January 3, 2006	Severe Winter Storms, Flooding, Landslides, Mudflows	30 counties including Alameda County
DR-1203	February 2 – Aril 30, 1998	Severe Winter Storms, Flooding	41 counties including Alameda County
DR-1155	December 28, 1996 – April 1, 1997	Severe Winter Storms, Flooding	48 counties including Alameda County
DR-1046	February 13 to April 19, 1995	Severe Winter Storms, Flooding, Landslides, Mudflows	57 counties including Alameda County
DR-1044	January 3 to February 10, 1995	Severe Winter Storms, Flooding, Landslides, Mudflows	42 counties including Alameda County
DR-758	February 12 – March 10, 1986	Severe Storms & Flooding	39 counties including Alameda County
DR-651	December 19, 1981 – January 8, 1983	Severe Storms, Flood, Mudslides & High Tide	10 counties including Alameda County
DR-283	February 16, 1970	Severe Storms & Flooding	17 counties including Alameda County

Source: FEMA, 2017b

According to NOAA NCEI, between 1996 and April 2017, no extreme heat nor tornado events were recorded in Alameda County. Three hail events occurred in the county, but not in the Tri-Valley planning area. Alameda County recorded 30 high wind events in this timeframe with wind magnitude ranging between 44 knots and 96 knots, 39 strong wind events with wind magnitude between 30 knots and 48 knots, and five thunderstorm wind events. Table 11-2 lists known severe weather events that impacted the planning area between 1970 and April 2017, along with solar flare events that occurred in North America.

Table 11-2. Severe Weather Events in the Tri-Valley Planning Area

Event Date	Event Type	FEMA Declaration	Location	Description
February 7, 2017	Atmospheric River	DR- 4308	Alameda County, planning area, Bay Area	An atmospheric river produced widespread roadway flooding, debris flows, strong winds, and overtopping of reservoir spillways in the Bay Area. Pleasanton recorded 2.45 inches of rain on Feb. 20.
January 20, 2017	Atmospheric River	DR- 4305	Alameda County, planning area, Bay Area	
January 10, 2017	Atmospheric River	DR- 4301	Alameda County, planning area, Bay Area	An atmospheric river produced widespread roadway flooding, debris flows, and strong winds in the Bay Area. Pleasanton recorded 2.15 inches of rain on Jan 10.
December 10 – 11, 2014	Heavy Rains and High Winds	N/A	Alameda County, planning area, and Bay Area	An atmospheric river brought heavy rains and gusty winds to the Bay Area for several days. Rainfall of 1.5 to 2 inches an hour was reported. A flash flood warning was issued for Dublin, Livermore and Pleasanton. Wind gusts were recorded up to 83 mph. Rainfall totals ranged from 5.78 to 7.24 inches. Power outages occurred across the Bay Area. Total rainfall in Pleasanton was 3.27 inches.
December 2006	Geomagnetic Storms and Solar Flares	N/A	United States	This event disabled GPS signal acquisition over the United States.
April 6-20, 2006	Heavy Rain and Debris Flows	DR-1646	Alameda County and planning area	Storms brought heavy rain causing landslides, eroding hillsides and cracked pavement. Landslides or erosion on private properties spilled over onto county rights-of-way. Overall, the County had approximately $10 million in damage to county roadways.
December 17, 2005 – January 12, 2006	Winter Storms (Severe Storms, Flood, Mudslides, Landslides)	DR-1628	Alameda County, planning area, Bay Area	Damage estimates for the region were over $100 million. Storms were blamed for two deaths from falling trees, around 50 businesses declared damage, and three homes were nearly wiped out by mudslides.
October 2003	Space Weather ("Halloween Storms of 2003")	N/A	Parts of the Europe and the United States	Solar flares impacted satellite-based systems and communications. A one-hour-long power outage resulted in Sweden. Aurorae were observed as far south as Texas.
December 28, 1996 – April 1, 1997	Severe Storms, Flooding, Mud and Landslides	DR-1155	48 counties including Alameda County	Over 12,000 people were evacuated in northern California. Levee breaks were reported across the Sacramento and San Joaquin Valleys. Over 23,000 homes and business, agricultural lands, bridges, and roads were damaged. The event caused eight deaths and $1.8 billion in damage.
March 13, 1989	Space Weather Storm	N/A	Quebec, Canada	A space weather storm disrupted the hydroelectric power grid in Quebec, Canada. This system-wide outage lasted for 9 hours and left 6 million people without power.
February 12 – March 10, 1986	Severe Storms & Flooding	DR-758	Bay Area including Alameda County	This event damaged over 12,000 homes, destroyed over 1,300 homes, and caused 13 deaths and 67 injuries in California. Damage totaled over $407.5 million.
January 3 – 5, 1982	Landslides, Floods, and Marine Effects	DR-651	Bay Area including Alameda County	A major storm caused widespread and catastrophic landslide damage throughout the Bay Area, resulting in numerous deaths and over $60 million in direct costs. In Alameda County, damage was concentrated in Oakland, Piedmont, and Berkeley. The County had approximately $3.5 million in damage.
February 10, 1970	Severe Storms & Flooding	DR-283	Bay Area including Alameda County	Heavy winds, storms and flooding impacted the Bay Area, including Alameda County. Impacted areas had over $27 million in damage.

Source: FEMA, 2017b; NOAA NCEI, 2017b

11.2.2 Location

All severe weather conditions profiled in this chapter have the potential to happen anywhere in the planning area. No extent mapping is currently available.

11.2.3 Frequency

The planning area can expect to experience some type of severe weather event at least annually. Figure 11-3 shows that the planning area can experience around five thunderstorms each year (NWS, 2016). The frequency of solar flares is difficult to estimate, and prediction of a specific future event is nearly impossible (Riley, 2012).

Source: NWS, 2016

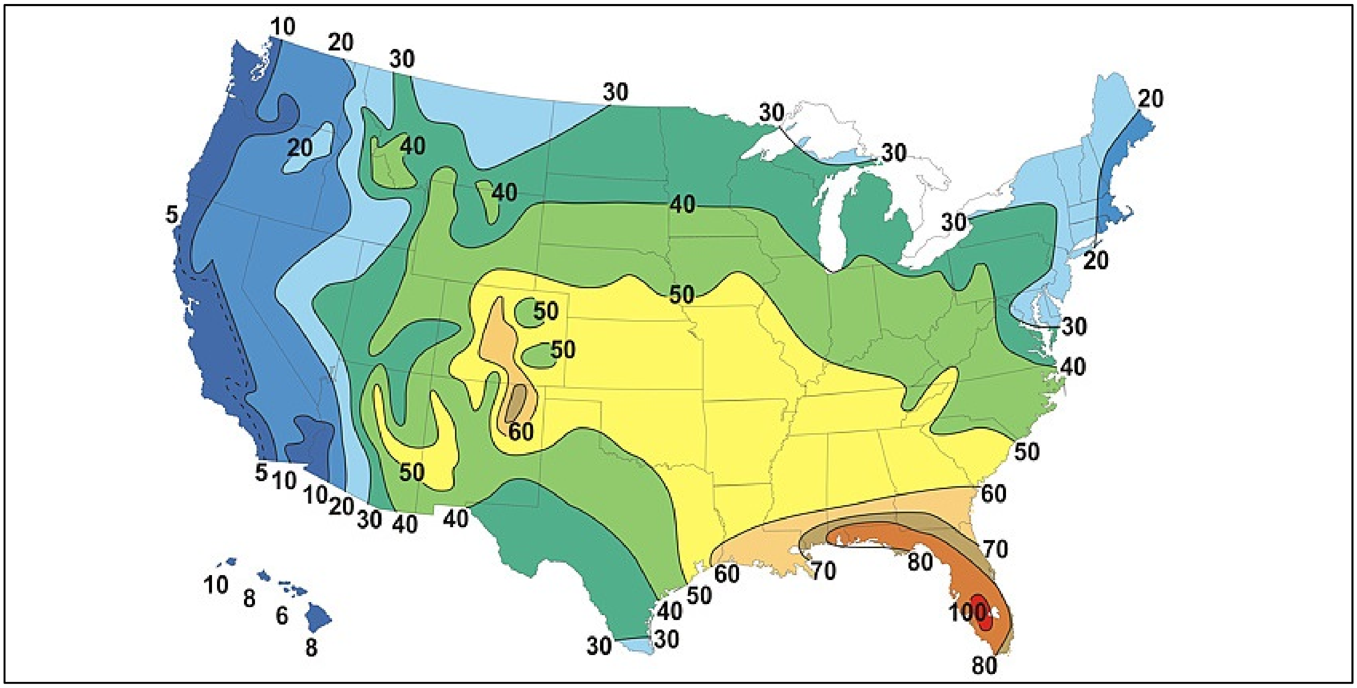


Figure 11-3. Annual Number of Thunderstorms in the United States

11.2.4 Severity

The most common problems associated with the severe weather conditions profiled in this assessment are immobility and loss of utilities. Fatalities are uncommon, but can occur. Roads may become impassable due to flooding, downed trees, or a landslide. Power lines may be downed due to high winds, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury. Physical damage to homes and facilities can be caused by wind or flooding.

Atmospheric rivers or heavy precipitation, which in the planning area almost always takes the form of rain, can have significant impacts, including crop damage, soil erosion, and increased risk of flood. These events can drop up to 12 inches of rain over a few days and cause widespread flooding and disruption to road and air travel. Stormwater runoff from heavy rains can also impair water quality by washing pollutants into water bodies. Thunderstorms carry the same risks as heavy precipitation events, and depending on the type of storm, they can also result in tornados, lightning, and heavy winds, increasing risk of injury and property damage (Keller, 2008).

Lightning severity is typically associated with both property damage and life safety (injuries and fatalities). The number of reported injuries from lightning is likely to be low, but planning area infrastructure losses can be up to thousands of dollars each year. Lightning also is associated with wildfire ignitions in the planning area.

Extreme heat is the primary weather-related cause of death in the U.S over a 30-year average from 1987 through 2016. In 2016, heat claimed 94 lives, though none of them were in California (NWS, 2016). Air-conditioning is the number one protective factor against heat-related illness and death. If a home is not air-conditioned, people can reduce their risk for heat-related illness by spending time in public facilities that are air-conditioned. Extreme heat is a concern to people, animals and pets as well as local nursery crops, cut flowers, and vegetable crops.

Windstorms can be a frequent problem in the planning area and have been known to cause damage to utilities. Strong, hot, dry offshore winds locally known as “diablo winds” can be particularly dangerous. These winds can occur at any time of year, but are especially dangerous in the driest months of summer and fall when vegetation is at its driest. 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. The FEMA *Winds Zones of the United States* map (Figure 11-4) indicates the strength of windstorms in the United States and the general location of the most wind activity, based on 40 years of tornado data and 100 years of hurricane data collected by FEMA. The planning area, along with most of the Western United States, is in Wind Zone I, where wind speeds can reach up to 130 mph.

Source: FEMA, 2010

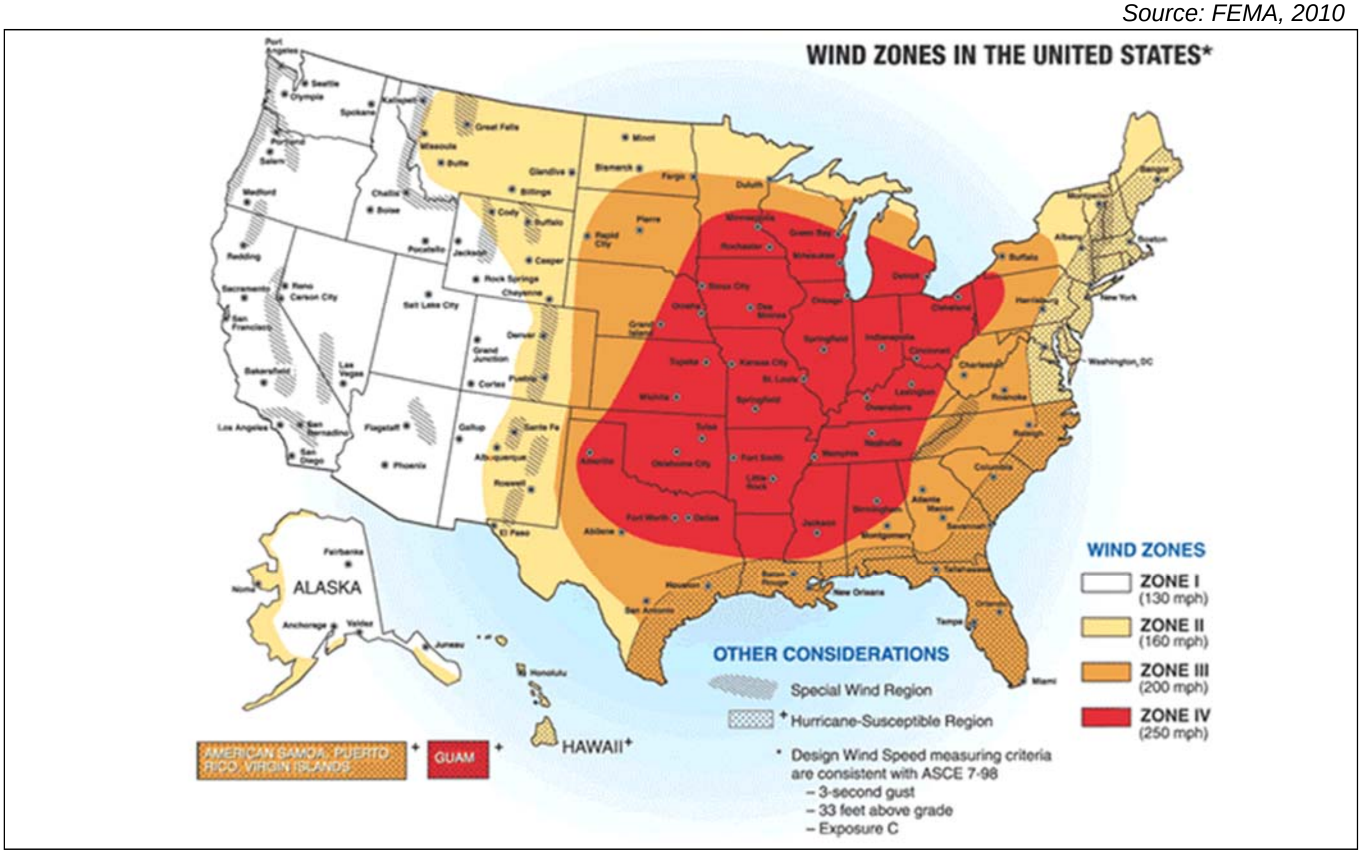


Figure 11-4. Wind Zones in the United States

Solar flares can lead to long-term power grid outages. Moderate solar storms have affected transformers as they are not very resilient to long electromagnetic pulses (Global Resilience Network, 2016). Recent events impacting the United States have disrupted the power grid, shut down satellites and air traffic precision navigation, and disabled GPS signals. Power outages induced by space weather can be life-threatening to those dependent on electricity for life support.

11.2.5 Warning Time

Meteorologists can often predict the likelihood of a severe weather event. 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 San Francisco Bay Area Weather Forecast Office of the NWS monitors weather stations and issues watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over NOAA weather radio and are forwarded to the local media for retransmission using the Emergency Alert System.

Space weather prediction in the United States is provided primarily by the Space Weather Prediction Center and the U.S. Air Force’s Weather Agency. 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 to civilian and commercial users.

11.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe weather are floods, falling and downed trees, mudslides, landslides and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

11.4 EXPOSURE

11.4.1 Population

A lack of clearly defined extent mapping for the severe weather conditions profiled in this chapter prevents a detailed analysis of exposure and vulnerability. However, it can be assumed that the entire planning area is exposed to some extent to all severe weather conditions profiled. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding.

11.4.2 Property

According to the County Assessor, there are 66,760 buildings within the census tracts that define the planning area. Most of these buildings are residential. It is estimated that 36 percent of the residential structures were built without the influence of a structural building code that would mitigate the severe weather conditions profiled in this assessment. All of these buildings are considered to be exposed to the severe weather hazard, but structures in poor condition or in particularly vulnerable locations (located on hilltops or exposed open areas) may risk the most damage. The frequency and degree of damage will depend on specific locations.

11.4.3 Critical Facilities and Infrastructure

All critical facilities exposed to flooding (Section 9.4.3) are also likely exposed to severe weather. Additional facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water and sewer systems may not function. Roads may become impassable from secondary hazards such as mudslides and landslides.

11.4.4 Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat. Storm surges can erode beachfront bluffs and redistribute sediment loads.

11.5 VULNERABILITY

11.5.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe weather events and could suffer more secondary effects of the hazard. Population vulnerabilities to specific severe weather conditions are as follows:

- **Severe Storms**—Nationally, lightning is one of the leading causes of weather-related fatalities, though lightning strikes are less common in the west than in other areas of the country. The majority of injuries and deaths associated with lightning occur when people are outdoors; however, almost one-third of lightning-related injuries occur indoors. Males are five times more likely than females to be struck by lightning and people between the ages of 15 and 34 account for 41 percent of all lightning strike victims.
- **Extreme Heat**—Individuals with physical or mobility constraints, cognitive impairments, economic constraints, or social isolation are typically at greater risk to the adverse effects of extreme heat. Some medical conditions, such as heat stroke, are directly attributable to extreme heat, while others may be exacerbated by it, resulting in medical emergencies.
- **Damaging Winds**—Debris carried by extreme winds and trees felled by gusty conditions can contribute directly to loss of life as well as increase the vulnerability of people by damaging buildings where people take shelter. Utility lines brought down by winds have been known to cause fires and create the possibility of lethal electric shock.
- **Space Weather —**The sun’s activities cause extreme space weather events that can affect the City’s population, mainly by power black-out events

11.5.2 Property

All property is vulnerable during the severe weather conditions profiled in this chapter, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Those in higher elevations and on ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

Loss estimations for the severe weather hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 11-3 lists the loss estimates.

Table 11-3. Loss Estimates for Severe Weather

	Exposed Value (Structure and Contents)	Estimated Loss Potential from Severe Weather		
		10% Damage	30% Damage	50% Damage
Dublin	$12,164,354,419	$1,216,435,442	$3,649,306,326	$6,082,177,209
Livermore	$20,508,103,666	$2,050,810,367	$6,152,431,100	$10,254,051,833
Pleasanton	$21,028,153,157	$2,102,815,316	$6,308,445,947	$10,514,076,578
Total	$53,700,611,242	$5,370,061,124	$16,110,183,373	$26,850,305,621

11.5.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from severe weather, mostly associated with secondary hazards. Landslides caused by heavy prolonged rains can block roads. High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating populations, and disrupting ingress and egress. Snowstorms in higher elevations can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly.

Prolonged obstruction of major routes due to landslides, snow, debris or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

Electric power losses caused by severe weather can be estimated using standard values for loss of service for utilities published in FEMA's *2009 Benefit Cost Analysis Reference Guide*. These figures provide estimated costs associated with the loss of power in relation to the populations in planning area (Table 11-4). The loss-of-use estimates for power failure associated with severe weather are presented as a cost per person per day of loss. The estimated loss of use provided for each jurisdiction represents the loss of service of the indicated utility for one day for 10 percent of the population. These figures do not take into account physical damage to utility equipment and infrastructure.

Table 11-4. Loss of Use Estimates for Power Failure

Jurisdiction	2016 Population Estimate[a]	Estimated Affected Population 10%	Electric Loss of Use Estimate ($126 per person per day)[b]
Dublin	57,349	5,735	$722,597
Livermore	88,138	8,814	$1,110,539
Pleasanton	74,982	7,498	$944,773
Total	220,469	22,047	$2,777,909

a. CA DOF, 2016
b. FEMA, 2009

11.5.4 Environment

The vulnerability of the environment to severe weather is the same as the exposure.

11.6 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The planning partners have adopted the International Building Code in response to California mandates. This code is equipped to deal with the impacts of severe weather events. Land use policies identified in general plans within the planning area also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partners are well equipped to deal with future growth and the associated impacts of severe weather.

11.7 SCENARIO

Severe weather impacts can be significant, particularly when secondary hazards occur. A worst-case event would involve prolonged high winds during a winter storm caused by an atmospheric river event. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads. Flooding and debris could further obstruct roads and bridges, further isolating residents.

11.8 ISSUES

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

- Older building stock in the planning area is built to low code standards. These structures could be highly vulnerable to severe weather events such as windstorms.
- The cities may need to open cooling centers during extreme heat events.
- Redundancy of power supply and communications equipment must be evaluated.
- The capacity for backup power generation is limited.
- Dead or dying trees as a result of drought conditions are more susceptible to falling during severe storm events.
- Public education on dealing with the impacts of severe weather needs to continue to be provided so that citizens can be better informed and prepared for severe weather events.
- Debris management (downed trees, etc.) must be addressed, because debris can impact the severity of severe weather events, requires coordination efforts, and may require additional funding.
- The effects of climate change may result in an increase of heavy rain or more atmospheric storm events, and will likely lead to increased temperatures and changes in overall precipitation amounts.

12. WILDFIRE

NOTE: "In October, 2017 Mendocino, Napa and Sonoma Counties experienced simultaneous wildland-urban interface fires that spread into suburban residential and commercial occupancies. There were over 7000 structures destroyed and 42 lives lost. These fires are currently under investigation, and conclusive information is not available to support the wildfire risk assessment for this plan. While these fires did not directly impact the planning area for this plan, they are likely to influence the understanding and assessment best management practices for wildfire in California and abroad in the future. Future updates to this chapter will utilize bets available data and science that is likely to be influenced by conclusions and observations from these events.

12.1 GENERAL BACKGROUND

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson. The potential for wildfire is primarily influenced by the following factors:

- Fuel, which may include living and dead vegetation on the ground, along the surface as brush and small trees, and above the ground in tree canopies.
- Topography, which includes both slope and elevation.
- Air conditions, including temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere.

DEFINITIONS

Wildfire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

Wildland urban interface area—An area susceptible to wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

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 (WUI) areas," where development is adjacent to densely vegetated areas.

12.1.1 Local Conditions Related to Wildfire

According to *Alameda County Community Wildfire Protection Plan* (CWPP, 2012), the planning area has a Mediterranean-like climate with no summer rains and potential high winds. Non-native and invasive weedy vegetation has replaced more fire resistant and ecologically stable native species in many places. In addition, highly flammable homes are located in high fire hazard zones

"Red flag" weather in the planning area features the strong, hot, dry offshore winds locally known as "diablo winds." These winds carry extremely dry air at high velocity and can push a fire down or up a slope quickly. They can occur at any time of year, but are especially dangerous in the driest months of summer and fall.

12.1.2 Wildfire Protection Responsibility in California

Hundreds of agencies have fire protection responsibility for wildland and WUI fires in California, and primary legal (and financial) responsibility for wildfire protection is divided by local, state, tribal, and federal organizations. In many instances, two fire organizations have dual primary responsibility on the same parcel of land— one for wildfire protection, and the other for structural or "improvement" fire protection. According to the *2013 California Multi-Hazard Mitigation Plan*, this layering of responsibility and resulting dual policies, rules, practices, and legal ordinances can cause conflict or confusion. To address wildfire jurisdictional responsibilities, the California state legislature in 1981 adopted Public Resource Code Section 4291.5 and Health and Safety Code Section 13108.5 establishing the following responsibility areas:

- **Federal Responsibility Areas (FRAs)**—FRAs are fire-prone wildland areas that are owned or managed by a federal agency such as the U.S. Forest Service, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Department of Defense. Primary financial and rule-making jurisdictional authority rests with the federal land agency. In many instances, FRAs are interspersed with private land ownership or leases. Fire protection for developed private property is usually not the responsibility of the federal land management agency; structural protection responsibility is that of a local government agency.
- **State Responsibility Areas (SRAs)**—SRAs are lands in California where California Department of Forestry and Fire Protection (CAL FIRE) has legal and financial responsibility for wildfire protection and where CAL FIRE administers fire hazard classifications and building standard regulations. SRAs are defined as lands that meet the following criteria:
  - Are county unincorporated areas
  - Are not federally owned
  - Have wildland vegetation cover rather than agricultural or ornamental plants
  - Have watershed or range/forage value
  - Have housing densities not exceeding three units per acre.

  Where SRAs contain built environment or development, the responsibility for fire protection of those improvements (non-wildland) is that of a local government agency.

- **Local Responsibility Areas (LRAs)**—LRAs include land in cities, cultivated agriculture lands, non-flammable areas in unincorporated areas, and lands that do not meet the criteria for SRA or FRA. LRA fire protection is typically provided by city fire departments, fire protection districts, and counties, or by CAL FIRE under contract to local governments. The Cities of Dublin, Livermore and Pleasanton are located in incorporated LRAs. LRAs may include flammable vegetation and WUI areas where the financial and jurisdictional responsibility for improvement and wildfire protection is that of a local government agency.

SRAs were originally mapped in 1985, and LRAs were originally mapped in 1996. During that time, many local governments made similar designations under their own authority. CAL FIRE recognized the need to remap both SRAs and LRAs with more recent data and technology to create more accurate zone designations.

California's SB 1241 (adopted in 2012) requires local governments to update the safety elements in their general plans to recognize wildfire risks in SRAs and "Very High Fire Hazard Severity Zones" (based on consistent statewide criteria and the severity of fire hazard that is expected to prevail in those areas). SB 1241 correlates strongly with AB 2140, which requires local jurisdictions to adopt a federally approved hazard mitigation plan through reference in the safety elements of their general plans. This bill also notes the requirement for the safety element to include information and policies on unreasonable risk from potential hazards, including fire. These bills are both designed to encourage integration within and between jurisdictions to enhance mitigation and prevention efforts. Information from a local general plan safety element should be considered with the development of a hazard mitigation plan, response procedures, evacuation planning, and long-term development.

12.2 HAZARD PROFILE

The 2013 *California Multi-Hazard Mitigation Plan* describes wildfire hazard and risk as follows:

> "The diversity of WUI settings and disagreement about alternative mitigation strategies has led to confusion and different methods of defining and mapping WUI areas. One major disagreement has been caused by terms such as "hazard" and "risk" being used interchangeably. Hazard is the physical condition that can lead to damage to a particular asset or resource. The term "fire hazard" is related to those physical conditions related to fire and its ability to cause damage, specifically how often a fire burns a given locale and what the fire is like when it burns (its fire behavior). Thus, fire hazard only refers to the potential characteristics of the fire itself.
>
> Risk is the likelihood of a fire occurring at a given site (burn probability) and the associated mechanisms of fire behavior that cause damage to assets and resources (fire behavior). This includes the impact of fire brands (embers) that may be blown some distance igniting fires well away from the main fire".

12.2.1 Past Events

According to the 2016 Alameda County Local Hazard Mitigation Plan, wildfires are common in the Bay Area, with large wildfires recorded in 1961, 1962, 1964, 1965, 1970, 1981, 1985, 1988, and 1991. However, none of these fires occurred in the Tri-Valley planning area. Between 1954 and April 2017, Alameda County was included in two FEMA major disaster (DR) fire management assistance declarations (DR-919 Oakland Hills Fire in 1991 and DR-295 Buckingham Norfolk Fire in 1970) but neither of these affected the planning area. With drought conditions in recent years, wildfires have occurred near the planning area, though none have caused sufficient damage to trigger a state or federal disaster declaration. The following wildfires of over 10 acres were recorded near the planning area in recent years (CAL FIRE, 2017):

- August 22, 2015—Burned 2,700 acres off Tesla Road near Correll Hollow between Livermore and Tracy. This fire took four days to contain with 18 fire personnel and five fire engines.
- June 25, 2015—Burned 53 acres off Tesla Road, southeast of Livermore.
- October 4, 2013—Burned 150 acres along Highland Road near Livermore.
- July 6, 2013, Fallon Fire—Burned 38 acres off Fallon Road and Camino Tasaajara near Dublin. The fire was contained within one day by Alameda County Fire Department.
- June 8, 2013, Vasco Fire—Burned 240 acres off Vasco Road and North Vasco Road, north of Livermore. The fire was contained within one day.

12.2.2 Location

CAL FIRE's Fire and Resource Assessment Program has modeled and mapped wildfire hazard zones using a science-based and field-tested computer model that designates moderate, high or very high fire hazard severity zones (FHSZ). The FHSZ model is built from existing CAL FIRE data and hazard information based on factors such as the following (CAL FIRE, 2017a):

- **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).

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. Figure 12-1 shows the FHSZ mapping for Alameda County. Table 12-1 lists the total area mapped in each zone.

Table 12-1. Record of Fire Affecting Planning Area

FHSZ Category	Total Area in Zone (acres)	Area Burned, 1878 – 2016	
		Acres	Percent of Total
Moderate	10,564	115	1.09%
High	9,455	498	5.26%
Very High	472	0	0.00%

Source: CAL FIRE, 2016

12.2.1 Frequency

Wildfire frequency can be assessed through review of the percent of a given area that has been burned in previous wildfire events. Table 12-1 summarizes CAL FIRE records of fires from 1878 to 2016. About 3 percent of the mapped wildfire risk zones in the planning area have burned in that 138-year period.

12.2.2 Severity

Potential losses from wildfire include human life, structures and other improvements, and natural resources. Given the immediate response times to reported fires, the likelihood of injuries and casualties is minimal. Smoke and air pollution from wildfires can be a health hazard, especially for children, the elderly and those with respiratory and cardiovascular diseases. First responders are exposed to dangers from the initial incident and after-effects from smoke inhalation and heat stroke. In addition, wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds.

Source: CAL FIRE, 2007

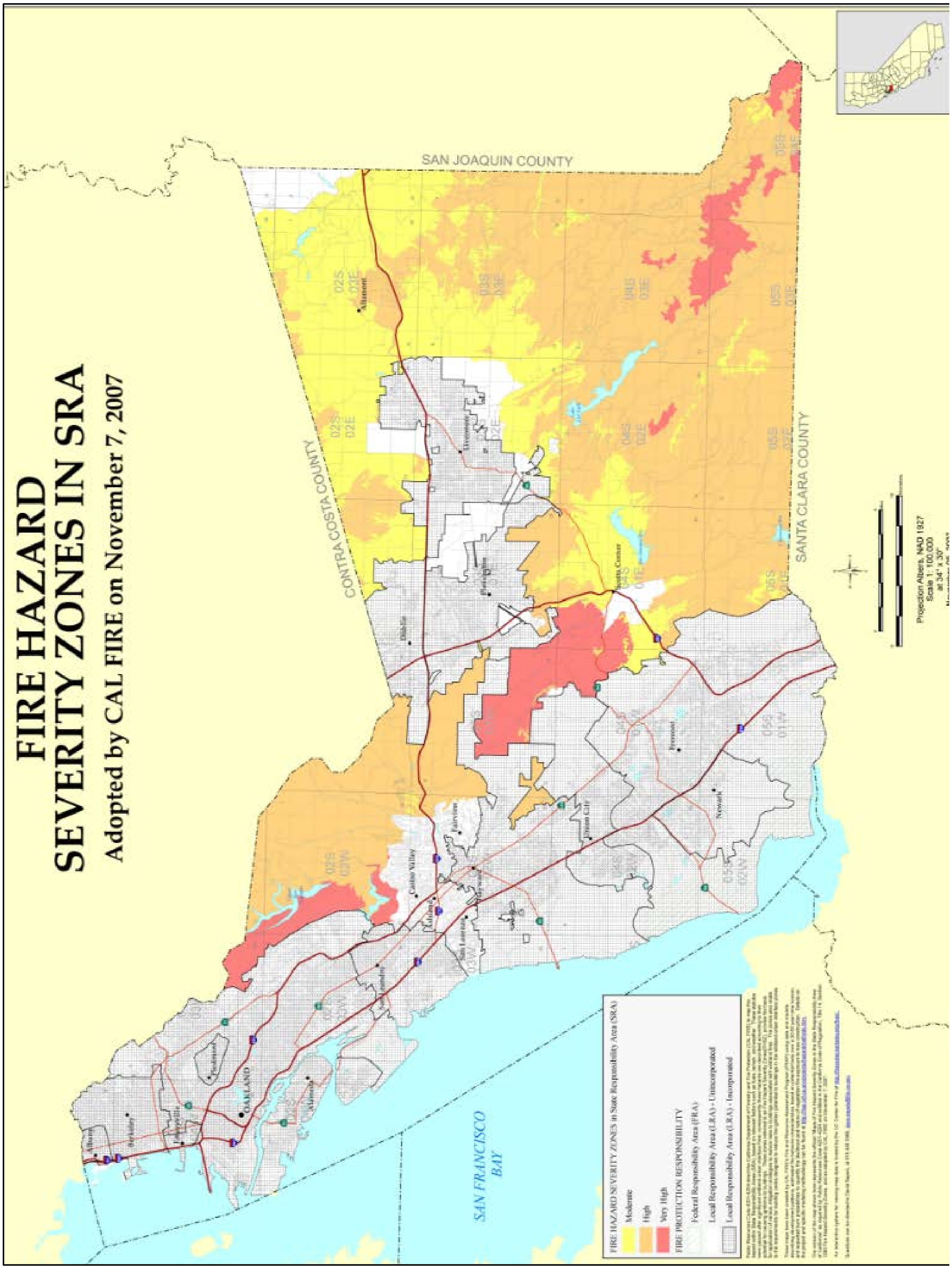


Figure 12-1. CAL FIRE FRAP Map for Alameda County

The largest WUI fire in the Bay Area, and one of the worst wildland fires in the United States, occurred in 1991 in the Oakland Hills of Alameda County. The fire resulted in $1.7 billion in losses and received a FEMA disaster declaration. The fire spread across 1,520 acres, destroyed 3,354 homes and 456 apartments, injured 150 people and took the lives of 25 people (Alameda County, 2016a). There are no recorded incidents of loss of life from wildfires in the planning area.

CAL FIRE's mapped fire hazard severity zones define the application of mitigation strategies to reduce risk associated with wildfires. Figure 12-2 shows fire hazard severity zones for the Tri-Valley planning area.

12.2.3 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. Severe 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.

12.3 SECONDARY HAZARDS

Wildfires can in some cases generate secondary effects that 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 contaminate reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff, which can weaken soils and cause slope failures. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

12.4 EXPOSURE

12.4.1 Population

Population could not be examined by FHSZ because the boundaries of census block groups do not coincide with the zone boundaries. However, population was estimated using the structure count of buildings in each mapped FHSZ and multiplying by the 2016 estimated average population per household (CA DOF, 2016). Table 12-2 presents the results.

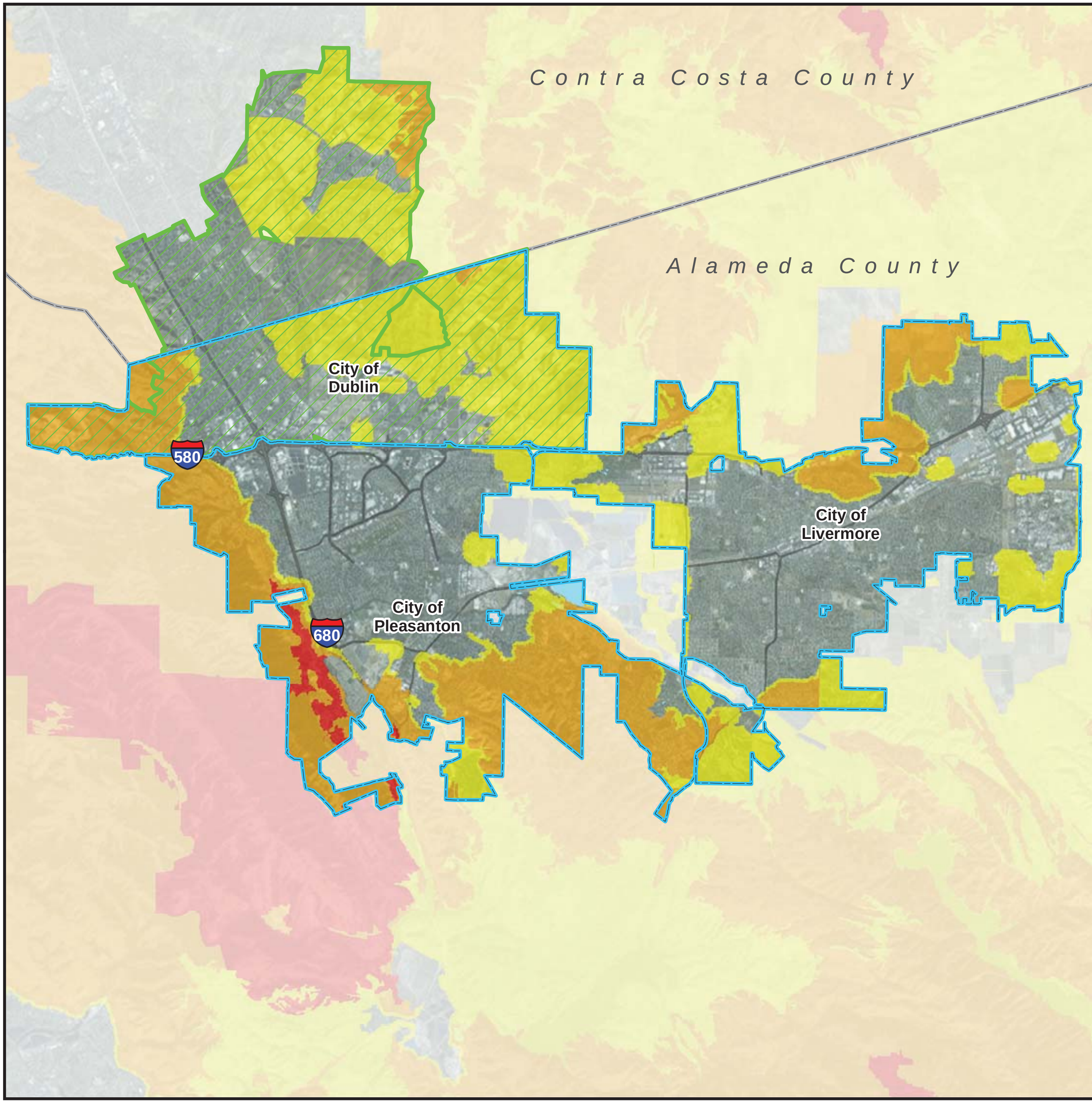
12.4.2 Property

The number of homes in the various wildfire hazard zones within the planning area and their values are summarized in Table 12-3 through Table 12-5. Table 12-6 shows the general land use of parcels exposed to the wildfire hazard in the planning area.

Tri-Valley Area

Figure 12-2.

Wildfire Severity Zones



- Municipal Boundaries
- Dublin San Ramon Services District
- Alameda County Boundary
- Water Bodies & Channels

Wildfire Severity Zone

- Moderate
- High
- Very High

N
W E
S

0 1 2 4

Miles

TETRA TECH

Map Data Sources: City of Dublin, City of Livermore, City of Pleasanton, CalFIRE, ESRI

Table 12-2. Population within Wildfire Hazard Areas

	Moderate FHSZ		High FHSZ		Very High FHSZ	
	Population Exposed[a]	% of Total Population Exposed	Population Exposed[a]	% of Total Population Exposed	Population Exposed[a]	% of Total Population Exposed
Dublin	23,087	38.7%	6,402	10.7%	0	0.0%
Livermore	7,140	8.0%	6,642	7.4%	0	0.0%
Pleasanton	5,942	7.8%	11,528	15.2%	2,492	3.3%
Total	36,170	16.1%	24,572	10.9%	2,492	1.1%

a. Exposed population calculated as percent of residential buildings exposed multiplied by estimated population on January 1, 2017, from California Department of Finance.

Table 12-3. Exposure and Value of Structures in Very High Wildfire Hazard Areas

	Buildings Exposed[a]	Value Exposed			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	0	$0	$0	$0	0.0%
Livermore	0	$0	$0	$0	0.0%
Pleasanton	708	$255,482,500	$129,473,890	$384,956,390	1.8%
Total	708	$255,482,500	$129,473,890	$384,956,390	0.7%

a. Fire hazard severity data downloaded from CAL FIRE website in May 2016.

Table 12-4. Exposure and Value of Structures in High Wildfire Hazard Areas

	Buildings Exposed[a]	Value Exposed			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	1,744	$631,760,619	$341,680,204	$973,440,823	8.0%
Livermore	2,038	$863,648,160	$655,619,139	$1,519,267,300	7.4%
Pleasanton	3,313	$1,749,485,861	$1,018,950,914	$2,768,436,776	13.2%
Total	7,095	$3,244,894,640	$2,016,250,257	$5,261,144,898	9.8%

a. Fire hazard severity data downloaded from CAL FIRE website in May 2016.

Table 12-5. Exposure and Value of Structures in Moderate Wildfire Hazard Areas

	Buildings Exposed[a]	Value Exposed			% of Total Replacement Value
		Structure	Contents	Total	
Dublin	6,300	$2,650,676,069	$1,451,005,773	$4,101,681,842	33.7%
Livermore	2,234	$1,267,065,382	$1,011,668,475	$2,278,733,857	11.1%
Pleasanton	1,705	$755,916,113	$459,120,197	$1,215,036,310	5.8%
Total	10,239	$4,673,657,564	$2,921,794,444	$7,595,452,009	14.1%

a. Fire hazard severity data downloaded from CAL FIRE website in May 2016.

Table 12-6. Land Use Within the Wildfire Hazard Areas

Land Use	Moderate FHSZ		High FHSZ		Very High FHSZ	
	Area (acres)	% of total	Area (acres)	% of total	Area (acres)	% of total
Residential	2,189	20.7%	3,496	37.0%	332	70.4%
Commercial	363	3.4%	450	4.8%	0	0.0%
Industrial	236	2.2%	56	0.6%	0	0.0%
Agriculture	24	0.2%	25	0.3%	0	0.0%
Religion / Assembly	133	1.3%	59	0.6%	5	1.1%
Government / Institutional	1,314	12.4%	0	0.0%	0	0.0%
Education	248	2.3%	85	0.9%	3	0.7%
Vacant / Rights-of-Way / Water / Open Space	6,056	57.3%	5,284	55.9%	131	27.8%
Total	10,564	100.0%	9,455	100.0%	472	100.0%

12.4.3 Critical Facilities and Infrastructure

Table 12-7 identifies critical facilities exposed to the wildfire hazard in the planning area.

Table 12-7. Critical Facilities and Infrastructure in Wildfire Hazard Areas

	Medical and Health Services	Emergency Services	Educational Facilities	Government / City Facilities	Utilities	Transportation Infrastructure	Hazardous Materials	Other Assets	Total
Moderate Hazard Zone									
Dublin	0	5	2	3	0	8	0	0	18
Livermore	0	0	3	0	6	12	3	0	24
Pleasanton	1	0	4	0	4	5	2	0	16
High Hazard Zone									
Dublin	2	0	1	0	0	0	0	0	3
Livermore	1	0	1	0	1	6	0	0	9
Pleasanton	1	1	0	0	33	9	1	0	45
Very High Hazard Zone									
Dublin	0	0	0	0	0	0	0	0	0
Livermore	0	0	0	0	0	0	0	0	0
Pleasanton	0	0	0	0	5	2	0	0	7
Total	5	6	11	3	49	42	6	0	122

Currently there are six registered Toxic Release Inventory hazardous material containment sites in wildfire risk zones. During a wildfire event, these materials could rupture due to excessive heat and act as fuel for the fire, causing rapid spreading and escalating the fire to unmanageable levels. In addition they could leak into surrounding areas, saturating soils and seeping into surface waters, and have a disastrous effect on the environment.

In the event of wildfire, there would likely be little damage to the majority of infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk to wildfire because most are made of wood and susceptible to burning. In the event of a wildfire, pipelines could provide a source of fuel and lead to a catastrophic explosion.

12.4.4 Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- Damaged Fisheries—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- Soil Erosion—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- Spread of Invasive Plant Species—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- Disease and Insect Infestations—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- Destroyed Endangered Species Habitat—Catastrophic fires can have devastating consequences for endangered species.
- Soil Sterilization—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called “fire regimes,” include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

12.5 VULNERABILITY

Structures, above-ground infrastructure, critical facilities and natural environments are all vulnerable to the wildfire hazard. There is currently no validated damage function available to support wildfire mitigation planning. Except as discussed in this section, vulnerable populations, property, infrastructure and environment are assumed to be the same as described in the section on exposure.

12.5.1 Population

There are no recorded incidents of loss of life from wildfires within the planning area. Given the immediate response times to reported fires, the likelihood of injuries and casualties is minimal; therefore, injuries and casualties were not estimated for the wildfire hazard.

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

12.5.2 Property

Loss estimations for wildfire are not based on damage functions, because no such functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 12-8 lists the loss estimates for the general building stock for jurisdictions that have an exposure to a fire hazard severity zone.

Table 12-8. Wildfire Loss Potential

		Loss Potential from Wildfire		
	Exposed Value (Structure and contents)	10% Damage	30% Damage	50% Damage
Dublin	$5,075,122,665	$507,512,266	$1,522,536,799	$2,537,561,332
Livermore	$3,798,001,157	$379,800,115	$1,139,400,347	$1,899,000,578
Pleasanton	$4,368,429,476	$436,842,947	$1,310,528,842	$2,184,214,737
Total	$13,241,553,297	$1,324,155,329	$3,972,465,989	$6,620,776,648

12.5.3 Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable to wildfire. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods.

12.6 FUTURE TRENDS IN DEVELOPMENT

The highly urbanized portions of the planning area have little or no wildfire risk exposure. Urbanization tends to alter the natural fire regime, and can create the potential for the expansion of urbanized areas into wildland areas. The expansion of the wildland urban interface can be managed with strong land use and building codes. The planning area is well equipped with these tools and this planning process has assessed capabilities with regards to the tools. As the planning area experiences future growth, it is anticipated that the exposure to this hazard will remain as assessed or even decrease over time due to these capabilities. Table 12-9 shows the future land use within the moderate, high, and very high FHSZ.

12.7 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. A dry summer could follow the wet spring, exacerbated by diablo winds. Carelessness with combustible materials or a tossed lit cigarette, or a sudden lightning storm could trigger a multitude of small isolated fires.

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

Table 12-9. Future Land Use Within the Wildfire Hazard Areas

Land Use	Moderate FHSZ		High FHSZ		Very High FHSZ	
	Area (acres)	% of total	Area (acres)	% of total	Area (acres)	% of total
Residential	2,409	22.8%	4,077	43.1%	408	86.4%
Commercial	298	2.8%	284	3.0%	7	1.4%
Industrial	940	8.9%	141	1.5%	0	0.0%
Agriculture	644	6.1%	313	3.3%	0	0.0%
Religion / Assembly	2,333	22.1%	159	1.7%	4	0.9%
Government / Institutional	167	1.6%	19	0.2%	0	0.0%
Education	3,774	35.7%	4,468	47.2%	53	11.2%
Vacant / Rights-of-Way / Water / Open Space	10,566	100.0%	9,462	100.0%	472	100.0%
Total	2,409	22.8%	4,077	43.1%	408	86.4%

While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

12.8 ISSUES

The major issues for wildfire are the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Wildfires could cause multiple secondary natural hazards.
- Climate change could affect the wildfire hazard.
- Future growth into interface areas should continue to be managed, particularly in the western hillside area of Pleasanton.
- Area fire districts need to continue to train on wildland-urban interface events.
- Vegetation management activities. This would include enhancement through expansion of the target areas as well as additional resources.
- Regional consistency of higher building code standards such as residential sprinkler requirements and prohibitive combustible roof standards.

13. CLIMATE CHANGE

13.1 GENERAL BACKGROUND

13.1.1 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. Worldwide, average temperatures have increased 1.7ºF since 1880 (NASA, 2017). Although this change may seem small, it can lead to large changes in climate and weather.

The warming trend 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, but 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, changes in land use and volcanic eruptions. According to the U.S. Environmental Protection Agency (EPA), carbon dioxide concentration measured about 280 parts per million (ppm) before the industrial era began in the late 1700s and reached 401 ppm in 2015 (EPA, 2016) (see Figure 13-1). In addition, the concentration of methane has almost doubled, and nitrous oxide is being measured at a record high of 328 parts per billion (ppb) (EPA, 2016a). In the United States, electricity generation is the largest source of these emissions, followed by transportation (EPA, 2016b).

Scientists are able to place this rise in carbon dioxide in a longer historical context through the measurement of carbon dioxide in ice cores. According to these records, carbon dioxide concentrations in the atmosphere are the highest that they have been in 650,000 years. According to NASA, this trend is of particular significance “because most of it is very likely human-induced and [it is] proceeding at a rate that is unprecedented in the past 1,300 years”. There is broad scientific consensus (97 percent of scientists) that climate-warming trends are very likely due to human activities (NASA, 2017). Unless emissions of greenhouse gases are substantially reduced, this warming trend and its associated impacts are expected to continue.

Climate change will affect the people, property, economy and ecosystems of the planning area in a variety of ways. Climate change impacts are most frequently associated with negative consequences, such as increased flood vulnerability or increased heat-related illnesses/public health concerns; however, other changes may present opportunities. 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.

13.1.2 How Climate Change Affects Hazard Mitigation

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.

Source: EPA, 2016

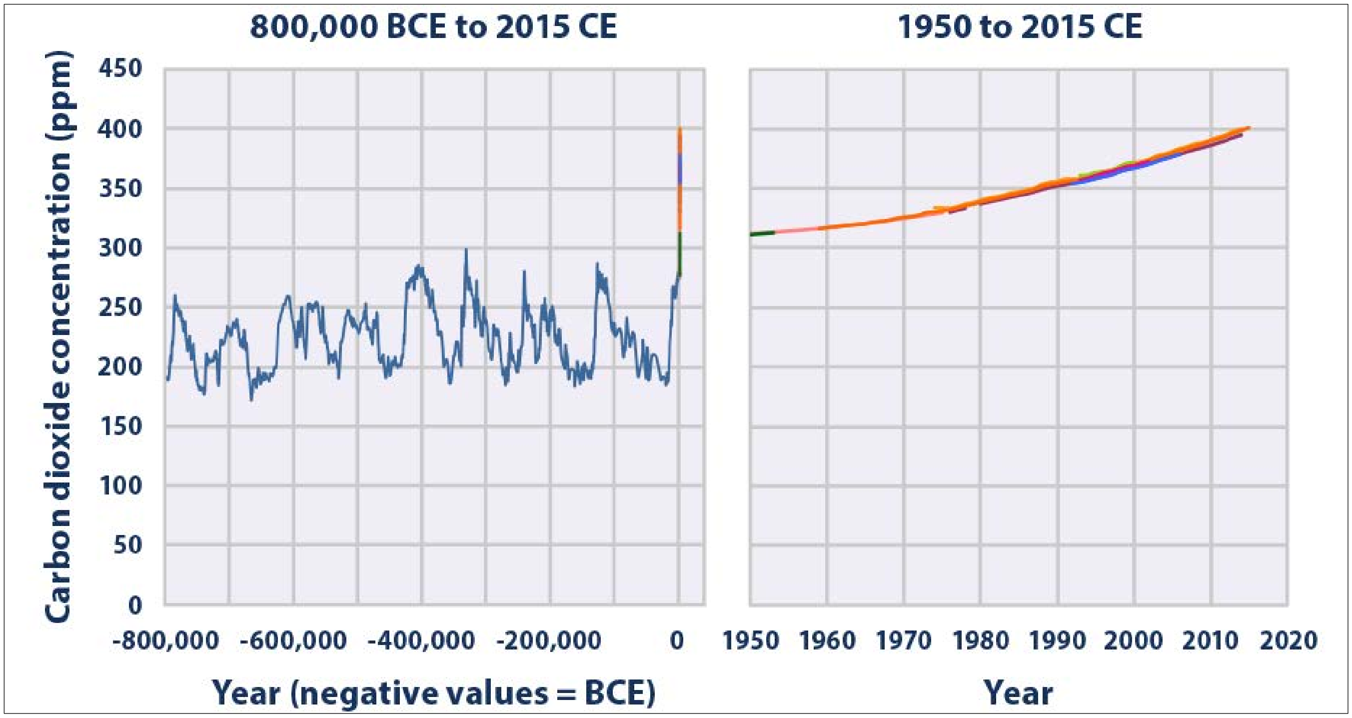


Figure 13-1. Global Carbon Dioxide Concentrations over Time

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 a 1-percent-annual-chance event might strike more often, leaving many communities at greater risk. The risks of, landslide, severe storms, extreme heat 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. This chapter summarizes current understandings about climate change in order to provide a context for the recommendation and implementation of hazard mitigation measures.

13.1.3 Current Indicators of Climate Change

The major scientific agencies of the United States and the world—including NASA, NOAA and the Intergovernmental Panel on Climate Change (IPCC)—agree that climate change is occurring. Multiple temperature records from all over the world have shown a warming trend. The IPCC has stated that the warming of the climate system is unequivocal (IPCC, 2014). Sixteen of the 17 warmest years on record occurred since 2001, and 2016 was the warmest year on record (NASA, 2016b).

Rising global temperatures have been accompanied by other changes in weather and climate. Many places have experienced changes in rainfall resulting in more intense rain, as well as more frequent and severe heat waves (IPCC, 2014). The planet's oceans and glaciers have also experienced changes: oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising. Global sea level has risen approximately 6.7 inches, on average, in the last 100 years (NASA, 2017). This has already put some coastal homes, beaches, roads, bridges, and wildlife at risk (USGCRP, 2009).

NASA currently maintains information on the vital signs of the planet. At the time of the development of this plan, the following trends and status of these signs are as follows (NASA, 2017a):

- Carbon Dioxide—Increasing trend, currently at 406.17 parts per million
- Global Temperature—Increasing trend, increase of 1.7 ºF since 1880
- Arctic Ice Minimum—Decreasing trend, 13.3 percent per decade
- Land Ice—Decreasing trend, 287.0 gigatonnes per year
- Sea Level—Increasing trend, 3.4 millimeters (0.04 inches) per year.

13.1.4 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 and the impacts of those changes will depend on global emissions of greenhouse gases and sensitivity in human and natural systems, the following impacts are expected in the United States:

- 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 1-4 feet by 2100
- The Arctic may become ice free.

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

- Increased temperature
- Reduced precipitation
- Sea level rise—coastal inundation and erosion
- Public health—heat and air pollution
- Reduced agricultural productivity
- Inland flooding
- Reduced tourism.

Some of these changes are direct or primary climatic changes, such as increased temperature, while others are indirect climatic changes or secondary impacts, such as heat wave frequency, resulting from these direct changes. 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 13-1.

Climate change projections contain inherent uncertainty, largely derived from the fact that they depend on future greenhouse gas emission scenarios. Generally, the uncertainty in greenhouse gas emissions is addressed by the presentation of differing scenarios: low-emissions or 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.

Table 13-1. Summary of Primary and Secondary Impacts

Primary Impact	Secondary Impact	Example Human and Natural System Impacts
Increased temperature	Heat wave	• Increased frequency of illness and death • Increased stress on mechanical systems, such as HVAC systems
Increased temperature and changes in precipitation	Changed seasonal patterns	• Reduced agricultural productivity • Reduced tourism
Increased temperature and/or reduced precipitation	Drought	• Reduced agricultural productivity • Decreased water supply
	Reduced Snowpack	• Decreased water supply • Reduced tourism
	Wildfire	• Increased incidence of landslide or mudslide • Reduced tourism • Increase in air pollution and related health impacts
Sea level rise	Permanent inundation of previously dry land	• Loss of assets and tax base • Loss of coastal habitat
	Larger area impacted by extreme high tide	• More people and structures impacted by storms • Increased incidence of loss of utilities and lifeline systems
	Increased coastal erosion	• Loss of assets and tax base
	Saltwater intrusion into freshwater systems	• Decreased water supply • Ecosystem disruption Sea level rise
Changes in wind patterns	Increased extreme events, including severe storms and fires	• More frequent disruption to systems resulting from severe storms
Ocean acidification		• Decreased biodiversity in marine ecosystems

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

Despite this uncertainty, climate change projections present valuable information to help guide decision-making for possible future conditions. The following sections summarize information developed for the planning area by Cal-Adapt, a resource for public information on how climate change might impact local communities, based on the most current data available. The projections are averaged across Alameda County and include information from two emissions scenarios, which were developed by the IPCC (Cal-Adapt, 2017):

- Low Emissions Scenario—Emissions peak around 2040 and then decline (this was designated Scenario B1 in previous IPCC analyses but is Scenario RCP 4.5 under more recent IPCC analyses)
- High Emissions Scenario—Emissions continue to rise strongly through 2050 and plateau around 2100 (this was designated Scenario A2 in previous IPCC analyses but is Scenario RCP 8.5 under more recent IPCC analyses).

Temperature

The historical (1961-1990) average maximum temperature in Tri-Valley planning area was 69.9ºF and the average minimum temperature was 44.6ºF. While average temperatures may fluctuate from year-to-year, and may differ from one municipality to the next, the trend for the planning area indicates that average temperatures are increasing (see Figure 13-2). The annual average maximum temperature increased by 7.7ºF when comparing 1961 to 1990 and 2070 to 2099 records. Average temperatures are expected to continue to rise. Table 13-2 shows the estimated average temperatures for 2050 and 2099 under the low and high emission scenario.

Source: Cal-Adapt, 2017

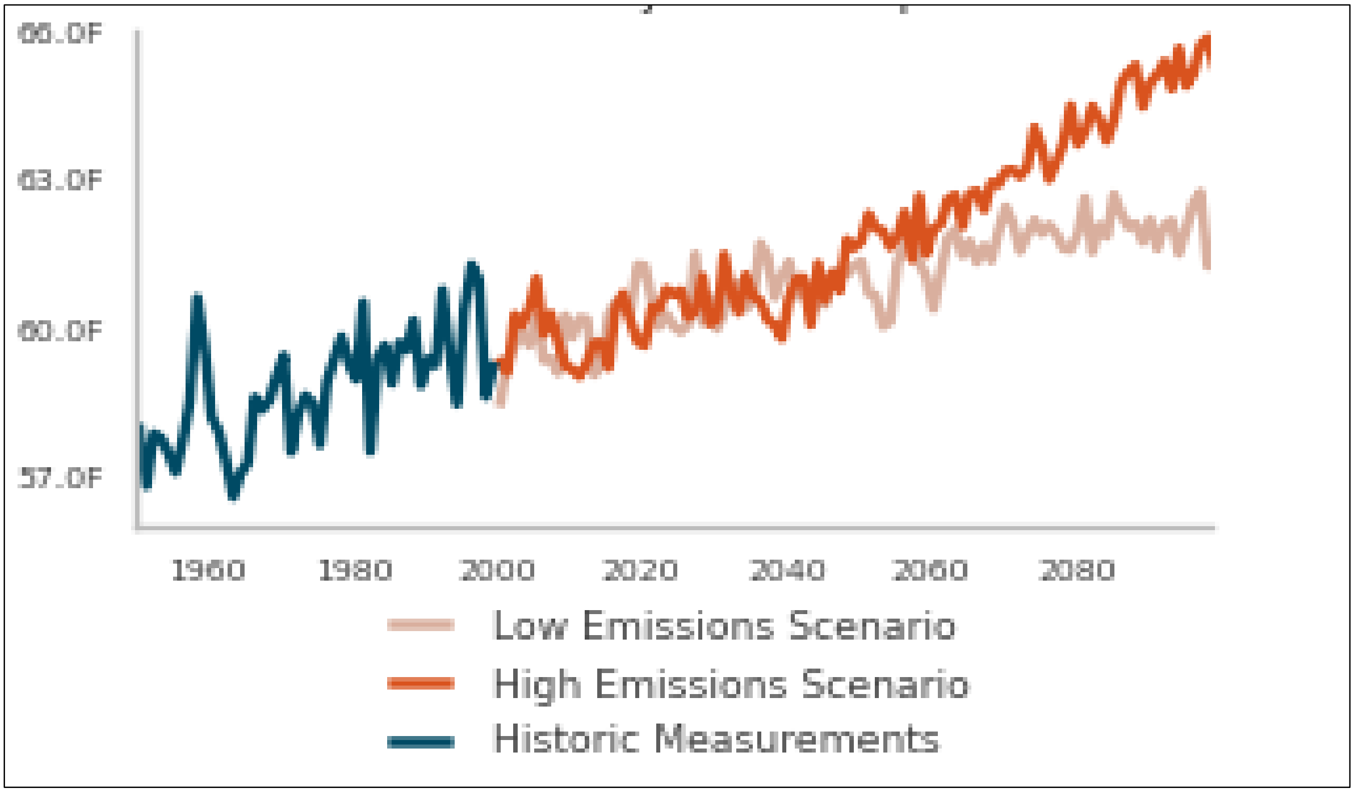


Figure 13-2. Observed and Projected Average Temperatures in Tri-Valley planning area

Table 13-2. Average Temperature Projections in Tri-Valley planning area

	2050 Projection (°F)				2099 Projection (°F)			
	Average Temperature		Difference from Historical Average		Average Temperature		Difference from Historical Average	
Emission Scenario	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Low Emissions (RCP 4.5)	73.9	50.1	+4.0	+5.5	76.23	49.3	+6.3	+4.7
High Emissions (RCP 8.5)	74.8	51.0	+4.9	+6.4	80.6	56.4	+10.7	+11.8

Extreme Heat

The extreme heat day temperature threshold for the planning area is 98.3°F. The historical average (1961-1990) number of extreme heat days is 4.3 days. In the low emissions scenario, there are projected to be an annual average of 13 days with temperatures over the extreme heat day threshold between 2017 and 2050 and between 2051 and 2099. In the high emissions scenario, there are projected to be an annual average of 20 days with temperatures over the extreme heat day threshold between 2017 and 2050 and an average of 19 days per year between 2051 and 2099 (see Figure 13-3).

Source: Cal-Adapt, 2017

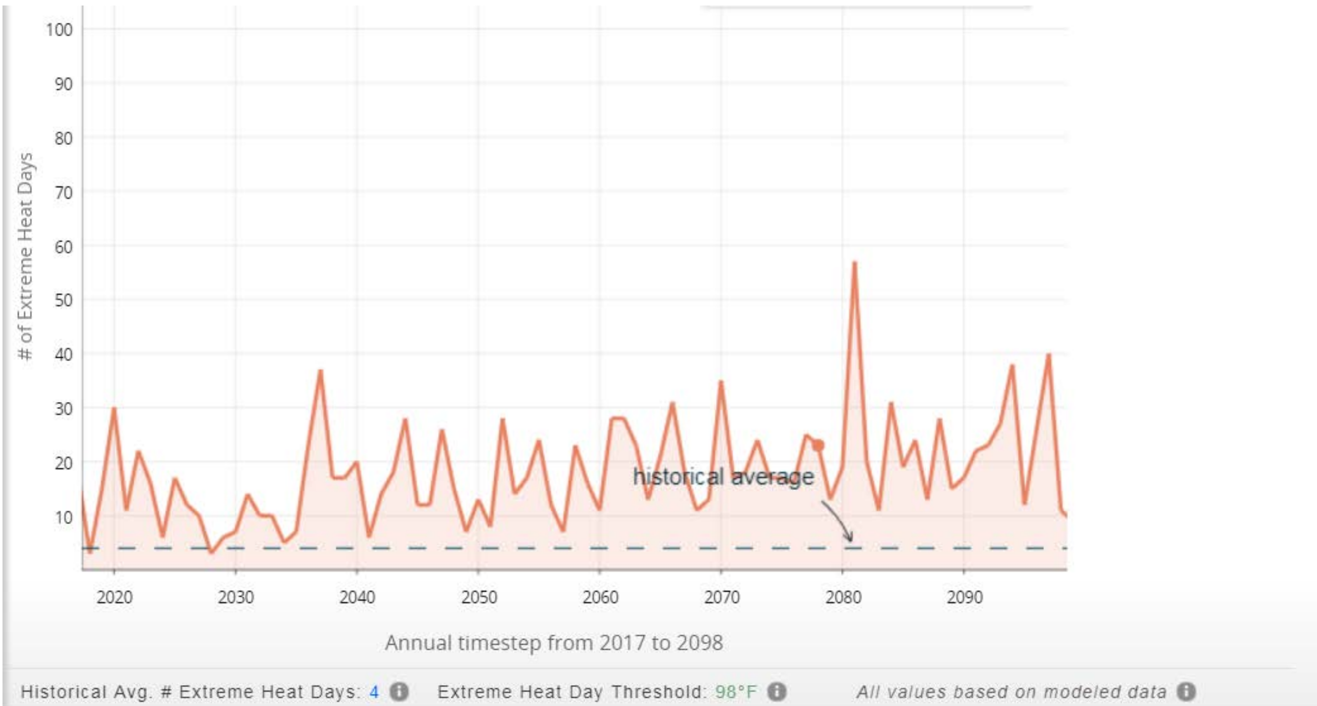


Figure 13-3. Projected Number of Extreme Heat Days by Year

Precipitation

Cal-Adapt shows that the historical annual mean precipitation (1961-1990) for the Tri-Valley planning area was 21.1 inches. Under the low and high emission scenario, annual precipitation is expected to average 22.75 inches from 2017 to 2050 and 29.22 inches from 2051 to 2099. In general, most precipitation is expected to continue to fall during the winter. Small changes in precipitation patterns in the state will have the potential to cause significant disruption to built and natural systems.

Snowpack

While there are no snow-water equivalency measurements for the planning area, Cal-Adapt indicates that changes in precipitation patterns may result in a reduction in snowpack. For example, Sierra Nevada snowpack may be reduced by as much as 70 to 90 percent.

Wildfire

Wildfire risk is expected to change in the coming decades (see Figure 13-4). Under both high- and low-emissions scenarios, the change in area burned in planning area decreases by 10 to 20 percent by 2050.

Sea Level Rise

Sea levels have been rising over the past several decades and are expected to continue to rise. Sea level rise is mostly attributed to two factors: the expansion of water as it warms (thermal expansion) and the melting of ice sheets and glaciers. As average ocean temperatures continue to increase, thermal expansion will continue and can be projected with some degree of certainty. Less certain is how quickly ice sheets will melt, accounting for most of the uncertainty in projections.

Source: Cal-Adapt, 2017

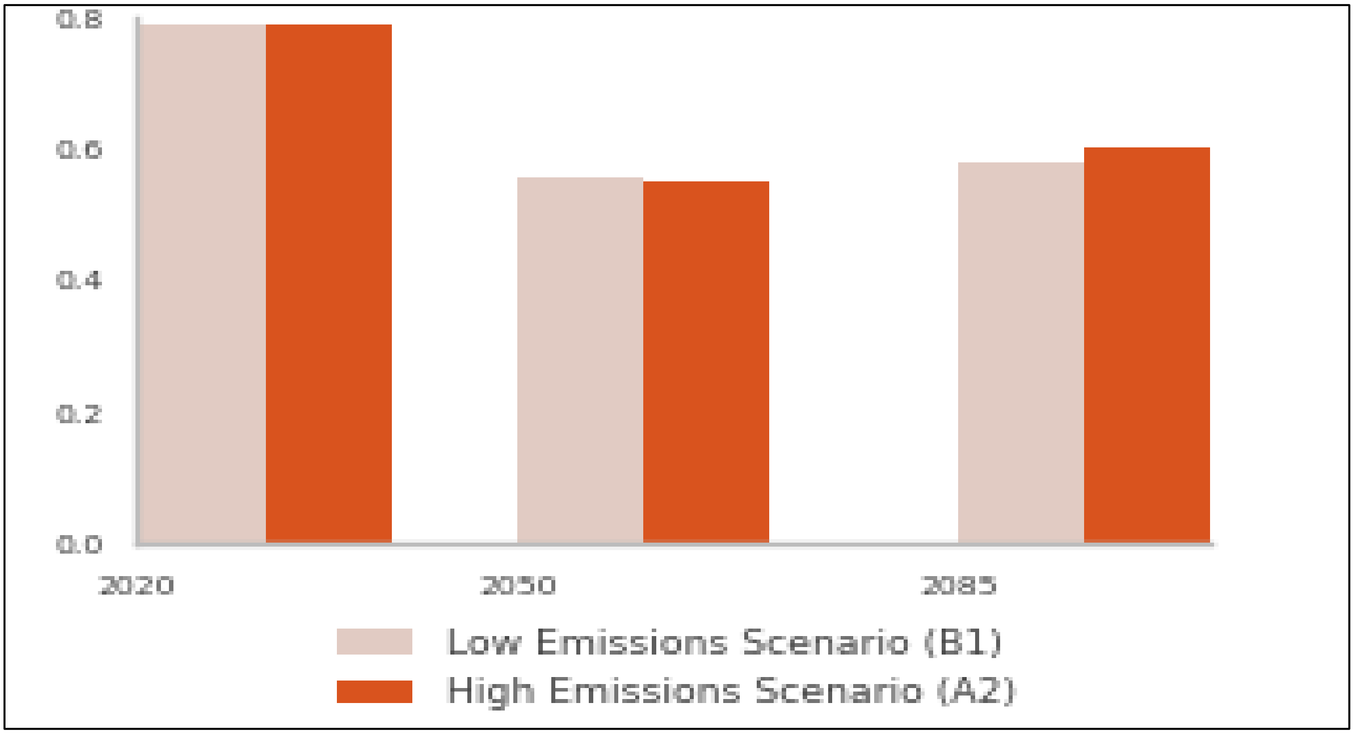


Figure 13-4. Projected Changes in Fire Risk, Relative to 2010 Levels

Sea level rise will cause currently dry areas to be permanently or chronically inundated. Temporary inundation from extreme tide events and storm surge also will change. Unlike many other impacts resulting from climate change, sea level rise will have a defined extent and location. This allows for a more-detailed risk assessment to be conducted for this climate change impact. Although the extent and timing of sea level rise is still uncertain, conducting an assessment of potential areas at risk provides information appropriate for planning purposes.

13.1.5 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. Generally, climate change discussions encompass two separate but inter-related considerations: mitigation and adaptation. The term “mitigation” can be confusing, because it’s meaning changes across disciplines:

- Mitigation in restoration ecology and related fields generally refers to policies, programs or actions that are intended to reduce or to offset the negative impacts of human activities on natural systems. Generally, mitigation can be understood as avoiding, minimizing, rectifying, reducing or eliminating, or compensating for known impacts (CEQ, 1978).
- Mitigation in climate change discussions is defined as “a human intervention to reduce the impact on the climate system.” It includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks (EPA, 2013).
- Mitigation in emergency management is typically defined as the effort to reduce loss of life and property by lessening the impact of disasters (FEMA, 2013).

In this chapter, mitigation is used as defined by the climate change community. In the other chapters of this hazard mitigation plan, mitigation is primarily used in an emergency management context.

The IPCC defines adaption as “the process of adjustment to actual or expected climate and its effects.” Mitigation and adaptation are related, as the world’s ability to reduce greenhouse gas emissions will affect the degree of adaptation that will be necessary. Some actions can both reduce greenhouse gas emissions and support adaptation to likely future conditions. Some adaptation actions also help communities reach other community goals (referred to as co-benefits). The ability to adapt to changing conditions is often referred to as adaptive capacity, which is “the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2014).

Societies across the world are facing the need to adapt to changing conditions and to identify ways to increase their adaptive capacity. Some efforts are already underway. 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.

Adaptive capacity goes beyond human systems, as some 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.

Assessment of the current efforts and adaptive capacity of the planning partners participating in this hazard mitigation plan are included in the jurisdiction-specific annexes in Volume 2.

13.2 VULNERABILITY ASSESSMENT

The following sections provide information on how each natural 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.

13.2.1 Dam Failure

Climate Change Impacts on the Hazard

On average, changes in California’s annual precipitation levels are not expected to be dramatic; however, small changes 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.

According to the California Department of Water Resources, flood flows on many California rivers have been record setting since the 1950s. This means that water infrastructure, such as dams, have been forced to manage flows for which they were not designed. The California Division of Safety of Dams has indicated that climate change may result in the need for increased safety precautions to address higher winter runoff, frequent fluctuations of water levels, and increased potential for sedimentation and debris accumulation from changing erosion patterns and increases in wildfires. According to the Division, climate change also will impact the ability of dam operators to estimate extreme flood events (DWR, 2017b).

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. These types of conditions were observed during the emergency spillway failure of Oroville dam in California in the spring of 2017 (see Figure 13-5).

Figure 13-5. Oroville Dam Emergency Spillway Failure in Spring 2017

Exposure, Sensitivity and Vulnerability

Population

Population exposure and vulnerability to the dam failure hazard are unlikely to change as a result of climate change. However, if areas previously protected by accredited levees are mapped in a special flood hazard area, the number of people residing in flood hazard areas may increase.

Property

Property exposure and vulnerability to the dam failure hazard are unlikely to change as a result of climate change. However, if areas previously protected by accredited levees are mapped in a special flood hazard area, the assets considered to be exposed to the flood hazard may increase.

Critical facilities

The exposure and vulnerability of critical facilities are unlikely to change as result of climate change. Dam owners and operators are sensitive to the risk and 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 factors that could increase the risk of design failures, such as increasing the natural water storage capacity in watersheds above dams.

Economy

Changes in the dam failure hazard related to climate change are unlikely to affect the local economy.

13.2.2 Drought

Climate Change 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” (NCA, 2014a).

Because future changes in precipitation patterns are still uncertain, the potential impacts and likelihood of drought are uncertain. That being said, DWR has already noted the impact of climate change on statewide water resources by charting changes in snowpack and river flow. As temperatures rise and more precipitation comes in the form of rain instead of snow, these changes will likely continue or grow even more significant. DWR estimates that the Sierra Nevada snowpack, which provides a large amount of the water supply for the planning area and other parts of the state, will experience a 48- to 65-percent reduction from historic April 1 averages by the end of the century (DWR, 2017b). Increasing temperatures may also increase net evaporation from reservoirs by 15 to 37 percent (DWR, 2013). The planning area’s water supply is also derived from groundwater resources. Increased incidence of drought may cause a drawdown in these resources without allowing opportunity for aquifer recharge.

Exposure, Sensitivity and Vulnerability

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 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 be sensitive to changes and 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. Ecosystems and biodiversity in the Bay 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, which include many special status species.

Economy

Increased incidence of drought could increase the potential for impacts on the local economy. Increased drought may impact the wine industry and related tourism activities.

13.2.3 Earthquake

Climate Change 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.

Exposure, Sensitivity and Vulnerability

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.

13.2.4 Flood

Climate Change 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. Scientists project greater storm intensity with climate change, resulting in more direct runoff and flooding. High frequency flood events (e.g. 10-year floods) in particular will likely increase with a changing climate. What is currently considered a 1-percent-annual-chance flood may strike more often, leaving many communities at greater risk. Going forward, model calibration 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, such as the Sierra Nevada watersheds, to contribute to peak storm runoff. 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.

Exposure, Sensitivity and Vulnerability

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. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams and bypass channels, as well as the design of local sewers and storm drains.

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.

Economy

If flooding becomes more frequent, there may be impacts on the local economy. More resources may need to be directed to response and recovery efforts, and businesses may need to close more frequently due to loss of service or access during flood events.

13.2.5 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.

13.2.6 Severe Weather

Climate Change Impacts on the Hazard

Climate change presents a challenge for risk management associated with severe weather. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. The science for linking the severity of specific severe weather events to climate change is still evolving; however, a number of trends have been recorded that indicate how climate change may be impacting these events. According to the U.S. National Climate Change Assessment (2014), there were more than twice as many high temperature records as low temperatures records broken between 2001 and 2012, and heavy rainfall events are becoming more frequent and more severe.

The 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. According to information on Cal-Adapt provided above, extreme heat days are likely to increase in the planning area.

Climate change impacts on other severe weather events such as thunderstorms and high winds are still not well understood.

Exposure, Sensitivity and Vulnerability

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, 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 disruption to service provision. 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 stress on already stressed systems.

Economy

Climate change impacts on the severe weather hazard may impact the local economy through more frequent disruption to services, such as power outages.

13.2.7 Wildfire

Climate Change 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.

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.

Exposure, Sensitivity and Vulnerability

Population

According to Cal-Adapt projections, wildfire risk in the vicinity of the planning area may actually decrease over the next century. Other areas of California and the western United States are expected to have increased risk to wildfire, with increases in annual acres burned. Although planning area residents may not experience increased risk to wildfire directly, secondary impacts, such as poor air quality may increase.

Property and Critical Facilities

If wildfire risk decreases, the exposure and vulnerability of property and critical facilities would remain the same.

Environment

It is possible that the exposure and vulnerability of the environment will be impacted by changes in wildfire risk due to climate change. Natural fire regimes may change, resulting in more or less frequent or higher intensity burns. These impacts may alter the composition of the ecosystems in areas in and surrounding planning area.

Economy

As the risk from wildfire is currently projected to decrease, direct impacts on the economy would not be likely.

13.3 ISSUES

The major issues for climate change are the following:

- Planning for climate change related impacts can be difficult due to the inherent uncertainty in projected future impacts.
- Average temperatures are expected to continue to increase in the planning area, which may lead to a host of primary and secondary impacts, such as an increased incidence of heat waves.
- Expected changes in precipitation patterns are poorly understood and could have significant impacts on the water supply and flooding in the planning area.
- Some impacts of climate change are poorly understood, such as potential impacts on the frequency and severity of earthquakes and thunderstorms.
- Atmospheric river events may result in stormwater flooding after stormwater management systems are overwhelmed.

14. PUBLIC HEALTH EMERGENCY

14.1 GENERAL BACKGROUND

An outbreak or an epidemic exists when there are more cases of a particular disease than expected in a given area, or among a specific group of people, over a particular period of time. In an outbreak or epidemic, it is presumed that the cases are related to one another or that they have a common cause (CDC, 2011). This chapter describes commonly recognized public health hazards that are a concern to the planning area.

DEFINITIONS

Epidemic—The spread of an infectious disease beyond a local population, reaching people in a wider geographical area. Several factors determine whether an outbreak will become an epidemic: the ease with which the disease spreads from vectors, such as animals, to people and the ease with which it spreads from person to person.

Influenza—A viral infection that attacks the respiratory system; commonly called flu.

Infectious diseases—Diseases caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi, that can be spread, directly or indirectly, from one person to another.

Pandemic—A worldwide epidemic.

Vector—An organism (such as an insect or rodent) that transmits pathogens that cause disease

Vector-borne illness—Diseases transmitted to people from insects and other animals. These include, but are not limited to, Hanta Virus, Plague, Tularemia, Lyme Disease, West Nile Virus and the Zika Virus.

Zoonotic diseases—Infectious diseases of animals that can cause disease when transmitted to humans.

14.1.1 Vector-Borne

Tick-Borne Illnesses

Ticks are small, insect-like creatures most often found in naturally vegetated areas. They feed by attaching to animals and humans, sticking their mouthparts into the skin, and sucking blood for up to several days. Ticks do not fall from trees, jump or fly. Most species are found on wild grasses and low plants. Adult ticks wait at the ends of grass or other foliage for a host to brush by so they may attach. Sometimes ticks carry bacteria or viruses that can be transmitted to a person while the tick is attached and feeding. There are 47 species of ticks in California, but only eight are known to commonly bite humans:

- Western blacklegged tick (*Ixodes pacificus*)
- American dog tick (*Dermacentor variabilis*)
- Pacific Coast tick (*Dermacentor occidentalis*)
- Wood tick (*Dermacentor andersoni*)
- Brown dog tick (*Rhipicephalus sanguineus*)
- *Ornithodoros hermsi*
- *Ornithodoros parkeri*
- *Ornithodoros coriaceus.*

Tularemia

Tularemia, named after Tulare County in California where it was first described in 1911, is a tick-borne disease of animals and humans caused by the bacterium *Francisella tularensis*. Tularemia is similar to plague, but is typically spread differently. While plague is usually spread to humans by fleas, humans usually become infected with Tularemia by tick and deer fly bites, skin contact with infected animals, ingestion of contaminated water or meat, or inhalation of contaminated dusts or aerosols. Symptoms vary depending upon the route of infection.

Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks. Although Tularemia can be life-threatening, most infections can be treated successfully with antibiotics. Steps to prevent Tularemia include use of insect repellent, wearing gloves when handling sick or dead animals, and not mowing over dead animals. Naturally occurring infections have been reported in all U.S. states except Hawaii.

Lyme Disease

Lyme disease, named after the city in Connecticut where it was first identified in 1975, is a tick-borne disease caused by the bacterium *Borrelia burgdorferi,* which normally lives in mice, squirrels and other small animals. It is transmitted among these animals and to humans through the bites of certain species of ticks. In the northeastern and north-central United States, the black-legged tick (or deer tick, *Ixodes scapularis*) transmits Lyme disease. In the Pacific coastal United States, the disease is spread by the western black-legged tick (*Ixodes pacificus*). Other major tick species found in the United States have not been shown to transmit the disease.

Typical symptoms include fever, headache, fatigue, and a skin rash. If left untreated, infection can spread to joints, the heart, and the nervous system. Lyme disease is diagnosed based on symptoms, physical findings (e.g., rash), and the possibility of exposure to infected ticks. Laboratory testing is helpful in later stages of the disease. Most cases of Lyme disease can be treated successfully with a few weeks of antibiotics. Steps to prevent Lyme disease include using insect repellent, removing ticks promptly, landscaping, and integrated pest management. The ticks that transmit Lyme disease can occasionally transmit other tick-borne diseases as well.

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is a potentially fatal tick-borne disease caused by the bacterium *Rickettsia rickettsii*. It is transmitted to humans by the bite of an infected American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick (*Dermacentor andersoni*), or brown dog tick (*Rhipicephalus sanguineus).*

Typical symptoms include fever, headache, abdominal pain, vomiting, and muscle pain. A rash may also develop, but is often absent in the first few days, and in some patients, never develops. Rocky Mountain spotted fever can be a severe or even fatal illness if not treated in the first few days of symptoms. It can be treated successfully with a few weeks of antibiotics. Steps to prevent the disease include using insect repellent, removing ticks promptly, landscaping, and integrated pest management. The ticks that transmit Rocky Mountain spotted fever can occasionally transmit other tick-borne diseases as well.

Mosquito-Borne Illnesses

Mosquito-borne diseases are diseases that are spread through the bite of an infected female mosquito. There are approximately 48 species of mosquitos in California that can carry disease. West Nile Virus and Zika Virus are a concern for the planning area and described below.

West Nile Virus

West Nile virus (WNV) is a potentially serious mosquito-borne disease that may affect residents in the planning area. Experts believe WNV is established as a seasonal epidemic in North America that flares up in the summer and continues into the fall. As of January 2017, human-infection cases of the virus had been reported in all states of the continental U.S. except Maine; Delaware and New Hampshire reported only non-human infections.

According to the Centers for Disease Control and Prevention (CDC), about 80 percent of people infected with WNV show no symptoms. The remainder have symptoms such as fever, headache, and body aches, nausea, vomiting, and sometimes swollen lymph glands or a skin rash on the chest, stomach and back. Symptoms can last for as short as a few days, though even healthy people have become sick for several weeks. About 1 percent of people infected with WNV will develop severe illness, with symptoms that can include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. These symptoms may last several weeks, and neurological effects may become permanent. There is no specific treatment for WNV infection. In more severe cases, people may need to go to the hospital where they can receive supportive treatment including intravenous fluids, help with breathing and nursing care.

WNV is a recent disease to affect California. Mosquitoes transmit the virus to birds, livestock and humans. WNV season is between June and November in the planning area. During WNV season, Alameda County's mosquito abatement program works to limit risks to residents by monitoring ponds and other possible mosquito breeding sites; trapping to detect high numbers of mosquitoes; treating sewer catch-basins to prevent breeding; collecting birds for testing; and educating residents and owners about removing standing water from private property to limit mosquito breeding and mosquito bites (Alameda County Public Health Department, 2017).

Zika Virus

Zika is a mosquito-borne disease transmitted by yellow fever mosquito (*Aedes aegypti)* and the Asian tiger mosquito *(Aedes albopictus)*. An *Aedes* mosquito can only transmit Zika virus after it bites a person who has this virus in their blood. The most common symptoms of Zika are fever, rash, joint pain, and conjunctivitis (red eyes). The illness is usually mild, with symptoms lasting for several days to a week after being bitten by an infected mosquito. People usually do not get sick enough to go to the hospital, and they rarely die of Zika. For this reason, many people might not realize they have been infected. However, Zika virus infection during pregnancy can cause a serious birth defect called microcephaly (abnormally small head and brain), as well as other severe fetal brain defects. Once a person has been infected, he or she is likely to be protected from future infections. Zika virus is not spread through casual contact, but can be spread by infected men to their sexual partners. There is a growing association between Zika and Guillain-Barré Syndrome, a disease affecting the nervous system.

The mosquitos that carry Zika are not native to California, but infestations have been reported in multiple counties in California, but not in Alameda County or the Tri-Valley planning area (CDPH, 2017). Thus far in California, Zika virus infections have been documented only in people who were infected while traveling outside the United States or through sexual contact with an infected traveler. From 2015 to the publishing of this document there has been no local mosquito-borne transmission of Zika virus in California.

14.1.2 Infectious Diseases

Influenza

Influenza, commonly called flu, is a viral infection that attacks the respiratory system. This disease is capable of claiming thousands of lives and adversely affecting critical infrastructure and key resources. An influenza pandemic has the ability to reduce the health, safety, and welfare of the essential services workforce; immobilize core infrastructure; and induce fiscal instability. The risk of a global influenza pandemic has increased over the last several years.

Pandemic influenza is different from seasonal influenza (or "the flu") because outbreaks of seasonal flu are caused by viruses that are already among people. Pandemic influenza is caused by an influenza virus that is new to people and is likely to affect many more people than seasonal influenza. In addition, seasonal flu occurs every year, usually during the winter season, while the timing of an influenza pandemic is difficult to predict. Pandemic influenza is likely to affect more people than the seasonal flu, including young adults. A severe pandemic could change daily life for a time, including limitations on travel and public gatherings.

The CDC's Influenza Division of the Centers for Disease Control and Prevention supports the World Health Organization's global network of National Influenza Centers (NIC). The Influenza Division also conducts epidemiologic research, including vaccine studies and serologic assays and provides international outbreak investigation assistance (CDC, 2011).

Seasonal Influenza

Seasonal epidemics of the flu typically occur in the fall and winter. The CDC estimates that the 2015-2016 flu season for California was moderate compared to previous years; however, more influenza-associated deaths were reported than the 2014-2015 season. Laboratory-confirmed influenza-associated deaths among patients under 65 have been reportable in California since the 2009 influenza pandemic. For the 2015-2016 flu season, there were 144 fatal cases of influenza-related illness statewide among those under 65, well below the 404 fatal cases during the 2013-2014 influenza season (CDPH, 2017).

Swine Flu (H1N1)

In April 2009, the World Health Organization (WHO) issued a health advisory on an outbreak of influenza-like illness caused by a new subtype of influenza A (A/H1N1) in Mexico and the United States. The disease spread rapidly, with the number of confirmed cases rising to 2,099 by May 7, despite aggressive measures taken against the disease by the Mexican government. On June 11, the WHO declared an H1N1 pandemic, marking the first global pandemic since the 1968 Hong Kong flu. On October 25, the U.S. declared H1N1 a national emergency. On August 10, 2010, the WHO declared an end to the 2009 H1N1 pandemic globally. The pandemic was mild compared to the Spanish Flu pandemic of 1918, which caused 100 million deaths worldwide—a total of 3 percent of the world’s total population.

H1N1 viruses and seasonal influenza viruses are co-circulating in many parts of the world. It is likely that the 2009 H1N1 virus will continue to spread for years to come, like a regular seasonal influenza virus.

Avian Flu (H5N1/H7N9)

The highly pathogenic H5N1 avian influenza virus is an influenza A subtype that occurs mainly in birds, causing high mortality among birds and domestic poultry. Outbreaks of highly pathogenic H5N1 among poultry and wild birds are ongoing in a number of countries such as Cambodia, China, Indonesia, Thailand, and Vietnam.

H5N1 virus infections of humans are rare and most cases have been associated with direct poultry contact during poultry outbreaks. Rare cases of limited human-to-human spread of H5N1 virus may have occurred, but there is no evidence of sustained human-to-human transmission. Nonetheless, because all influenza viruses have the ability to change and mutate, scientists are concerned that H5N1 viruses one day could be able to infect humans more easily and spread more easily from one person to another, potentially causing another pandemic.

While the H5N1 virus does not now infect people easily, infection in humans is much more serious when it occurs than is infection with H1N1. More than half of people reported infected with H5N1 have died.

Infections in humans and poultry by a new avian influenza A virus (H7N9) continue to be reported in China. While mild illness in human cases has been seen, most patients have had severe respiratory illness and some have died. The only case identified outside of China was recently reported in Malaysia. Source investigation by Chinese authorities is ongoing. Many of the people infected with H7N9 are reported to have had contact with poultry. However, some cases reportedly have not had such contact. Close contacts of confirmed H7N9 patients are being followed to determine whether any human-to-human spread of H7N9 is occurring. No sustained person-to-person spread of the H7N9 virus has been found at this time. However, based on previous experience with avian flu viruses, some limited human-to-human spread of this the virus would not be surprising.

As of the publication of this document, H5N1 and the new H7N9 virus have not been detected in people or birds in the United States.

Viral Hemorrhagic Fevers

Viral hemorrhagic fevers (VHFs) are a group of illnesses caused by four families of viruses (Ebola, Marburg, Lassa fever, and yellow fever). VHF describes a multisystem syndrome (multiple systems in the body are affected). Characteristically, the overall vascular system is damaged and the body’s ability to regulate itself is impaired. These symptoms are often accompanied by hemorrhage (bleeding); however, the bleeding itself is rarely life-threatening. While some types of hemorrhagic fever viruses can cause relatively mild illnesses, many cause severe, life-threatening disease.

The viruses that cause VHFs are distributed over much of the globe. However, because each virus is associated with one or more particular host species, the virus and the disease it causes are usually seen only where the host species live. Some hosts, such as the rodent species carrying several of the New World arenaviruses, live in geographically restricted areas. Therefore, the risk of getting VHFs caused by these viruses is restricted to those areas. Other hosts range over continents, such as the rodents that carry viruses that cause the hantavirus pulmonary syndrome in North and South America, or the rodents that carry viruses that cause hemorrhagic fever with renal syndrome in Europe and Asia.

The only VHF discussed in detail for this hazard mitigation plan is Ebola.

Ebola

The 2014 Ebola virus outbreak was unprecedented in geographical reach and impact on health care systems across the globe. This was the largest and deadliest Ebola virus outbreak ever recorded. It was the first time the West African countries of Guinea, Liberia, Sierra Leone, Nigeria, Mali, and Senegal saw the virus. Ebola is more common in Central African countries, such as the Democratic Republic of Congo and Sudan, where it was first discovered in 1976. It was also the first time that Ebola made it to the United States and Europe, prompting world-wide preparedness and response efforts. Figure 14-1 shows areas that ultimately were affected. The outbreak was closely monitored and traveler screenings were developed for those returning from West Africa.

Source: World Health Organization

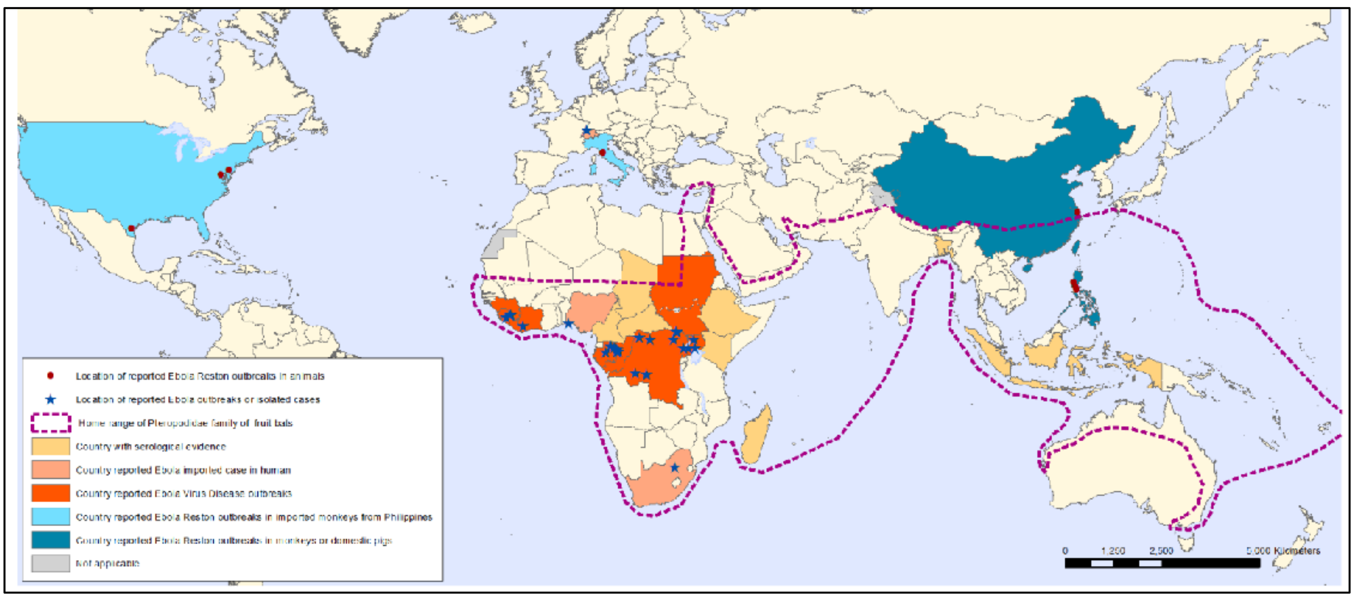


Figure 14-1. 2014 Distribution of Ebola Virus Outbreaks in Humans and Animals

In August 2014, two U.S. healthcare workers returned to the United States for treatment for Ebola. The case that most impacted the health care system in the United States was a patient diagnosed with Ebola in Dallas, Texas who died due to Ebola in October 2014. The nurse who provided care for him later tested positive for Ebola. This caused responses across the country from hospitals, emergency medical teams, fire departments and public health agencies to enhance isolation precautions, develop emergency policies, train with personal protective equipment and conduct multi-agency emergency exercises in case the spread of Ebola became a pandemic.

Before the 2014 outbreak, only 2,200 cases of Ebola had been recorded and 68 percent were fatal. Twenty percent of new Ebola infections were linked to burial traditions in which family and community members wash and touch dead bodies before burial. In Guinea, 60 percent of Ebola infections were linked to traditional burial practices. As of the date of this plan, there have been no reported Ebola cases in California.

Enterovirus

Non-polio enteroviruses are very common. There are more than 100 non-polio enteroviruses. One of the more common types is Enterovirus D68 (EV-D68). First identified in California in 1962, it causes about 10 to 15 million infections and tens of thousands of hospitalizations each year in the United States. Most people who get infected with this virus do not get sick or they only have mild illness, like the common cold. This virus spreads from person-to-person when an infected person coughs, sneezes, or touches a surface that is then touched by others (CDC, 2016).

In the summer and fall of 2014, the United States experienced a nationwide outbreak of EV-D68 associated with severe respiratory illness. From mid-August 2014 to January 15, 2015, 1,153 people in 49 states and the District of Columbia were diagnosed with respiratory illness caused by EV-D68. Almost all of the confirmed cases were among children, many of whom had asthma or a history of wheezing. There likely were many thousands of mild EV-D68 infections for which people did not seek medical treatment/or get tested (CDC, 2016a).

Norovirus

Norovirus is a highly contagious virus that causes acute gastroenteritis (inflammation of the stomach and intestines). It can spread quickly in closed and crowded environments such as hospitals, nursing homes, daycare centers, schools and cruise ships. Norovirus is the most common cause of acute gastroenteritis in the United States. Every year, it causes an estimated 19 to 21 million cases of acute gastroenteritis. While it is possible to become infected with norovirus year-round, norovirus infection happens most often from November to April. There can be a higher incidence of norovirus illnesses in years when a new strain of the virus is going around (CDPH, 2016).

Norovirus is found in the feces and vomit of infected people and can spread easily from person to person. People can become infected in several ways, including:

- Having direct contact with another person who is infected (for example, caring for or sharing foods or eating utensils with someone who is ill)
- Eating food or drinking liquids contaminated with norovirus, such as food touched by an ill food handler or undercooked seafood that has been harvested from contaminated waters
- Touching contaminated surfaces or objects and then touching the mouth before hand washing.

The CDPH and local health departments monitor norovirus outbreaks. Although healthcare providers are not required to report individual cases of norovirus to the local health department, outbreaks are reportable. When outbreaks are reported, CDPH and local health departments investigate to confirm and identify the strain of norovirus, find the cause of the outbreak, prevent further infections, and educate the public (CDPH, 2016).

14.2 HAZARD PROFILE

The severity of human health hazards is dependent upon the hazard and the population exposed to it. As the population increases, so does the risk of exposure to hazards. The key to reducing the disease hazard is isolation so that the exposed population does not continue to spread the hazard to the uninfected population. For disease and weather-related human health hazards, promoting education and personal preparedness will help to mitigate and reduce the severity of the hazard.

14.2.1 Past Events

Vector-Borne

The following is a summary of recent vector-borne disease outbreak events:

- In Alameda County, between 2006 and 2015, there were 35 confirmed cases of Lyme disease and six reported cases of West Nile Virus (CDPH, 2015).
- As of September 16, 2016, 18 Zika cases were reported in Alameda County, all from returning travelers.

Infectious Diseases

- In the United States during the 2009 H1N1 influenza pandemic, there were 60 million confirmed cases of the disease, 270,000 people hospitalized due to the illness and 12,000 deaths. In California, there were 4,134 people hospitalized due to the illness and 596 deaths. In Alameda County, there were 243 confirmed cases, with 29 deaths (CDPH, 2011).
- The most recent data for influenza in the State of California is for the 2015-2016 flu season. The CDPH recorded 144 fatal and 355 non-fatal ICU cases of influenza. In Alameda County, there were 5 fatal and 19 non-fatal ICU cases recorded for the same period. Overall, the influenza season was more moderate than the previous three seasons (CDPH, 2016a).
- California was impacted by the Enterovirus D68 outbreak in 2014. By October 2014, there were 32 reported cases in the state. Two of those cases were reported in Alameda County (Seipel, 2014).
- In 2015, California experienced a norovirus outbreak. Between October and December, there were 32 confirmed cases of norovirus (CDPH, 2015).

14.2.2 Location

All of the planning area is susceptible to the human health hazards discussed in this chapter. While some hazards, such as Lyme disease, can have a geographic presence within the planning area, other diseases can cause exposure to the planning area from outside the local region. Planning area residents who travel can become exposed to diseases while abroad and bring the diseases back with them, potentially placing the region at risk for exposure. Extreme weather poses an equal human health hazard across the planning area.

14.2.3 Frequency

Predicting the future occurrences of disease outbreaks is difficult; however, based on the history of past occurrences, it is likely that the planning area will be impacted in the future. An increase in population and population density in the planning area have the potential to increase residents' exposure and susceptibility to outbreaks. Infected mosquitos and ticks will continue to inhabit and impact the planning area.

14.2.4 Severity

The severity of the human health hazard varies from individual to individual. Typically, young children and older adults are more susceptible to acquiring communicable diseases due to developing or diminishing immune systems. These populations often experience the most severe of symptoms, as their immune systems are not capable of fighting off infection or efficiently regulating temperature. In general, severity varies depending on the pathology of the disease, the health of the infected, and the availability of treatments for alleviating symptoms or curing the disease.

14.3 SECONDARY HAZARDS

The largest secondary impact caused by human health hazards is economic. Large outbreaks of any human health hazard could reduce the work force significantly, causing businesses and agencies to close or be greatly impacted.

Another secondary impact is stigmatization. The fear of the human health hazard and fear of the unknown can lead to isolation, violence and self-inflicted injury. Hospitals and health care providers can be overwhelmed with the “worried well” seeking care and comfort. Providing key and critical information can reduce and mitigate this secondary risk.

14.4 EXPOSURE AND VULNERABILITY

14.4.1 Population

All citizens in the planning area could be susceptible to the human health hazards discussed in this chapter. A large outbreak or epidemic, a pandemic or a use of biological agents as a weapon of mass destruction could have devastating effects on the population of the planning area. The young and the elderly, those with compromised immune systems, and those with specialized medical needs are considered the most vulnerable.

14.4.2 Property

None of the health hazards discussed in this chapter would have significant measurable impact on the structural environment or property of the planning area.

14.4.3 Critical Facilities and Infrastructure

None of the health hazards discussed in this chapter would have significant measurable impact on the critical facilities or infrastructure of the planning area.

14.4.4 Environment

None of the health hazards discussed in this chapter would have significant measurable impact on the environment of the planning area. While many of the vectors of the health hazards discussed in this chapter rely on local or regional environments for their survival, the human health hazard that they carry or potentially transmit would have no significant measurable impact on the environment.

14.4.5 Economy

The economic impact of a human health hazard could be localized to a single region or population, or could be widespread. The impact could be significant, depending on the hazard, number of cases and the availability of resources to care for those affected by the hazard. Other financial impacts could be absorbed or managed by the organization affected.

14.5 FUTURE TRENDS IN DEVELOPMENT

The potential for communicable diseases, vector-borne diseases or extreme weather in the planning area is not likely to lessen or prohibit growth or development.

14.6 SCENARIO

A worst-case human health scenario for the planning area would be an epidemic or large-scale incident of any of the human health hazards discussed in this chapter. Medical treatment facilities in the planning area would be overwhelmed and taxed beyond their capabilities as the numbers of patients escalates. Impacts on the work force could have acute and long-term economic impacts on the planning area's primary employers. First responders would be exposed to the human health hazards, which could deplete the medical work force and could have profound impact on the potential escalation of the scenario.

14.7 ISSUES

Important issues associated with the human health hazards include but are not limited to the following:

- Prevention through vaccination and personal emergency and disaster preparation will help to reduce the impacts of human health hazards.
- Medical and response personnel need to be integrated in a unified command to provide care when needed in response to human health hazards.
- Medical and response personnel must be adequately trained and supplied.
- Up-to-date and functional all-hazard contingency planning should be carried out.
- A system needs to be in place to inform the public with a unified message about the human health hazard.
- Health agencies and facilities require surge capacity management and adaptation to the rising number and needs of the region.

15. HUMAN-CAUSED HAZARDS

15.1 GENERAL BACKGROUND

Although the DMA does not require an assessment of human-caused hazards, this plan includes human-caused hazards for the following reasons:

- The planning partners take a proactive approach to disaster preparedness in order to protect the public safety of all citizens.
- Preparation for and response to a human-caused disaster will involve much of the same staff training, critical decision-making, and commitment of resources as for a natural hazard.
- The hazard mitigation planning effort is an opportunity to inform the public about all hazards, including human-caused hazards.
- The likelihood of a human-caused hazard in the planning area is greater than several of the identified natural hazards in this plan.

Human-caused hazards fall into the following categories:

- Intentional, criminal, malicious acts, including acts of terrorism, cyber threats, civil unrest, riots, and active threats.
- Technological incidents that arise accidentally from human activities such as the manufacture, transportation, storage and use of hazardous materials; pipeline failure and release; and transportation.

DEFINITIONS

Active threats—Shootings, secondary explosives, and/or chemical or biological threats.

Acts of terrorism—The unlawful use or threatened use of force or violence against people or property with the intention of intimidating or coercing societies or governments. Terrorism is either foreign or domestic, depending on the origin, base, and objectives of the terrorist or organization.

Civil unrest—Groups of people purposely choosing not to observe a law, regulation or rule, usually to bring attention to a cause, concern or agenda.

Cyber threat—An intentional and malicious action to compromise the digital infrastructure of a person or organization, often for financial or terror-related reasons.

Hazardous material—A substance or combination of substances that, because of quantity, concentration, physical, chemical, or infectious characteristics, may cause or contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, or pose a present or potential hazard to human life, property, or the environment.

Technological hazards—Hazards from accidents associated with human activities such as the manufacture, transportation, storage and use of hazardous materials.

Weapons of mass destruction—Chemical, biological, radiological, nuclear, and explosive weapons associated with terrorism.

15.1.1 Intentional Hazards

In dealing with intentional human-caused hazards, 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.

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 must react to the incident, locate, isolate and neutralize further damage, and conduct investigate to bring criminals to justice.

Terrorism

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

- Domestic terrorism involves groups or individuals acting without foreign direction against the government or population, such as the 1995 bombing of the Alfred P. Murrah federal building in Oklahoma City. The FBI is the primary response agency for domestic terrorism. The FBI coordinates domestic preparedness activities of the United States to limit acts posed by terrorists.
- International terrorism involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the United States, or whose activities transcend national boundaries. Examples include the 1997 bombing of Mobil Oil's headquarters, the 1983 bombing of the U.S. Capitol, the 1993 bombing of the World Trade Center, and the September 11, 2001 attacks at the World Trade Center and the Pentagon.

The three key elements to defining a terrorist event are as follows:

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

Terrorism evokes strong emotional reactions, ranging from anxiety to fear to anger to depression. Those involved with terrorism response are trained to deal with the public's emotional reaction swiftly as response to the event occurs. 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, thereby reducing service to those actually affected. The public will 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.

Terrorism involves the use of weapons of mass destruction, including biological, chemical, nuclear and radiological weapons; arson, incendiary, explosive and armed attacks; industrial sabotage and intentional hazardous materials releases; agro-terrorism; and cyberterrorism (FEMA 386-7). 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. The following are potential methods used by terrorists that could affect the Alameda County and the planning area as a direct target or collaterally:

- Conventional bomb
- Biological agent
- Chemical agent
- Nuclear bomb
- Radiological agent
- Arson/incendiary attack
- Armed attack
- Cyber-terrorism
- Agro-terrorism
- Intentional hazardous material release.

Table 15-1 provides a hazard profile summary for terrorism-related hazards. Most terrorist events in the United States have been bombing attacks, involving detonated or undetonated explosive devices, tear gas, pipe bombs, and 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. Terrorist acts 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.

Table 15-1. 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 clear.	Extent of damage is determined by type and quantity of explosive. Effects generally static other than cascading consequences, incremental structural failure, etc.	Over-pressure at a given location is inversely proportional to the cube of the distance from the blast; thus, each extra length of distance provides progressively more protection. Terrain, forestation, structures, etc. can absorb and/or deflect 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 dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/ containers; or munitions.	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 incremental structural failure, etc.	Mitigation includes fire detection and protection systems and fire-resistive construction. 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 or failure to maintain fire protection systems can increase the effectiveness of a fire weapon.
Armed Attack	Tactical assault or sniping from remote location, or random attack in response to 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.
Radiological Agent	Radioactive contaminants dispersed using sprayers/ aerosol generators, or by point or line sources such as munitions.	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.

Hazard	Application Mode[a]	Hazard Duration[b]	Static/Dynamic Characteristics[c]	Mitigating and Exacerbating Conditions[d]
Biological Agent	Liquid or solid contaminants dispersed with sprayers or by point or line sources such as munitions, covert deposits, and moving sprayers.	Hours to years, depending on the agent and the conditions in which it exists.	Contamination can be spread via wind and water, depending on the agent used and the effectiveness with which it is deployed. Infection can spread via humans or animals.	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.
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.
Nuclear Bomb	Detonation of nuclear device underground, at the surface, in the air, or at high altitude.	Light/heat flash and shock wave last for seconds; radiation and fallout can last 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 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.	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.

a. Application Mode—The human acts or unintended events necessary to cause the hazard to occur.

b. Duration—The length of time the hazard is present. For example, the duration of a tornado may be just minutes, but 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—The tendency of a hazard or its effects to expand, contract, or remain confined in time, magnitude, and space. For example, the physical destruction caused by an earthquake is generally confined to the place in which it occurs, and it does not usually get worse unless aftershocks or other cascading failures occur; in contrast, 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. Mitigating and Exacerbating Conditions—Mitigating conditions are 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. In contrast, exacerbating conditions are 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.

Source: FEMA 386-7 (2003a)

The effects of terrorism can include injuries, loss of life, property damage, or disruption of services such as electricity, water supplies, transportation, or communications. Effects may be immediate or delayed. 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.

In dealing with terrorism, the unpredictability of human beings must be considered. People with a desire to perform such acts may seek out targets of opportunity that do not fall into established lists of critical areas or facilities. First responders train to respond not only to organized terrorism events, but also to random acts by individuals who, for a variety of reasons—ranging from fear to emotional trauma to mental instability—choose to harm others and destroy property. While education, heightened awareness, and early warning of unusual circumstances may deter terrorism, intentional acts that harm people and property are possible at any time. Public safety entities must react to the threat, locating, isolating, and neutralizing further damage and investigating potential scenes and suspects to bring criminals to justice.

Active Threats

Active threats may include active shootings, secondary explosives, and/or chemical or biological threats.

Active Shooter

Active shooter attacks are typically motivated by the desire to maximize human casualties. They are differentiated from other attack types by the indiscriminate nature of the victim's targets of opportunity rather than actions directed toward a specific target. Active shooter attacks have evolved over the last decade ranging from "lone wolf" shooters who act alone and without any organizational affiliation to organized groups acting in concert to achieve a specific objective. Current active shooter threat force tactics commonly employ a blend of lone shooters and multi-person teams as part of a larger assault.

Active shooters may use small arms, light weapons, or a combination of the two depending on the type of attack. Small arms refers to revolvers, automatic pistols, rifles, shotguns, assault rifles, light machine guns, etc. Light weapons refer to medium caliber and explosive ordinance, grenade launchers, rocket propelled grenades, etc. With additional planning and preparation, attackers can increase their likelihood of success in also including a wider array of weapons, to include improvised explosive devices.

Biological Threats

Biological hazards include disease-causing microorganisms and pathogens, such as bacteria and viruses. The distinguishing characteristic of these substances is their ability to multiply within a host and cause an infection. Some bacteria and viruses can spread from one individual to another. Infections typically occur as a result of airborne exposure, skin contact, or ingestion. In general, exposure to bacteria and viruses can occur through inhalation (as is the case with airborne *B. anthracis* spores, which cause anthrax), ingestion of contaminated food or water (the case with *E. coli*, which causes gastrointestinal infection), contact with infected individuals, or contact with contaminated surfaces (which may be harboring, for example, viruses that cause influenza). As a result, domestic and transnational threat groups have considered targeting heating, ventilation, and air conditioning systems of large commercial buildings.

Anthrax has been used as a weapon for nearly 100 years and is one of the most likely agents to be used in a biological threat. Its spores are easily found in nature, can be produced in a lab, and can last for a long time. It can be released quietly and without anyone knowing. Microscopic spores can be put into powders, sprays, food, and water. Due to their size, one may not be able to see, smell or taste them (CDC, 2016b). Terrorists may release anthrax spores in public places. In 2001, letters containing powdered anthrax spores were sent through the U.S. mail, causing skin and lung anthrax in 22 people. Five people died, all due to lung anthrax.

If a biological attack were to occur within the planning area, a large number of personnel could be impacted. Buildings in the impacted area and transportation infrastructure might be closed for investigation and cleanup. These areas would not be accessible until cleanup is completed, which would impact the businesses. Hospitals could become overwhelmed with people coming in fearing contamination. Residents and businesses may need to shelter in place in the area of the attack.

Chemical Threats

Chemical weapons are often classified according to their effect on the body, based on the primary organ system affected by exposure. They are poisonous vapors, aerosols, liquids, and solids that have toxic effects on humans, animals, and plants. Exposure pathways include inhalation, skin contact, ingestion or injection. Depending on the severity of exposure, impacts may include temporary illness or injury, permanent medical conditions, or death. An attack using chemical threats can come without warning. Signs of a chemical release include difficulty breathing; eye irritation; losing coordination; nausea; or a burning sensation in the nose, throat and lungs (Ready.gov, 2016). Harmful chemicals that could be used in an attack include the following:

- Chemical weapons developed for military use (warfare agents)
- Toxic industrial and commercial chemicals that are produced, transported, and stored in the making of petroleum, textiles, plastics, fertilizers, paper, foods, pesticides, household cleaners, and other products
- Chemical toxins of biological origin such as ricin (U.S. Department of Homeland Security, 2004).

There have been reports of chlorine found in explosive devices, mortars, rockets, and missiles. Chlorine has been used in the past, mainly in blunt, terrorist-style attacks. Some experts believe that groups are trying to advance their technology for deploying the chemical in combat operations (Tilghman, 2015). Chlorine is an acutely toxic industrial compound that can cause severe coughing, pulmonary, eye and skin irritation, and even death at higher concentrations (USACHPPM, 2015).

A chemical release in the planning area could lead to closed down streets and major transportation routes (including bridges) for extended periods of time, causing transportation delays and traffic. Many homes and businesses would also be impacted as they would need to be evacuated for an extended period of time. There could also be impact on the environment and/or natural resources that would require cleanup. Hazardous material response teams and fire-rescue would be needed to respond to the incident and coordinate cleanup efforts.

Explosive Devices

Improvised explosive device (IED) attacks are the favored method of terrorist groups around the world. The evolution in explosive materials, firing devices, and their ease of concealment and delivery has increased the effectiveness of this hazard. IED attacks are typically motivated by the desire to maximize human casualties. Explosive incidents account for 70 percent of all terrorist attacks worldwide. These types of attacks range from small-scale letter bombs to large- scale attacks on specific buildings. According to the FBI, 172 improvised explosive devices were reported in the United States between October 2012 and April 2013.

IEDs generally consist of TNT equivalent explosives (e.g. black or smokeless powder) in a container (e.g. galvanized pipe, paint can, etc.). These propellants are easily purchased on the commercial market. IEDs may also contain added shrapnel to induce greater casualties or shaped charges that direct the force of the explosive towards the target. Devices may be hidden in everyday objects such as briefcases, flowerpots or garbage cans, or on the person of the attacker in the case of suicide bombers. The most commonly used container is galvanized pipe, followed by PVC pipe. When shrapnel is added to the device, the type of shrapnel varies; BBs and other small pieces of hardware are common, as is glass or gravel.

An attack using IEDs or other explosive devices within the planning area has potential large-scale consequences that may require multi-agency and multi-jurisdictional coordination. Depending on the location of the attack, businesses and other venues may be closed for investigation and due to damage. If the attack occurred in or near residences, evacuations and/or sheltering may occur.

Fire as a Weapon

The use of fire for criminal, gang, and terrorist activities, as well as targeting first responders, is not new. The World Health Organization estimates that 195,000 people die each year from fire, while according to the Global Terrorism Database an average of 7,258 people die annually from terrorism, and that includes deaths in conflict zones such as Afghanistan and Iraq (Stewart, 2013).

Cyber Threats

A cyber threat 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 threats become increasingly frequent and destructive.

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, organization, and nation.

Cyber-Attacks

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 computer security measures designed to protect an individual or organization. The initial attack is followed by more severe attacks for the purpose of causing harm, stealing data, or financial gain. Organizations are prone to different types of attacks that can be either automated or targeted in nature. Table 15-2 describes the most common cyber-attack mechanisms faced by organizations today.

With millions of threats created each day, the importance of protection against cyber-attacks becomes a necessary function of everyday operations for individuals, government facilities, and businesses. The increasing dependency on technology for vital information storage and the often automated method of infection means higher stakes for the success of measurable protection and education. Cyber-attacks may lead to widespread business interruptions and likely considerable repair and response costs. A cyber-attack could cause sewage pump stations to fail, which could result in contaminated beaches, unsanitary conditions and/or potentially unsafe water supply.

Since 2013, a new type of cyber-attack is becoming increasingly common against individuals and small- and medium-sized organizations. This attack is called cyber ransom. Cyber ransom 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 (Figure 15-1). In October 2015, the FBI said that commonly used ransomware is so difficult to override, that victims should pay the ransom to retrieve their data (Danielson, 2015).

Table 15-2. Common Mechanisms for Cyber-attacks

Type	Description
Socially Engineered Trojans	Programs designed to mimic legitimate processes (e.g. updating software, running antivirus software). 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.
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.
Password Attacks	Third party attempts to crack a user's password and 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.
Drive-by Downloads	Malware is downloaded unknowingly by the victims when they visit an infected site.
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.
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.
Malvertising	Malware downloaded to a system when the victim clicks on an affected ad.
Advanced Persistent Threat	An attack in which the attacker gains access to a network and remains undetected. Advanced Persistent Threat attacks are designed to steal data instead of cause damage.

Source: Danielson, 2015

Figure 15-1. Pop-Up Message Indicating Ransomware Infection

If an attack were to occur that impacted the planning area, multi-jurisdictional response would need to be coordinated, in accordance with local and county emergency operations plans. To reduce the planning area's vulnerability, cyber security should be improved by providing network defense intelligence and conducting regular evaluations of network security posture and readiness. Additionally, the planning area should provide education on cyber threats and cyber-attack measurements.

Cyberterrorism

Cyberterrorism 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, cyberterrorism seeks to evoke very strong emotional reactions, but it does so through information technology rather than a physically violent or disruptive action. Cyberterrorism has three main types of objectives (Kostadinov, 2012):

- **Organizational**—Cyberterrorism 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 cyberterrorism 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**—Cyberterrorism 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 cyberterrorism 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.

Civil Unrest

Civil disturbance refers to groups of people purposely choosing not to observe a law, regulation or rule, usually in order to bring attention to their cause, concern or agenda. Disturbances may take the form of small gatherings or large groups blocking or impeding access to planning area municipality facilities or businesses to actions directed at intimidating staff, visitors, and causing property damage. Civil disturbances can arise from a number of causes for a variety of reasons. Protests intended to be a peaceful demonstration to the public and the government can escalate into general chaos.

The circumstances surrounding civil disturbance may be spontaneous or may result from escalating tensions within an institutional facility, community or the larger society. This was the case in Ferguson, MO and other recent national examples, where local police activities resulted in a massive community response that began as protest but evolved into less controlled, potentially violent response from community members. Civil disorder can erupt anywhere, but the most likely locations are areas with large population groupings or gatherings. Civil disorder can also occur near locations where a “trigger event” occurred, as was the case in Ferguson.

The following types of large gatherings are typically associated with civil disturbances:

- **Crowds**:
  - A casual crowd is identified as individuals or small groups with nothing in common to bind them together. If they have an agenda, it is their own. Casual crowds are made up of individuals or small groups occupying the same common place.
  - Sighting crowds are people gathering for an event. People migrating to sporting events, gathering to observe a fire or accident, and those that attend music concerts are all types of sighting crowds. Individuals or small groups gather at these events for the same purpose. It is the event and/or one’s curiosity that compels a crowd to come together.
  - Agitated crowds have responses based on the elements (people, space, and event). Individuals with strong emotional feelings within a crowd can quickly spread and influence the rest of the crowd. As more people within the crowd become emotionally involved, a sense of unity may develop, causing changes in the overall demeanor of the crowd. Yelling, screaming, and name-calling are all associated with an agitated crowd.

- **Mobs—**Mobs have all the elements found in the crowd types described above, but also display aggressive, physical, and sometimes violent actions. Under these conditions, individuals within a crowd will often say or do things they usually would not do. Extreme acts of violence and property damage are often part of mob activities. They consist of, or involve, the elements of people and groups being mixed together and becoming fluid. Mobs are usually emotional, loud, tumultuous, violent, and lawless. There are different levels of mobs (Alvarez and Bachman, 2007):
  - An aggressive mob is one that attacks, riots, and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.
  - An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control and can be characterized by unreasoning terror.
  - An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits an authority’s lack of control in safeguarding property.
  - An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent up emotions in highly charged situations.
  - A flash mob is a large group of people who gather in some predetermined location, perform some brief action, and then quickly disperse. Youth flash mobs in Boston, Philadelphia, Brooklyn, New York, Kansas City, Missouri, Orange, New Jersey, and elsewhere in the United States have resulted in violence, vandalism, injuries, and arrests.

- **Riots**—A riot is form of civil disorder characterized by a group lashing out in a violent public disturbance against authority, property, or people. Riots typically involve vandalism and the destruction of property, public or private. The property targeted varies depending on the riot and the inclinations of those involved. Targets can include shops, cars, restaurants, government institutions, and religious buildings.

Civil disorders can result in numerous secondary hazards. Depending on the size and scope of the incident, civil disturbance may lead to widespread urban fire, utility failure, transportation interruption, and environmental hazards. Civil disorders can be a secondary hazard after a severely destructive disaster. This may include looting, blocking of roadways, which may impact emergency response vehicles, and demonstrations.

15.1.2 Technological Hazards

Technological hazards are associated with human activities such as the manufacture, transportation, storage and the use of hazardous materials. Incidents related to these hazards are assumed to be accidental, with unintended consequences. Technological hazards in the planning area can be categorized as follows:

- Hazardous materials incidents
- Pipeline and utility failure
- Transportation accidents.

Hazardous Materials Incidents

Hazardous materials are substances that are considered severely harmful to human health and the environment, as defined by the U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Many hazardous materials are commonly used substances that are harmless in their normal uses but dangerous if released. The EPA designates more than 800 substances as hazardous and identifies many more as potentially hazardous due to their characteristics and the circumstances of their release.

If released or misused, hazardous substances can cause death, serious injury, long-lasting health effects, and damage to structures, other properties, and the environment. Many products containing hazardous substances are used and stored in homes, and these products are shipped daily on highways, railroads, waterways, and pipelines. The following are the most common type of hazardous material incidents:

- **Fixed-Facility Hazardous Materials Incident**—This is the uncontrolled release of materials from a fixed site capable of posing a risk to health, safety and property. It is possible to identify and prepare for a fixed-site incident because federal and state laws require those facilities to notify state and local authorities about what is being used or produced at the site.
- **Hazardous Materials Transportation Incident**— A hazardous materials transportation incident is any event resulting in uncontrolled release of materials during transport that can pose a risk to health, safety, and property as defined by Department of Transportation Materials Transport regulations. Transportation incidents are difficult to prepare for because there is little if any notice about what materials could be involved should an accident happen. Hazardous materials transportation incidents can occur at any place within the country, although most occur on the interstate highways or major federal or state highways, or on the major rail lines. In addition to materials such as chlorine that are shipped throughout the country by rail, thousands of shipments of radiological materials, mostly medical materials and low-level radioactive waste, take place via ground transportation across the United States. Many incidents occur in sparsely populated areas and affect very few people.
- **Interstate Pipeline Hazardous Materials Incident**—A significant number of interstate natural gas, heating oil, and petroleum pipelines run through California. These are used to provide natural gas to the utilities in California and to transport these materials from production facilities to end-users.

CERCLA, the Emergency Planning and Community Right-to-Know Act, and California law require responsible parties to report hazardous material releases if certain criteria is met. CERCLA requires that all releases of hazardous substances (including radionuclides) exceeding reportable quantities be reported by the responsible party to the National Response Center. If an accidental chemical release exceeds the Right-to-Know Act applicable minimal reportable quantity, the facility must notify state emergency response commissions and local emergency planning committees for any area likely to be affected by the release, and provide a detailed written follow-up as soon as practicable. Information about accidental chemical releases must be made available to the public.

Pipeline and Utility Failure

Raw Materials Pipelines

Transmission and distribution pipelines provide two differing services. Transmission pipelines transport raw material for further refinement. These pipes are large and far reaching, operating under high pressure. Distribution pipelines provide processed materials to end users. These are smaller in diameter, some as small as a half an inch, and operate under lower pressure.

Although pipelines are the safest and most reliable way to transport natural gas, crude oil, liquid petroleum products, and chemical products, there is still an inherent risk due to the nature of the hazardous materials. Pipelines are regulated by the Office of the State Fire Marshal. The Pipeline and Hazardous Materials Safety Administration enforces oil and gas pipeline safety regulations. The federal government enforces hazardous material transport pursuant to its interstate commerce regulation authority. Pipelines are also monitored by system control and data acquisition (SCADA) systems that measuring flow rate, temperature and pressure. The SCADA system transfers real-time data via satellite from the pipelines to a control center where the valves, pumps, and motors are remotely operated. If tampering with the pipeline occurs, an alarm sounds. The ensuing valve reaction is instantaneous, with the alarm system isolating any rupture and setting off a chain reaction that shuts down pipeline pumps and alerts pipeline operators within seconds.

Failures of distribution and transmission pipelines can occur when pipes corrode, are damaged during excavation, are incorrectly operated, or are damaged by other forces. More serious accidents occur on distribution pipelines than on any other type due to their number, intricate networking, and location in highly populated areas.

Water

Water disruption is a secondary impact from a natural disaster or intentional act. A breach in the pipelines that carry water through the planning area would have significant temporary impacts on the cities until alternative water sources are pumped and treated. Long-term disruption would have significant impacts on residences and businesses in the planning area if demand exceeds secondary supplies and water conservation measures do not provide enough relief to reduce demand to equal the secondary supplies.

Wastewater

Disruption of the planning area's wastewater collection and wastewater treatment plants would have significant citywide and regional impacts. Such disruption could result if the system were to be overwhelmed by a significant storm or discharge of materials in such quantities that the treatment plant could not adequately treat the waste. Natural hazards such as earthquake or flood, major power outages, or terrorism directed at the facilities and systems could disrupt the process of collecting and treating millions of gallons of sewage. Wastewater treatment plants may also have emergencies internal to the plant such as oxygen deficiencies that render them incapable of treating waste. The disruption of service may also have significant environmental impacts on the waterways adjacent to the treatment plants.

Petroleum Refineries

A petroleum refinery's main job is to separate crude oil into its many parts, which are then reprocessed into products. The type, number, and size of process units at a particular refinery depends on factors such as the type of crude oil and the products made. The units making up a refinery are tanks, furnaces, distillation towers, reactors, heat exchangers, pumps, pipes, fittings, and valves. Products include the following:

- Fuels, such as gasoline, diesel, heating oil, kerosene, jet fuel, bunker fuel oil, and liquefied petroleum gas
- Solvents, including benzene, toluene, xylene, hexane, and heptane, which are used in paint thinners, dry-cleaning solvents, degreasers, and pesticide solvents
- Lubricating oils and insulating, hydraulic, and medicinal oils
- Petroleum wax
- Greases, which are primarily a mixture of various fillers
- Asphalt.

These products can be hazardous not only in their final state but as they are being processed and refined. The principal hazards at refineries are fire and explosion. Refineries process a multitude of products with low flash points. Although systems and operating practices are designed to prevent such catastrophes, they can occur. In a refinery, hazardous chemicals can come from many sources and in many forms. In crude oil, there are not only the components sought for processing, but impurities such as sulfur, vanadium, and arsenic compounds. The oil is split into many component streams that are further altered and refined to produce the final product range. Most, if not all, of these component stream chemicals are inherently hazardous to humans, as are the other chemicals added during processing. Hazards include fire, explosion, toxicity, corrosiveness, and asphyxiation.

At refineries, the potential for fires, explosions, releases of flammable or toxic materials, or other accidents that could cause injuries, fatalities, or spills could occur and would be primarily associated with the flammable vapors and other flammable materials transported as cargo by tankers visiting the marine terminal. Damage prevention measures include routine inspection and maintenance, corrosion protection, continuous monitoring and control technologies, public awareness programs, and integrity management and emergency response plans.

Transportation Accidents

Transportation accidents are incidents involving air, road or rail travelers resulting in death or serious injury. The potential for transportation accidents that block ingress, egress, and movement through the planning area is significant, as is the likelihood of hazardous material incidents resulting from a traffic or rail accident.

15.2 HAZARD PROFILE

15.2.1 Past Events

Intentional Hazards

Terrorism Events

The Bay Area has not experienced a regional terrorism event. However, the 2016 hosting of the Super Bowl in Santa Clara County increased mainstream exposure of the Bay Area for potential future terrorist events. The 2012 Alameda County Emergency Operations Plan (EOP) identifies two incidents in the county (Alameda County EOP, 2012):

- September 9, 2003—A bombing at Shaklee Corp in Pleasanton was attributed to a faction of the Animal Liberation Front.

- August 8, 2003—Two bombings at the Chiron Corp in Emeryville were attributed to a faction of the Animal Liberation Front.

Cyber Threats

In December 2015, University of California at Berkeley experienced a massive cyber-attack that left upwards of 80,000 people exposed to cyber-crime. The university is one of the largest employers in the Bay Area, and this cyber-attack reached beyond jurisdictional and county lines to affect the entire Bay Area.

On December 1, 2014, a global cyber-attack shut down web access to agenda, minutes, and video for many Bay Area government agencies, including Alameda County. The San Francisco-based company Granicus, which provides web services for government agencies nationwide, reported the outage (Johnson, 2014).

Civil Unrest

The 2012 Alameda County EOP and other resources identify the following civil unrest incidents (Alameda County EOP, 2012):

- November 24 – December 10, 2014—After a grand jury decision in the Michael Brown case in Ferguson, MO, there was a 17-day revolt in Oakland that resulted in marches, blocked roadways, looting of businesses, destruction of property, and arrests.
- October 20, 2011— Occupy Oakland protesters took to the streets in Oakland over economic inequality, corporate excess, and homelessness. Hundreds of participants set up tents in Frank Ogawa Plaza. Some arrests were made for disruptive behavior; however, for the most part, the protest remained peaceful.
- January 7, 2009—This was the most notorious civil disturbance in Alameda County and occurred as a response to shooting by a Bay Area Rapid Transit police officer. It began as a peaceful protest but turned into a destructive riot resulting in trash can fires, multiple cars set on fire, broken storefront windows, and looting of stores.

Over the years, fights and lock-downs occur and some develop into full-scale threatening riots at the Alameda County Jail, Santa Rita, in Dublin. One occasion was August 26, 2010, when an inmate was killed. Security measures have not completely stopped the violence perpetrated on inmates and staff. The Federal Correctional Facility in Dublin is a low security federal correctional institution for female inmates that has not had recorded riots or fatalities.

In Pleasanton on September 9, 2016, hundreds of protesters gathered and 23 were arrested for civil disobedience at the Alameda County Fairgrounds. They gathered to protest the "militarization of police" at an event called Urban Shield, an annual law enforcement preparedness training.

Technological Hazards

Hazardous Materials

Although hazardous material incidents can happen almost anywhere, certain areas are at higher risk. Jurisdictions near roadways that are frequently used for transporting hazardous materials and jurisdictions with industrial facilities that use, store, or dispose of such materials all have an increasing potential for major incidents, as do jurisdictions crossed by certain railways, waterways, airways and pipelines. Hazardous materials are transported through the planning area via highways and pipelines. The planning area's level of exposure to hazardous materials can be understood by examining the type of businesses, commercial traffic routes, and highway exposure.

Alameda County and its incorporated cities have experienced many accidental hazardous materials incidents. On November 7, 2007, a container ship struck a pier bumper at the western span of the Bay Bridge, which caused 58,000 gallons of bunker fuel to be released into the water. Oil slicks, oil globs, and oiled and dead wildlife were reported around the Bay and Pacific coastline. Beaches, marines and other shoreline areas were closed for cleanup in Alameda County and surrounding areas. In 2009, an oil tanker, located south of the Bay Bridge, was being fueled when human errors caused the tanks to overflow. This released 400 gallons of fuel into the bay and led to birds being oiled and approximately 6 miles of East Bay being oiled, specifically Bay Farm Island and Alameda Island (Alameda County EOP, 2012).

Table 15-3 lists the number of hazardous material incidents reported to Cal OES Warning Center by year and spill site type between 2012 through 2016. Additional historical hazardous material spill report data is available on Cal OES website. The records show that a total of 166 hazardous materials spills occurred over 5-year timeframe in Tri-Valley planning area.

Table 15-3. Hazard Materials Spills in Tri-Valley Planning Area Reported to Cal OES (2012-2016)

Spill Site	2012	2013	2014	2015	2016	Total
Airport	0	0	0	0	0	0
Industrial Plant	0	2	0	2	0	4
Merchant/Business	3	5	3	6	6	23
Military Base	0	0	0	0	0	0
Oil Field	0	0	0	1	0	1
Other	3	5	2	2	5	17
Pipeline	0	0	0	2	1	3
Rail Road	0	1	2	2	1	6
Refinery	0	1	0	0	0	1
Residence	2	1	1	0	7	11
Road	15	11	18	14	10	68
School	0	0	0	0	0	0
Service Station	5	6	9	7	1	28
Treatment/Sewage Facility	0	1	0	0	0	1
Utilities/Substation	0	0	1	0	0	1
Waterways	1	0	0	0	1	2
Total	29	33	36	36	32	166

Source: Cal OES, 2017

Pipeline Incidents

Accidents involving underground pipelines in Alameda County have caused injury, fatalities and property damage. Recent events have involved natural gas lines in Oakland, Union City, Berkeley, and Livermore. In particular, on September 9, 2010 a natural gas pipeline explosion in San Bruno (San Mateo County) killed eight people and reduced the Crestmoor neighborhood to ashes. There have been incidents involving hazardous liquids as well, including an event on May 20, 2016 involving crude oil in Tracy (PHSMA, 2016).

According to Pipeline and Hazardous Materials Safety Administration (PHSMA), between 2010 to July 2017, there was one reported natural gas pipeline incident in the planning area. The incident occurred on June 11, 2012 in Livermore, when Pacific Gas & Electric had an unintentional release of gas (PHSMA, 2016).

Transportation Accidents

According to the 2012 Alameda County EOP, the County has not experienced an incident of a commercial flight or large plane. However, a number of general aviation aircraft incidents have occurred. These types of incidents are typically localized and somewhat contained.

Alameda County has experienced train derailments in the past. Recent events have been small, with minimal damage. In August 2004, a non-hazmat car derailed and two tank cars carrying methanol were damaged. Material release was not reported. In July 2005, a train derailed near a Kinder Morgan pipeline, which had to be shut down in case of any release (Alameda County EOP, 2012).

Between 1990 and 2016, there have been two aviation fatality incidents in Livermore, none in Dublin and Pleasanton as reported by the National Transportation Safety Board (NTSB). The following is information regarding recent incidents in the planning area (NTSB, 2017):

- May 9, 2010, Livermore—A Piper PA-280235 pilot used visual flight into instrument meteorological conditions which resulted in a collision with obstacles and terrain. Two fatalities occurred.
- May 1, 2007, Livermore—A Beech 36 collided with terrain nine miles from the Livermore airport. It resulted in two fatalities.

The California Office of Traffic Safety provides the total number of fatal and injury collisions on local city streets between 2010 through 2014 (see Table 15-4). Over this five-year period, 3,744 fatal and injury collisions have occurred in the Tri-Valley planning area.

Table 15-4. Total Fatal and Injury Collision Data for Tri-Valley Planning Area

Jurisdiction	2010	2011	2012	2013	2014	Total
Dublin	103	94	112	87	131	527
Livermore	271	275	267	268	472	1,553
Pleasanton	305	216	283	320	540	1,664
Total	679	585	662	675	1,143	3,744

Source: California Office of Traffic Safety, 2017

The only railway accident reported in recent years occurred on March 8, 2016 when a commuter train detailed after it struck a downed tree on the tracks. The incident occurred in Niles Canyon, south of the City of Pleasanton, where two train cars derailed and one plunged into a creek. It occurred at night and only nine people were injured (San Francisco CBS Local, 2016).

15.2.2 Location

Intentional Hazards

Terrorism, Civil Unrest, and Active Threats

The State of California and Office of Homeland Security have identified numerous high-profile targets for potential terrorists in California. Large population centers, high-visibility tourist attractions, and critical infrastructure accessible to the public present security challenges of an ongoing nature in California. The network of highways, railways, ports, and airports used to transport significant amounts of hazardous materials poses a significant technological hazards threat. Multiple incidents may happen simultaneously, and all typically require a multi-agency, multi-jurisdictional response.

In particular, the Santa Rita County Jail and Federal Correctional Facility, both in Dublin, are locations where civil unrest may occur. Also, the Lawrence Livermore National Laboratory and Sandia National Laboratory are U.S. Department of Energy national labs are critical facilities that may have active threats.

Cyber Threats

Both public and private operations in the Cities of Dublin, Livermore and Pleasanton are threatened on a near-daily basis by the millions of currently engineered cyber-attacks developed to automatically seek technological vulnerabilities. Possible cyberterrorist targets include the banking industry, power plants, air traffic control centers, and water systems; especially facilities that rely on computers, computer systems, and programs for their operations.

Technological Hazards

Hazardous Materials Release

Hazardous materials are stored before and after they are transported to their intended use. This may include service stations that store gasoline and diesel fuel in underground storage tanks; hospitals that store radioactive materials, flammable materials and other hazardous substances; or manufacturers, processors, distributors, and recycling plants for chemical industries that store a variety of chemicals on site (FEMA, 2013). For the purpose of this plan, fixed sites include buildings or property where hazardous materials are manufactured or stored, and are regulated under various programs by the EPA.

The Toxic Substances Control Act of 1976 (TSCA) provides the EPA with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. Certain substances are generally excluded from TSCA, including food, drugs, cosmetics, and pesticides. TSCA addresses the production, importation, use, and disposal of specific chemicals, including polychlorinated biphenyls (PCBs), asbestos, radon, and lead-based paint. According to TSCA, there are no facilities with these substances in the planning area (EPA, 2017a).

Facilities identified in the Resource Conservation and Recovery Act Information databases (RCRA Info) were also reviewed for this plan. Hazardous waste information is contained in RCRA Info, a national program management and inventory system about hazardous waste handlers. In general, entities that generate, transport, treat, store, and dispose of hazardous waste are required to provide information about their activities to state environmental agencies. These agencies pass on the information to regional and national EPA offices. This regulation is governed by the RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984. There are 73 RCRA facilities in Dublin, 162 facilities in Livermore, and 132 facilities in Pleasanton (EPA, 2017b).

Petroleum Refineries

There are five petroleum refinery operations along the Bay Area’s Contra Costa-Solano refinery belt.

Pipelines and Utilities

Distribution pipelines run through highly populated areas providing refined materials for public use and consumption. Large gas distribution lines, called “mains,” along with much smaller service lines that travel to homes and businesses, account for the vast majority of underground pipeline system.

Figure 15-2 shows gas transmission and hazardous liquid pipelines as well as the locations of accidents and incidents within the planning area. Both natural gas and hazardous liquid pipelines traverse the planning area. The primary operator of the gas transmission pipelines is Northern California Power Agency and Pacific Gas & Electric. The primary operator for the hazardous liquid pipeline is Shell Pipeline Company (PHMSA, 2017a).

Source: PHMSA National Pipeline Mapping System, 2017

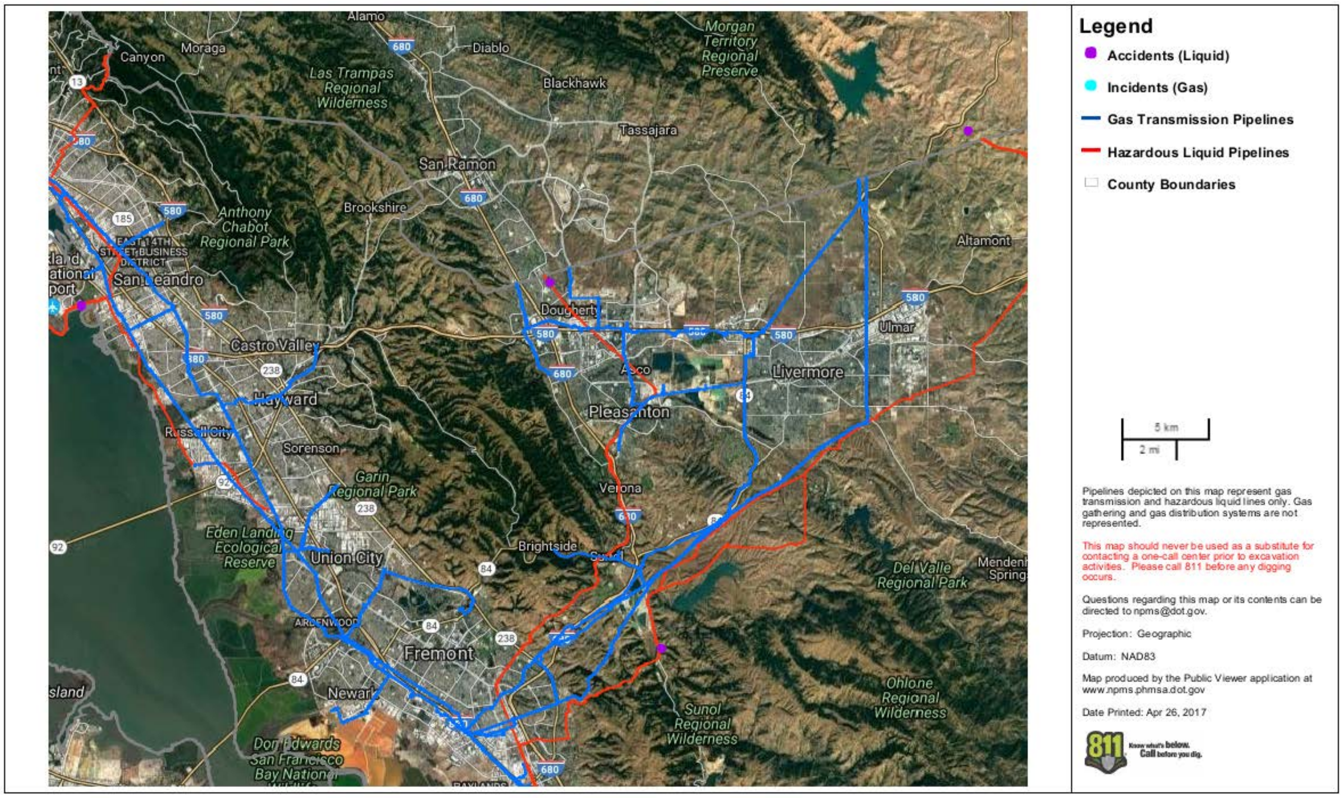


Figure 15-2. Gas Transmission and Hazardous Liquid Pipelines Near the Planning Area

Zone 7 Water Agency (Zone 7), a water wholesaler, provides treated drinking water to four major retailers in the Valley area that serve approximately 240,000 people and businesses. The wholesale water has three sources: South Bay Aqueduct that originates from the California State Water Project; Lake Del Valle storage reservoir that is approximately 10 miles from Livermore; and groundwater from local wells (Zone 7, 2017) (see Figure 7-6).

Transportation Incidents

Incidents involving hazardous materials in transit or incidents occurring on roads and rail can occur through a variety of vehicles in and around the planning area. In the City of Dublin, there are 193 miles of road and no commuter train or transportation rails. In the City of Livermore, there are 348 miles of roadway, 12 miles of railroad and the Altamont Commuter express commuter train. In the City of Pleasanton, there are 340 miles of roadway, 6 miles of commuter train, and 8 miles of transportation rail (ABAG Local HMP Annex, 2010).

The Tri-Valley planning area is serviced by the Livermore Municipal Airport. It was a 5,255-foot main paved runway and a second 2,700-foot unlighted training runway. The nearest airports with scheduled airline service are Oakland, San Jose, and Stockton.

The main artery through the planning area is Interstate 580, which feeds traffic from the Bay Area to the Central Valley of California.

Union Pacific Railroad freight line traverses the Cities of Livermore and Pleasanton and Amtrak passenger train has a station in Livermore. The Altamont Commuter Express commuter train stops in Livermore and Pleasanton. It extends from Stockton to San Jose.

15.2.3 Frequency

Intentional Hazards

Terrorism, Civil Unrest, and Active Threats

As of 2016, California's economy was the largest of any state in the United States. The planning area's proximity to San Francisco and Silicon Valley presents unique conditions for terrorist attacks. The transportation, energy, and communications systems that cross the planning area have impacts on the local, regional, and even national economy. In general, the risks of a terrorist event involving a WMD are as follows:

- **Chemical**—The risk of a chemical event is present in the Cities of Dublin, Livermore and Pleasanton. The agricultural community in Alameda County uses and stores significant amounts of chemicals for peaceful and productive means that could be used in destructive ways.
- **Explosives**—Pipe bomb and suspicious package events have occurred in Alameda County in the past. While none of the events has been specifically identified as a WMD-related attack, the elements necessary to construct a WMD are readily available. Additionally, the agricultural communities maintain sufficient products and quantities for use in explosive events.
- **Radiological/Nuclear**—The major transportation arteries for vehicles or rail that cross through the planning area contribute to the risk of a radiological event. Such products can unknowingly pass through any one of the regional transportation corridors.
- **Biological**—Anthrax incidents that occurred in the United States in October 2001 demonstrate the potential for spreading terror through biological WMDs. The introduction of Newcastle disease in the United States demonstrates how an agent can be introduced to livestock, causing harm to public health and the economy.
- **Combined Hazards—**WMD agents can be combined to have a greater total effect. When combined, the impacts of the event can be immediate and longer-term. Casualties will likely suffer from both immediate and long-term burns and contamination. Given the risks associated with chemical agents in Alameda County, the possibility exists for such a combined event to occur.

Cyber Threats

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

Cyberterrorism is much less common than cyber-attacks, and the frequency is unknown.

Technological Hazards

Hazardous material incidents may occur at any time in the Cities of Dublin, Livermore and Pleasanton, given the presence of transportation routes bisecting the planning area, the location of businesses and industry that use hazardous materials, the presence of scattered illegitimate businesses such as clandestine drug laboratories at any given time, and the improper disposal of hazardous waste.

15.2.4 Severity

The severity of human-caused hazards could range from a minor transportation accident or power outage to a full-scale terrorist attack.

The term mass casualty incident (MCI) is often applied to transportation accidents involving air and rail travel, as well as multi-vehicle highway accidents. However, MCIs may also result from hazardous materials incidents or acts of violence, such as shootings or hostage situations. Effects may include serious injuries, loss of life, and associated property damage. Because large numbers of patients may be involved, significant MCIs may tax local emergency medical and hospital resources, and therefore require a regional response. MCIs may occur throughout the planning area, day or night, at any time of the year: Interstate 580 offer the potential for MCIs because of the heavy volume of traffic, although no highway or surface street in the City is exempt from this hazard.

The railroad tracks traversing Alameda County, carrying Amtrak passengers as well as freight, also face the risk of an MCI, as do the air corridors above the county. Severe weather may play a role in roadway, air, or rail accidents. MCIs may also result from acts of violence or terrorism, which could include a chemical, biological or radiological incident, contaminating persons and requiring mass decontamination.

Hazardous Materials

Table 15-5 shows the number of injuries and fatalities associated with hazardous material spills reported to Cal OES Warning Center between 2012 through 2016. Additional historical hazardous material spill report data is available on the Cal OES website. The records show that eight people were injured and five fatalities occurred in a 5-year timeframe in planning area.

Table 15-5. Injuries and Fatalities from Hazardous Materials Spills in Tri-Valley Planning Area

Severity	2012	2013	2014	2015	2016	Total
Number of Injuries	2	1	3	0	2	8
Number of Fatalities	0	1	3	1	0	5
Total	2	2	6	1	2	13

Source: Cal OES, 2017

Hazardous material releases also affect the environment through contamination of soil, but data are not available on the area that has been affected by such contamination.

15.2.5 Warning Time

Very few terrorism incidents—fewer than 5 percent—are preceded by a warning. Technological accidents occur without predictability under circumstances that give responders little time to prepare.

15.3 SECONDARY HAZARDS

The largest secondary impact caused by human-caused hazards would be economic, and could be significant:

- The cost of a terrorist act would be felt in terms of loss of life and property, disruption of business activity and long-term emotional impacts. Recovery would take significant resources and expense at the local level.
- Computer security breaches associated with data and telecommunications losses can have significant economic impact.
- Pipeline and tank failure impacts can include both the cost of community recovery for the area surrounding the failure site and the cost of disruption of services for the transported material.
- Hazardous materials releases have the potential to cause major disruptions to local businesses that house hazardous materials. Additionally, a hazardous materials release could cause businesses to close if they are located in the path of the hazardous materials flow.
- The economic impacts should a transportation facility be rendered impassable would be significant. The loss of a roadway or railway would have serious effects on the local economy and ability to provide services. Loss of major travel routes would result in loss of commerce, and could impact the ability to

provide emergency services to citizens by delaying response times or limiting routes for equipment such as fire apparatus, police vehicles, and ambulances. The ability to receive fuel deliveries would also be impacted. The effects of re-routed traffic could have a serious impact on local roadways.

15.4 EXPOSURE

15.4.1 Population

A human-caused hazard event could range from an isolated accident to a highly coordinated attack by multiple agents upon multiple targets. Large-scale incidents have the potential to kill or injure many citizens in the immediate vicinity, and may also affect people a relative distance from the initial event. Variables affecting exposure for a WMD attack and a hazardous material accident include the physical and chemical properties of the WMD, the ambient temperature, wind speed, wind direction, barometric pressure, and humidity.

Computer models can provide general data to first responders to advise evacuations or sheltering in place. With so many variables to determine “toxic endpoints” as defined by the California Environmental Protection Agency, distances are difficult to forecast. In general, those close to transportation corridors or businesses with acutely hazardous materials are more at risk for some sort of effect. Each chemical incident will be different and the scenarios are too numerous to describe in this plan.

Hazardous materials pose a significant risk to emergency response personnel. All potential first responders and follow-on emergency personnel must be properly trained to the level of emergency response actions required of their individual position at the response scene. Hazardous materials also pose a serious long-term threat to public health and safety, property and the environment.

15.4.2 Property

The planning area is located in Alameda County, among the fastest growing counties in California, making it a higher profile target for terrorism. Additionally, the planning area’s proximity to San Francisco and Silicon Valley make it vulnerable to secondary and cascading effects of a possible terrorist threat.

15.4.3 Critical Facilities and Infrastructure

Terrorism events can pose a serious long-term threat to damaging critical facilities and infrastructure. In particular, the industrial corridor along the northern and northwestern portions of the county are highly visible targets. The high-profile buildings in the planning area include the Federal Correctional Facility, the Alameda County Jail - Santa Rita, and Camp Parks, which are all in Dublin. Additionally, Lawrence Livermore National Laboratory and Sandia National Laboratory are considered high profile critical facilities within the planning area. Critical facilities are limited to City facilities, Alameda County facilities, and other government facilities, private utility infrastructure and administrative offices, and medical facilities.

Critical facilities may house hazardous materials and rail, highways, and interstates transport hazardous materials on a daily basis. The exposure of critical facilities and infrastructure to a terrorism event or hazardous material incident is based on the facility’s criticality and physical vulnerability:

- Criticality is a measure of the potential consequence of an accidental or terrorist event as well as the attractiveness of the facility to a potential adversary or threat. The criticality for each critical facility is based on the factors shown in Table 15-6.
- Vulnerability is a measure of the physical opportunity for an accident or an adversarial attack. This assessment takes into consideration physical design, existing countermeasures, and site layout. The vulnerability for each critical facility is based on the criteria shown in Table 15-7.

Table 15-6. Criticality Factors

Criterion	Low Criticality	Medium Criticality	High Criticality
Awareness[a]	Not known/Neighborhood	City/Region/County	State/National
Hazardous Materials[b]	None / limited and secure	Moderate to large and secure	Large, minimum or no security
Collateral Damage Potential[c]	None or low	Moderate/immediate area or within 1 mile radius	High/immediate area or within 1 mile radius
Site Population[d]	0 – 300	301 – 1,000	1,001 or greater
Public/ Emergency Function[e]	No emergency function, or could be used for emergency function in the future	Support emergency function—redundant site	Emergency function—critical service with or without redundancy

a. Awareness—How aware is the public of the existence of the facility, site, system, or location?
b. Hazardous Materials—Are flammable, explosive, biological, chemical and/or radiological materials present on site?
c. Collateral Damage Potential—What are the potential consequences for the surrounding area if the asset is attacked or damaged?
d. Site Population—What is the potential for mass causalities, based on the capacity of the facility.
e. Public or Emergency Functions—Does the facility perform a function during an emergency? Is this facility or function capable of being replicated elsewhere?

Table 15-7. Vulnerability Criteria

Criterion	Low Vulnerability	Medium Vulnerability	High Vulnerability
Accessibility[a]	Remote location, secure perimeter, tightly controlled access	Controlled access, protected or unprotected entry	Open access, unrestricted, patrolling security, sign restrictions
Automobile Proximity[b]	Not within 75' – 100'	Not within 25' – 50'	Adjacent or not within 10'
Asset Mobility[c]	Moves or is relocated frequently	Moves or is relocated occasionally	Permanent/Fixed
Proximity to other Critical Facilities[d]	Greater than 1.5 – 2 miles	Greater than 3/4 - 1 mile	Within 1/2 – 3/4 mile
Secure Design[e]	No areas for concealment of packages, air intakes are on roof, access ways are not under the structure.	Area of concealment present, greater than 25' from the structure; Air intakes located at least 10' above ground, may have under structure access drives.	Areas of concealment within 25', air intakes at ground level, under structure access drives.

a. Accessibility—How accessible is the facility or site to the public?
b. Automobile Proximity—How close can an automobile get to the facility? How vulnerable is the facility to a car bomb attack?
c. Asset Mobility—Is the facility or asset's location fixed or mobile? If mobile, how often is it moved, relocated, or repositioned?
d. Proximity to other critical facilities—If the facility is close to other critical facilities then there could be an increased probability of the facility receiving collateral damage.
e. Secure design—General evaluation of areas of obstruction, air intake locations, parking lot and road design and locations and other site design aspects.

15.4.4 Environment

The risk of human-caused hazards to the environment is considerable. Hazardous materials spilled along roads or railways could easily pollute rivers, streams, wetlands, riparian areas and adjoining fields. Other hazardous materials released into the air could severely impact plant and animal species. Reducing the risk exposure to the built environment can also mitigate potential losses to the natural environment.

15.5 VULNERABILITY

15.5.1 Population

Although human-caused hazards have not resulted in a large number of deaths in this area, this type of hazard can be deadly and widespread. Injuries and casualties were not estimated for this hazard. Any individuals exposed to human-caused hazards are considered to be at risk, particularly those working as first responder professionals.

15.5.2 Property

All structures in the planning area are physically vulnerable to a human-caused hazard. The emphasis on accessibility, the opportunity for roof access, driveways underneath some structures, unmonitored areas, the proximity of many structures to transportation corridors and underground pipelines, and the potential for a terrorist to strike any structure randomly all have an impact on the vulnerability of structures.

15.5.3 Critical Facilities and Infrastructure

The U.S Office of Homeland Security's 2003 *National Strategy for the Physical Protection of Critical Infrastructure of Critical Infrastructure and Key Assets* lays a foundation to work together to prepare and protect critical infrastructure and key assets nationwide from terrorist events. Critical facilities and infrastructure entities know their vulnerabilities to terrorism. They have executed numerous preparedness plans and exercises for years and fortified their facilities to minimize their vulnerability.

The impact of a hazardous material spill or transportation incident will likely be localized to the particular facility, hospital, airport, railroad, road, or highway. The potential losses to existing development vary because of the variable nature of the hazardous material spill, but costs from product loss, property damage and decontamination and other costs can add up to millions of dollars.

15.5.4 Environment

The environment vulnerable to a human-caused hazard is the same as the environment exposed to the hazard. While human-caused disasters have caused significant damage to the environment, estimating damage can be difficult. Loss estimation platforms such as Hazus are not equipped to measure environmental impacts of these types of hazards. The best gauge of vulnerability of the environment would be a review of damage from past human-caused hazard events. Loss data for damage to the environment were not available at the time of this plan update. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

Most hazardous materials incidents are localized and are quickly contained or stabilized. Depending on the characteristic of the hazardous material or the volume of product involved, the affected area can be as small as a room in a building or as large as many square miles that require soil remediation. More widespread effects occur when a product contaminates the municipal water supply or water system such as a river, lake, or aquifer. Such environmental damage can linger for decades.

15.5.5 Economic impacts

Economic impacts from human-caused hazards could be significant. The cost of a terrorist act would be felt in terms of loss of life and property, disruption of business activity and long-term emotional impacts. Recovery would take significant resources at the local level.

Utility losses could cause a reduction in employment, wholesale and retail sales, utility repairs, and increased medical risks. The planning area may lose sales tax and property taxes, and the finances of private utility companies and the businesses that rely on them would be disrupted.

The economic impact of data and telecommunications losses can be great, as computer security breaches, crime conducted via the world wide web such as identify theft, and many more forms of human-caused economic losses occur daily. Millions of dollars are lost each year as criminals and cyberterrorists steal sensitive information and funds from individuals and organizations.

The economic impacts would be significant if a transportation facility were rendered impassable. The loss of a roadway or railway would have serious effects on the planning area's economy and ability to provide services. Loss of travel routes on Interstate 580 would result in loss of commerce, and may impact the planning area's ability to provide emergency services to its citizens by delaying response times or limiting routes for egress to critical healthcare facilities or ingress of equipment such as fire apparatus, police vehicles, and ambulances. Fuel deliveries would also be impacted. The effects of re-routed traffic could also have a serious impact on local roadways. Heavy traffic on routes through the planning area already occur at peak commute times when Interstate 580 is congested.

15.6 FUTURE TRENDS IN DEVELOPMENT

The potential for human-caused hazards is not likely to lessen or prohibit development in the planning area. The threat of human-caused hazards and the availability of Homeland Security Funds will influence future development of critical facilities.

15.7 SCENARIO

Two human-caused hazard scenarios could have a significant impact on the planning area:

- The first scenario would involve hazardous materials being transported via rail, pipeline, or highway (Interstate 580) across the planning area. The release of hazardous materials via intentional or unintentional means could impact large population centers within the planning area. Advance knowledge of these shipments and their contents would play a role in preparedness for this scenario, thus reducing its potential impact. The biggest issue in response to hazardous material is material identification and containment.
- The second scenario would be a large-scale cyber-attack on Dublin, Livermore, and Pleasanton city servers. Such an attack would require the planning area governments to revert to non-network based operations and put a strain on daily operations. If such an attack would last for an extended period of time, fiscal operations may be impacted.

15.8 ISSUES

Future actions needed at the local level to address human-caused hazards include but are not limited to the following:

- Continue all facets of emergency preparedness training for police, fire, public works, and city manager/public information staff in order to respond quickly in the event of a human-caused disaster. Enhance awareness training for all employees to recognize threats or suspicious activity in order to prevent an incident from occurring.
- Work with the private sector to enhance and create business continuity plans in the event of an emergency.

- Encourage local businesses to adopt information technology and telecommunications recovery plans.
- Prepare and present the human-caused hazard risk and preparedness program to the public through meetings, town hall gatherings, and preparedness fairs and outreach.
- Maintain any and all citizen advisory groups and periodically e-mail emergency preparedness information including human-caused hazard preparedness instructions and reminders.
- Work proactively with hazardous materials facilities to follow best management practices:
  - Placards and labeling of containers
  - Emergency plans and coordination
  - Standardized response procedures
  - Notification of the types of materials being transported through the planning area at least annually
  - Random inspections of transporters as allowed by each company
  - Installation of mitigating techniques along critical locations
  - Routine hazard communication initiatives
  - Consideration of using safer alternative products.
- Continue all facets of the hazardous materials team training and response through commitment of resources from the Fire Department budget.
- Work with the private sector to enhance and create business continuity plans in the event of an emergency.
- Coordinate with planning area school districts to ensure that their emergency preparedness plans include preparation for human-caused incidents.

16. RISK RANKING

A risk ranking was performed for the natural hazards of concern described in this plan. This risk ranking assesses the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area, using methodologies promoted by FEMA. The results are used in establishing mitigation priorities.

When available, estimates of risk were generated with data from Hazus or GIS using methodologies promoted by FEMA, based on the hazard profiles and exposure and vulnerability evaluations presented in Chapters 6 through 14. For hazards of concern with less quantitative datasets, 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 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.

All planning partners used the same methodology to rank risk for impacts on their jurisdictions (see Volume 2 for these rankings). The risk ranking at the planning partner scale was used to inform the action plan development process for each partner. Planning partners were directed to identify mitigation actions addressing hazards that, at a minimum, had a "high" risk ranking (see Section 16.3). Actions that address hazards with a "medium", "low" or no hazard ranking are considered optional by this planning process.

This chapter summarizes the planning-area-wide risk ranking prepared by the planning team using aggregate results of the risk assessment. The risk ranking methodology and results were reviewed, discussed and approved by the Steering Committee via facilitated brainstorming sessions.

16.1 PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- 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)
- No exposure—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	Low	1
Drought	High	3
Earthquake	High	3
Flood	High	3
Landslide	Medium	2
Severe Weather	High	3
Wildfire	High	3

16.2 IMPACT

Hazard impacts were assessed in three categories: impacts on people, impacts on property and impacts on the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total ***population exposed*** 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. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  - High—50 percent or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium—25 percent to 49 percent of the population is exposed to a hazard (Impact Factor = 2)
  - Low—25 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 were assigned based on the percentage of the total ***property value exposed*** to the hazard event:
  - High—30 percent or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
  - Medium—15 percent to 29 percent of the total assessed property value is exposed to a hazard (Impact Factor = 2)
  - Low—14 percent or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0)
- **Economy**—Values were assigned based on the percentage of the total ***property value vulnerable*** to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total assessed value of the property exposed to the hazard. For some hazards, such as wildfire, landslide and severe weather, vulnerability was considered to be the same as exposure due to the lack of loss estimation tools specific to those hazards. Loss estimates separate from the exposure estimates were generated for the earthquake and flood hazards using Hazus.
  - High—Estimated loss from the hazard is 20 percent or more of the total exposed property value (Impact Factor = 3)
  - Medium—Estimated loss from the hazard is 10 percent to 19 percent of the total exposed property value (Impact Factor = 2)
  - Low—Estimated loss from the hazard is 9 percent or less of the total exposed property value (Impact Factor = 1)
  - No impact—No loss is estimated from the hazard (Impact Factor = 0)

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1.

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	3	9
Drought	No impact	0	0
Earthquake	High	3	9
Flood	Low	1	3
Landslide	Medium	2	6
Severe Weather	Medium	2	6
Wildfire	Medium	2	6

Table 16-3. Impact on Property from Hazards

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (2)
Dam Failure	High	3	6
Drought	No Impact	0	0
Earthquake	High	3	6
Flood	Low	1	2
Landslide	Medium	2	4
Severe Weather	Medium	2	4
Wildfire	Medium	2	4

Table 16-4. Impact on Economy from Hazards

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

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 operations, as summarized in Table 16-5.

Based on these ratings, a category of high, medium or low was assigned to each hazard. The hazards ranked as being of highest concern are the earthquake and wildfire hazards. Hazards ranked as being of medium concern are dam failure, flood, landslide and severe weather. The hazard ranked as being of lowest concern is drought. 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	1	9+6+3 =18	18
Drought	3	0+0+2 = 2	6
Earthquake	3	9+6+3 = 18	54
Flooding	3	3+2+1 = 6	18
Landslide	2	6+4+3 = 13	26
Severe Weather	3	6+4+1 = 11	33
Wildfire	3	6+4+2 = 12	36

Table 16-6. Hazard Risk Ranking

Hazard	Rating Number	Category
Earthquake	54	High
Wildfire	36	High
Severe Weather	33	Medium
Landslide	26	Medium
Flood	18	Medium
Dam Failure	18	Medium
Drought	6	Low

Tri-Valley Local Hazard Mitigation Plan

PART 3—MITIGATION STRATEGY

17. 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 guiding principle, 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 guiding principle, goals, objectives and actions in this plan all support each other. Goals were selected to support the guiding principle. Objectives were selected that met multiple goals. Actions were prioritized based on the action meeting multiple objectives.

17.1 GUIDING PRINCIPLE

A guiding principle focuses the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome. The Steering Committee selected the following guiding principle for the 2017 planning effort:

> Through community partnerships, establish a plan to reduce the vulnerability to hazards in order to protect the health, safety, welfare, environment and economy of the planning area.

17.2 GOALS

The following are the eight mitigation goals for this plan:

9. Ensure that hazards are identified and considered in land use decisions.
10. Improve local emergency management capability.
11. Promote community awareness, understanding, and interest in hazard mitigation policies and programs.
12. Incorporate hazard mitigation as an integrated public policy and standard practice.
13. Reduce community exposure and vulnerability to hazards where the greatest risk exists.
14. Increase resilience of infrastructure and critical facilities.
15. Promote an adaptive and resilient planning area that responds proactively to future conditions.
16. Develop and implement mitigation strategies that identify the best alternative to protect natural resources, promote equity, and use public funds in an efficient and cost effective manner.

The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved.

17.3 OBJECTIVES

Each selected objective meets multiple goals, serving as a stand-alone measurement of the effectiveness of a mitigation action, rather than as a subset of a goal. The objectives also are used to help establish priorities. The objectives are as follows:

1. Develop and provide updated information to improve the understanding of the locations, potential impacts, and linkages among threats, hazards, vulnerability, and measures needed to protect life safety health, property and the environment.

2. Use local general plan, zoning, and subdivision requirements to help establish resilient and sustainable communities.
3. Improve systems that provide warning and emergency communications.
4. Encourage the retrofit of vulnerable structures in the planning area.
5. Consider programs that incentivize risk reduction.
6. Reduce repetitive property losses due to all hazards by updating land use, design, and construction policies.
7. Continually build linkages and promote dialog about emergency management within the public and private sectors.
8. Incorporate risk reduction considerations in new and updated infrastructure and development plans to reduce the impacts of natural hazards.
9. Inform the public, including underrepresented community groups, on the risk of exposure to natural hazards and ways to increase the public's capability to prepare for, respond to, recover from, and mitigate the impacts of these events.
10. Identify projects that simultaneously reduce risk while increasing planning area resilience and sustainability.
11. Where feasible and cost-effective, research, develop, and promote adoption of building and development laws, regulations, and ordinances exceeding the minimum levels needed for life safety.
12. Encourage hazard mitigation measures that promote and enhance natural processes, minimize adverse impacts on the ecosystem, and promote social equity.

18. MITIGATION BEST PRACTICES AND ADAPTIVE CAPACITY

18.1 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 hazard of concern evaluated in this plan. The catalogs present alternatives that are categorized in two ways:

- By who would have responsibility for implementation:
  - Individuals (personal scale)
  - Businesses (corporate scale)
  - Government (government scale).
- By 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.

Hazard mitigation actions recommended in this plan were selected from among the alternatives presented in the catalogs. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process, are consistent with the established goals and objectives, and are within the capabilities of the planning partners to implement. Some of these actions may not be feasible based on the selection criteria identified for this plan. The purpose of the catalog was to provide a list of what could be considered to reduce risk of the flood hazard within the planning area. Actions in the catalog that are not included for the partnership's action plan were not selected for one or more of the following reasons:

- The action is not feasible.
- The action is already being implemented.
- There is an apparently more cost-effective alternative.
- The action does not have public or political support.

The catalogs for each hazard are presented in Table 18-1 through Table 18-7.

Table 18-1. Alternatives to Mitigate the Dam Failure Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• 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 regulatory 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. ❖ Develop comprehensive planning policies that encourage wise land use in hazard prone areas. ❖ Develop a post-disaster recovery plan that addresses the dam failure hazard. ❖ Develop a debris management plan.

Table 18-2. Alternatives to Mitigate the Drought Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• 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: ❖ Reduce water system losses ❖ Distribute water saving kits ❖ Increase use of recycled water ❖ Diversify water supply diversion points ❖ Develop recycled water projects • Increase the ability to respond to or be prepared for the hazard: ❖ Enhance hazard mapping based on data and science ❖ Public education on drought resistance ❖ Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers ❖ Implement drought contingency plan ❖ Develop criteria "triggers" for drought-related actions ❖ Improve accuracy of water supply forecasts ❖ Prioritize groundwater projects for competitive funding ❖ Develop a post-disaster recovery plan that addresses the drought hazard ❖ Develop a debris management plan

Table 18-3. Alternatives to Mitigate the Earthquake Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• 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 ❖ Identify projects that limit transportation downtime • Increase the ability to respond to or be prepared for the hazard: ❖ Enhance hazard mapping based on data and science ❖ 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, 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. ❖ Identify food security strategies, including distribution priorities ❖ Develop comprehensive planning policies that encourage wise land use in hazard prone areas. ❖ Develop a post-disaster recovery plan that addresses the earthquake hazard. ❖ Develop a debris management plan.

Table 18-4. Alternatives to Mitigate the Flooding Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• Manipulate the hazard: ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • Reduce exposure to the hazard: ❖ Locate outside of hazard area ❖ Elevate utilities above base flood elevation ❖ Use low-impact development techniques • Reduce vulnerability to the hazard: ❖ Raise structures above base flood elevation ❖ Elevate items within house above base flood elevation ❖ Build new homes above base flood elevation ❖ Flood-proof structures • Increase the ability to respond to or be prepared for the hazard: ❖ Buy flood insurance ❖ Develop household plan, such as retrofit savings, communication with outside, 72-hour self-sufficiency during and after an event	• Manipulate the hazard: ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • Reduce exposure to the hazard: ❖ Locate critical facilities or functions outside hazard area ❖ Use low-impact development techniques • Reduce vulnerability to the hazard: ❖ Build redundancy for critical functions or retrofit critical buildings ❖ Provide flood-proofing when new critical infrastructure must be located in floodplains • Increase the ability to respond to or be prepared for the hazard: ❖ Keep cash reserves for reconstruction ❖ Support and implement hazard disclosure for sale of property in risk zones. ❖ Solicit cost-sharing through partnerships with others on projects with multiple benefits.	• Manipulate the hazard: ❖ Maintain drainage system ❖ Institute low-impact development techniques on property ❖ Dredging, levee construction, and providing regional retention areas ❖ Structural flood control, levees, channelization, or revetments. ❖ Stormwater management regulations and master planning ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff • Reduce exposure to the hazard: ❖ Locate or relocate critical facilities outside of hazard area ❖ Acquire or relocate identified repetitive loss properties ❖ Promote open space uses in 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: ❖ Harden infrastructure, bridge replacement program ❖ Provide redundancy for critical functions and infrastructure ❖ Adopt higher regulatory standards. ❖ Stormwater management regulations and master planning. ❖ Adopt "no-adverse impact" floodplain management policies that strive to not increase the flood risk on downstream communities. ❖ Preserve natural spaces that serve as buffers against flood • Increase the ability to respond to or be prepared for the hazard: ❖ Enhance hazard mapping based on data and science ❖ 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 the probable impacts of climate change on the flood hazard ❖ Consider the residual risk associated with structural flood control in future land use decisions ❖ National Flood Insurance Program compliance ❖ Adopt a Stormwater Management Master Plan ❖ Comprehensive planning policies-Wise land use in hazard prone areas ❖ Develop a post-disaster recovery plan that addresses the flood hazard ❖ Develop a debris management plan

Table 18-5. Alternatives to Mitigate the Landslide Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• 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: ❖ Enhance hazard mapping based on data and science ❖ 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. ❖ Develop comprehensive planning policies that encourage wise land use in hazard prone areas. ❖ Develop a post-disaster recovery plan that addresses the landslide hazard. ❖ Develop a debris management plan.

Table 18-6. Alternatives to Mitigate the Severe Weather Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• 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. ❖ Prioritize utility recovery based on safety and critical infrastructure needs	• 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 ❖ Designate snow routes and strengthen critical road sections and bridges • Increase the ability to respond to or be prepared for the hazard: ❖ Enhance hazard mapping based on data and science ❖ 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 ❖ Develop a post-disaster recovery plan that addresses the severe weather hazards ❖ Develop a debris management plan

Table 18-7. Alternatives to Mitigate the Wildfire Hazard

Personal-Scale	Corporate-Scale	Government-Scale
• Manipulate the hazard: ❖ Clear potential fuels on property such as dry overgrown underbrush and diseased trees • Reduce exposure to the hazard: ❖ Create and maintain defensible space around structures ❖ Locate outside of hazard area ❖ Mow regularly • Reduce vulnerability to the hazard: ❖ Create and maintain defensible space around structures and provide water on site ❖ Use fire-retardant building materials ❖ Create defensible spaces around home • Increase the ability to respond to or be prepared for the hazard: ❖ Employ techniques from the National Fire Protection Association's Firewise Communities program to safeguard home ❖ Identify alternative water supplies for fire fighting ❖ Install/replace roofing material with non-combustible roofing materials.	• Manipulate the hazard: ❖ Clear potential fuels on property such as dry underbrush and diseased trees • Reduce exposure to the hazard: ❖ Create and maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area • Reduce vulnerability to the hazard: ❖ Create and maintain defensible space around structures and infrastructure and provide water on site ❖ Use fire-retardant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. • Increase the ability to respond to or be prepared for the hazard: ❖ Support Firewise community initiatives. ❖ Create /establish stored water supplies to be utilized for firefighting.	• Manipulate the hazard: ❖ Clear potential fuels on property such as dry underbrush and diseased trees ❖ Implement best management practices on public lands. • Reduce exposure to the hazard: ❖ Create and maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area ❖ Enhance building code to include use of fire resistant materials in high hazard area. • Reduce vulnerability to the hazard: ❖ Create and maintain defensible space around structures and infrastructure ❖ Use fire-retardant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. ❖ Consider higher regulatory standards (such as Class A roofing) ❖ Establish biomass reclamation initiatives • Increase the ability to respond to or be prepared for the hazard: ❖ Enhance hazard mapping based on data and science ❖ 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 ❖ Develop comprehensive planning policies that encourage wise land use in hazard prone areas. ❖ Develop a post-disaster recovery plan that addresses the wildfire hazard. ❖ Develop a debris management plan.

18.2 ADAPTIVE CAPACITY

Adaptive capacity is defined as “the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2014b). This term is typically used while discussing climate change adaptation; however, it is similar to the alternatives presented in the tables for building local capacity. In addition to hazard-specific capacity building, the following list provides general alternatives that planning partners considered to build capacity for adapting to both current and future risks (Cal EMA, et al., 2012a and 2012b):

- Incorporate climate change adaptation into relevant local and regional plans and projects.
- Establish a climate change adaptation and hazard mitigation public outreach and education program.
- Build collaborative relationships between regional entities and neighboring communities to promote complementary adaptation and mitigation strategy development and regional approaches.
- Establish an ongoing monitoring program to track local and regional climate impacts and adaptation strategy effectiveness.
- Increase participation of low-income, immigrant, non-English-speaking, racially and ethnically diverse, and special-needs residents in planning and implementation.
- Ask local employers and business associations to participate in local efforts to address climate change and natural hazard risk reduction.
- Conduct a communitywide assessment and develop a program to address health, socioeconomic, and equity vulnerabilities.
- Focus planning and intervention programs on neighborhoods that currently experience social or environmental injustice or bear a disproportionate burden of potential public health impacts.
- Use performance metrics and data to evaluate and monitor the impacts of climate change and natural hazard risk reduction strategies on public health and social equity.
- Develop coordinated plans for mitigating future flood, landslide, and related impacts through concurrent adoption of updated general plan safety elements and local hazard mitigation plans.
- Implement general plan safety elements through zoning and subdivision practices that restrict development in floodplains, landslide, and other natural hazard areas.
- Identify and protect locations where native species may shift or lose habitat due to climate change impacts (sea level rise, loss of wetlands, warmer temperatures, and drought).
- Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.
- Promote economic diversity.
- Incorporate consideration of climate change impacts as part of infrastructure planning and operations.
- Conduct a climate impact assessment on community infrastructure.
- Identify gaps in legal and regulatory capabilities and develop ordinances or guidelines to address those gaps.
- Identify and pursue new sources of funding for mitigation and adaptation activities.
- Hire new staff or provide training to current staff to ensure an adequate level of administrative and technical capability to pursue mitigation and adaptation activities.

19. AREA-WIDE ACTION PLAN AND IMPLEMENTATION

19.1 ACTIONS INCLUDED IN PLAN

The Steering Committee reviewed the catalogs of hazard mitigation alternatives and selected area-wide actions to be included in a hazard mitigation action plan. The selection of area-wide actions was based on the risk assessment of identified hazards of concern and the defined hazard mitigation goals and objectives. Table 19-1 lists the recommended hazard mitigation actions that make up the action plan. The timeframe indicated in the table is defined as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

19.2 BENEFIT-COST REVIEW

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project 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 projects 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 project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

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

Benefit ratings were defined as follows:

- **High—**Project will provide an immediate reduction of risk exposure for life and property.
- **Medium—**Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low—**Long-term benefits of the project are difficult to quantify in the short term.

Table 19-1. Action Plan

Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agencies	Estimated Cost	Sources of Funding	Timeline[a]
Action AW-1—Continue to maintain a planning area-wide hazard mitigation website that will store the hazard mitigation plan and provide the public an opportunity to monitor plan implementation progress. Each planning partner can support this action by including an action in its own action plan of creating a link to the planning-area-wide hazard mitigation website.						
New and Existing	All Hazards	1,7,9	City of Pleasanton	Low	General Funds	Ongoing
Action AW-2— Leverage public outreach partnering capabilities in the planning area (such as Community Emergency Response Teams) to promote a uniform and consistent message on the importance of proactive hazard mitigation.						
New and Existing	All Hazards	1,7,9	Livermore Pleasanton Fire	Low	District Funds	Ongoing
Action AW-3— Coordinate mitigation planning and project efforts in the planning area to leverage all resources available to the planning partnership.						
New and Existing	All Hazards	7,10	Designated POC for each Planning Partner	Low	General Funds for each planning partner	Short Term
Action AW-4— Where appropriate, support retrofitting, purchase, or relocation of structures in hazard-prone areas to protect the structures from future damage, with repetitive loss and severe repetitive loss properties as a priority. Seek opportunities to leverage partnerships in the planning area in these pursuits.						
Existing	All Hazards	4,5,11	Designated POC for each Planning Partner	High	FEMA Grant Funding	Long Term
Action AW-5— Continue to update hazard mapping with best available data and science as it evolves, within the capabilities of the partnership. Support FEMA's RiskMAP initiative.						
New and Existing	All Hazards	1,7,9	Designated POC for each Planning Partner	Medium	FEMA mitigation grant funding, FEMA's Cooperating Technical Partners program, Planning Partner capital improvement program funding	Long term
Action AW-6— To the extent possible based on available resources, provide coordination and technical assistance in applying for grant funding.						
New and Existing	All Hazards	7,10	Alameda County OES, ALCOEMA	Low	General Funds, FEMA Grant Funding (eligible pre-award costs)	Short term
Action AW-7— Maintain a steering committee as a working body over time to monitor progress of the hazard mitigation plan, provide technical assistance to planning partners, manage data, and oversee the update of the plan according to schedule. This body will continue to operate under the ground rules established at its inception.						
New and Existing	All Hazards	7,10	Designated POC for each Planning Partner	Low	General Funds	Ongoing
Action AW-8— All planning partners will collaborate and share information to support the development of debris management plans for the planning area. While each planning partner will be responsible for the development of their own plans, they will attempt to standardize the content and format based on a regional template.						
New and Existing	All Hazards	1,7,10,12	Designated POC for each Planning Partner	Medium	General Funds	Short term

a. Ongoing indicates continuation of an action that is already in place. Short-term indicates implementation within five years. Long-term indicates implementation after five years.

Using this approach, projects 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.

For many of the strategies identified in this action 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 projects 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.

19.3 AREA-WIDE ACTION PLAN PRIORITIZATION

Table 19-2 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:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).
- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM or other grant programs. Project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority**—A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the time line for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

Table 19-2. Prioritization of Area-Wide Mitigation Actions

Action #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is project Grant Eligible?	Can Project Be Funded under Existing Programs/ Budgets?	Priority (High, Medium, Low)
AW-1	3	Medium	Low	Yes	No	Yes	High
AW-2	3	Medium	Low	Yes	No	Yes	High
AW-3	2	Medium	Low	Yes	No	Yes	High
AW-4	3	High	High	Yes	Yes	No	Medium
AW-5	3	Medium	Medium	Yes	Yes	Yes	High
AW-6	2	Medium	Low	Yes	Yes	Yes	High
AW-7	2	Medium	Low	Yes	No	Yes	High
AW-8	4	Medium	Medium	Yes	No	Yes	High

19.4 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing bodies of the jurisdictions requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. 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, all planning partners will formally adopt the plan. DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting this plan for all planning partners can be found in Appendix C of this volume.

19.5 ANALYSIS OF AREA-WIDE MITIGATION ACTIONS

Each recommended action was classified based on the hazard it addresses and the type of mitigation it involves. Table 19-3 shows the classification based on this analysis. Mitigation types used for this categorization are as follows:

Table 19-3. Analysis of Mitigation Actions

Hazard	Planning Area Actions That Address the Hazard, by Mitigation Type					
	Prevention	Property Protection	Public Education and Awareness	Natural Resource Protection	Emergency Services	Structural Projects
Dam Failure	3,5,6	4	1,2,5,7	-	8	-
Drought	3,5,6	4	1,2,5,7	-	8	-
Earthquake	3,5,6	4	1,2,5,7	-	8	-
Flooding	3,5,6	4	1,2,5,7	-	8	-
Landslide	3,5,6	4	1,2,5,7	-	8	-
Severe Weather	3,5,6	4	1,2,5,7	-	8	-
Wildfire	3,5,6	4	1,2,5,7	-	8	-

- **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 citizens 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.
- **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, and wetland restoration and preservation.
- **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.

19.6 PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a five-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as general or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

The plan maintenance strategy is the formal process that will ensure that the Tri-Valley Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. It includes the following:

- A process for monitoring and evaluating the plan and producing an updated plan every five years. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

- A plan for how public participation will be integrated throughout the plan maintenance and implementation process.
- Guidance for incorporating the mitigation strategies outlined in this plan into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation.

Pursuant to 44CFR 201.6(c)(4)(i), the plan maintenance matrix shown in Table 19-4 provides a synopsis of responsibilities for plan monitoring, evaluation, and update, which are discussed in further detail in the sections below.

19.6.1 Plan Monitoring and Implementation

The effectiveness of the hazard mitigation plan depends on its monitoring, implementation, and incorporation of its action items into partner jurisdictions' existing plans, policies and programs. Together, the action items in the plan provide a framework for activities that the Planning Partnership can implement over the next 5 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 planning partners will have individual responsibility for overseeing the plan monitoring and implementation strategy, with primary responsibility identified in each jurisdictional annex plans (see planning partner annexes in Volume 2) and summarized in Table 19-4. At a minimum, the planning partners will track and report the status of the jurisdiction-specific hazard mitigation actions for inclusion into the Midterm Progress Report, described in Section 19.6.3.

19.6.2 Plan Evaluation

Evaluating how well a plan achieves intended goals and objectives ensures that the Planning Partnership remains cognizant of the continued short- to long-term efforts to reduce hazard impacts. Establishing a schedule for monitoring ensures that the hazard mitigation plan will remain a living document that provides benchmarks for building more resilient communities. Plan evaluation will be achieved through the assessment of the status of actions as submitted by planning partners for the development of the Midterm Progress Report described in Section 19.6.3.

19.6.3 Midterm Progress Report

Each planning partner will evaluate the progress of its individual action plan at the midterm of the period between the completion of this plan and the next update. This progress report should be completed within two and a half years of plan approval, or upon initiation of an accelerated plan update as described under Section 19.6.4, whichever occurs first. The 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 actions that involve hazard mitigation.

Table 19-4. Plan Maintenance Matrix

Task	Approach	Timeline	Lead Responsibility[a]		Support Responsibility
Monitoring	Preparation of status updates and action implementation tracking as part of submission for Midterm Progress Report.	2-1/2 years after the adoption and final approval of the plan by FEMA. Actual reporting period TBD	Dublin	City Manager	Jurisdictional points of contact identified in Volume 2 annexes
			Livermore	City Manager	
			Pleasanton	General Manager	
			DSRDS	General Manager	
			Dublin USD	Maintenance and Operations Supervisor	
			Livermore Valley JUSD	Deputy Superintendent	
Evaluation	Review the status of previous actions as submitted by the monitoring task lead and support to assess the effectiveness of the plan; compile the Midterm Progress Report; assess appropriate action for preparing 2021/2022 hazard mitigation plan update.	2-1/2 years after final plan approval by FEMA, or upon comprehensive update to General Plan or major disaster	City of Dublin City of Livermore City of Pleasanton Dublin/San Ramon Services District Dublin Unified School District Livermore Valley Joint Unified School District		Jurisdictional points of contacts identified in Volume 2 annexes
Update [b]	The Tri-Valley partnership will reconvene the planning partners, at a minimum, every 5 years to guide a comprehensive update to review and revise the plan.	Every 5 years or upon comprehensive update to General Plan or major disaster	The governing body for all planning partners covered by this plan		Jurisdictional point of contacts identified in Volume 2 annexes
Grant Monitoring and Coordination	As grant opportunities present themselves, the Tri-Valley planning partners will consider options to pursue grants to fund actions identified in this plan	As grants become available	ALCOEMA provides a regional platform for grant notification and coordination		Jurisdictional point of contacts identified in Volume 2 annexes
Continuing Public Involvement	The principle means for providing the public access to the implementation of this plan will be the Tri-Valley HMP website: https://www.tri-valley-hmp.com/	Annually	Livermore-Pleasanton Fire District		All planning partners will provide a link to LHMP website on their jurisdictional websites
Plan Integration	Integrate relevant information from LHMP into other plans and programs where viable and opportunities arise	Ongoing	The governing body for all planning partners covered by this plan		Jurisdictional point of contacts identified in Volume 2 annexes

a. Responsible lead party may designate an alternate
b. The approach to the plan update process may change based on partnership decisions made during the evaluation phase and the preparation of the midterm progress report as described in Section 19.6.2 and Section 19.6.3.

The Steering Committee has created a template to guide the planning partners in preparing a progress report (see Appendix D). The progress report template may be used as a tool for annual progress reporting at the discretion of the planning partners and based on available jurisdictional resources. The completed report should be distributed as follows:

- Posted on the hazard mitigation website dedicated to the hazard mitigation plan
- Provided to the local media through a press release
- Presented to planning partner governing bodies to inform them of the progress of actions implemented during the reporting period.

Progress reporting is not a federal requirement. However, it may enhance the Planning Partnership's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize a planning partner's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with other partners. Upon completion, the mid-term progress report will be posted to the hazard mitigation website, which will invite the public to provide comment on its content.

19.6.4 Plan Update

Local hazard mitigation plans must be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). The planning partners intend to update the hazard mitigation plan on a five-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than five years based on the following triggers:

- A presidential disaster declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of a planning partner's general plan.

The update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plans will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new policies identified under other planning mechanisms (such as the comprehensive plan).
- 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.
- Planning partner governing bodies will adopt the updated plan.

When developing the Midterm Progress Report, jurisdictional partners will evaluate the appropriate course of action for a plan update. The progress report will recommend a process for updating the plan based on available resources, regional initiatives, and overall timing. Options for updating this plan include the following:

- Development of an updated multi-jurisdictional plan similar to the current plan
- Development of single jurisdictional plans
- Participation in development of an operational-area initiative led by Alameda County.

19.6.5 Grant Monitoring and Coordination

The Alameda County Emergency Managers' Association (ALCO EMA) provides an opportunity to maintain awareness of current and future grant opportunities. Currently, Dublin, Livermore, Pleasanton and Dublin/San Ramon Services District participate in ALCO EMA through the Alameda County Fire Department's contracted emergency management services. All planning partners have agreed to continue to coordinate with each other as grant opportunities arise.

19.6.6 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the hazard mitigation website and by distribution of the midterm progress report to the media. The website will house the final plan and become the central source of information about the plan, the partnership and plan implementation and the platform for the public to provide comment on plan directives and initiatives. The website will also house the mid-term progress report as discussed in Section 19.6.3 and will be set up so that the public can provide comment on the report's content and conclusions. All planning partners have agreed to provide links to the website on their individual websites. The Livermore-Pleasanton Fire District has agreed to maintain the hazard mitigation plan website. Copies of the plan will be distributed to local libraries. 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 Planning Partnership at the time of the update.

The public outreach strategy used during development of the current update, as described in Section 3.8.1, provides a framework for public engagement through the planning process. It can be adapted for continued public outreach through the plan performance period.

19.6.7 Integration with 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 plan was prepared. The comprehensive plans of the planning partners are considered to be integral parts of this plan. The planning partners, through adoption of comprehensive plans and zoning ordinances, have planned for the impact of natural hazards. The plan development process provided them with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their comprehensive plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the planning area. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

All municipal planning partners committed to linking the hazard mitigation plan to their comprehensive plans by identifying a mitigation action as such and giving that action a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Emergency response plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Master fire protection plans.

Specific activities identified for incorporating mitigation into other planning mechanisms can be found in each jurisdictional annex located in Volume 2 of this hazard mitigation plan. Some action items in this plan can be implemented through 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.

REFERENCES

Alameda County. 2012. *Alameda County Community Wildfire Protection Plan* (CWPP). Retrieved from Alameda County Fire Department.

Alameda County. 2012. *Alameda County Emergency Operations Plan*. Accessed 2017. https://www.acgov.org/ready/documents/EmergencyOperationsPlan.pdf.

Alameda County. 2016. Tax assessor data. Alameda County Assessor's Office.

Alameda County. 2016a. *Alameda County Multi-Hazard Mitigation Plan*. Access April 2017.

Alameda County. 2017. Alameda County Library. "Tri-City Local History Resources". Accessed 2017. http://guides.aclibrary.org/content.php?pid=117063&sid=1016667.

Alameda County. 2017. Alameda County Public Health Department. "West Nile Virus". Accessed 2017. http://www.acphd.org/west-nile-virus.aspx.

Alameda County Community Development Agency (CDA). 2005. *Historical and Cultural Resource Survey, Alameda County*. Accessed 2017. https://www.acgov.org/cda/planning/landuseprojects/documents/.pdf.

Alameda Creek Alliance. 2017. "Map of the Alameda Creek Watershed." Accessed May 2017. http://www.alamedacreek.org/learn-more/map-watershed.php.

Alvarez, A. and Bachman, R. 2007. "Violence: The Enduring Problem." Sage Publications, Inc. November 2.

Association of Bay Area Governments (ABAG). 2010. *Annex to 2010 ABAG Local Hazard Mitigation Plan Taming Natural Disasters*. Accessed 2017. http://resilience.abag.ca.gov/2011mitigation/2010annex/.

Association of State Dam Safety Officials. 2013. "Introduction to Dams." Dam Safety 101. Accessed 2017. http://www.damsafety.org/news/?p=e4cda171-b510-4a91-aa30-067140346bb2.

Brown, W. et al. 2001. U.S. Geological Survey (USGS). "Hazard Maps Help Save Lives and Property." 2001. Accessed 2017. http://pubs.usgs.gov/fs/1996/fs183-96/fs183-96.pdf.

Cal-Adapt. 2017. "Exploring California's Climate Change Research." Accessed June 2017. http://cal-adapt.org/.

California Code of Regulations (CCR). 2017. http://leginfo.legislature.ca.gov/faces/codesTOCSelected.xhtml?tocCode=WAT&tocTitle=+Water+Code+-+WAT.

California Department of Conservation. 2010. "The Alquist-Priolo Earthquake Fault Zoning (AP) Act." Accessed 2017. http://www.conservation.ca.gov/cgs/rghm/ap.

California Department of Finance, (CA DOF) 2016. http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php "Forecasting." Accessed April 2017. http://www.dof.ca.gov/Forecasting/Demographics/.

California Department of Finance, (CA DOF) 2017. http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php "Forecasting." Accessed April 2017. http://www.dof.ca.gov/Forecasting/Demographics/.

California Department of Finance, (CA DOF) 2017a. http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php "Forecasting." Accessed April 2017. http://www.dof.ca.gov/Forecasting/Demographics/.

California Department of Forestry and Fire Protection (CAL FIRE). 2017. "Incident Information." Accessed April 2017. http://cdfdata.fire.ca.gov/incidents/incidents_archived.

California Department of Forestry and Fire Protection (CAL FIRE). 2017a. "FRAP Maps." FRAP Projects. Accessed April 2017. http://frap.fire.ca.gov/.

California Department of Public Health (CDPH). 2015. Retrieved from Vector-Borne Disease Section Annual Report 2015: https://archive.cdph.ca.gov/programs/vbds/Documents/VBDSAnnualReport15.pdf

California Department of Public Health (CDPH). 2016. "Norovirus (Norwalk Virus)". Accessed 2017. http://www.cdph.ca.gov/HealthInfo/discond/Pages/Norovirus.aspx.

California Department of Public Health (CDPH). 2016a. Retrieved from Influenza and Other Respiratory Diseases Surveillance Report, 2015-2016 Season: https://archive.cdph.ca.gov/HealthInfo/discond/Documents/CA%20Year%20End%20Flu%20Summary_2015-2016_final.pdf.

California Department of Public Health (CDPH). 2017. "Annual Reports". https://archive.cdph.ca.gov/HealthInfo/discond/Pages/Influenza(Flu).aspx

California Department of Water Resources (DWR). 2005. *The California Water Plan*. Accessed May 2017. http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v4c06a01_cwp2009.pdf.

California Department of Water Resources (DWR). 2010. *California Drought Contingency Plan*. Accessed May 2017. http://www.water.ca.gov/waterplan/docs/cwpu2013/Final/vol4/drought/01California_Drought_Contigency_Plan.pdf.

California Department of Water Resources (DWR). 2013. *The California Water Plan Update*. Accessed May 2017. http://www.waterplan.water.ca.gov/docs/cwpu2013/Final/Vol2_SanFranciscoBayRR.pdf.

California Department of Water Resources (DWR). 2013a. *The California Water Plan Update*. Accessed May 2017. http://www.waterplan.water.ca.gov/docs/cwpu2013/Final/Vol2_SanFranciscoBayRR.pdf.

California Department of Water Resources (DWR). 2017. "State Hydrologic Data." Accessed May 2017. http://www.watersupplyconditions.water.ca.gov.

California Department of Water Resources (DWR), Division of Safety of Dams. 2017. "Statutes and Regulations Pertaining to Supervision of Dams and Reservoirs". http://www.water.ca.gov/damsafety/statutes_regulations/index.cfm.

California Department of Water Resources (DWR), Division of Safety of Dams. 2017a. "Listing of Dams." Accessed 2017. http://www.water.ca.gov/damsafety/damlisting/index.cfm.

California Department of Water Resources (DWR). 2017b. Climate Change page of California DWR website. http://www.water.ca.gov/climatechange/.

California Emergency Management Agency (Cal EMA) et al. 2012. "*California Climate Adaptation Planning Guide*." Accessed 2017. http://resources.ca.gov/docs/climate/APG_Understanding_Regional_Characteristics.pdf.

California Employment Development Department (CA EDD). 2017. "Unemployment Rate and Labor Force." Accessed May 2017. http://www.labormarketinfo.edd.ca.gov/data/unemployment-and-labor-force.html.

California Geologic Survey (CGS). 2011. "Landslide Inventory and Deep Landslide Susceptibility Map." http://www.conservation.ca.gov/cgs/geologic_hazards/landslides#landslideprograms.

California Governor's Office of Emergency Services (Cal OES). 2013. *State of California Multi-Hazard Mitigation Plan.* Accessed 2017. http://hazardmitigation.calema.ca.gov/plan/state_multi-hazard_mitigation_plan_shmp.

California Governor's Office of Emergency Services (Cal OES). 2013a. *State of California Multi-Hazard Mitigation Plan.* Accessed 2017. http://hazardmitigation.calema.ca.gov/plan/state_multi-hazard_mitigation_plan_shmp.

California Governor's Office of Emergency Services (Cal OES). 2013b. *State of California Multi-Hazard Mitigation Plan.* Accessed 2017. http://hazardmitigation.calema.ca.gov/plan/state_multi-hazard_mitigation_plan_shmp.

California Governor's Office of Emergency Services (Cal OES). 2017. California State Warning Center Hazardous materials spill report data. http://www.caloes.ca.gov/cal-oes-divisions/warning-center.

California Office of Governor (CA.gov). 2017. "Governor Brown Lifts Drought Emergency, Retains Prohibition of Wasteful Practices." https://www.gov.ca.gov/news.php?id=19748

California Office of Traffic Safety. 2017. Retrieved from OTS Collision Rankings: http://www.ots.ca.gov/Media_and_Research/Rankings/default.asp.

Centers for Disease Control and Prevention (CDC). 2011. "Principles of Epidemiology in Public Health Practice, Third Edition: An Introduction to Applied Epidemiology and Biostatistics." Accessed 2017. http://www.cdc.gov/ophss/csels/dsepd/ss1978/index.html.

Centers for Disease Control and Prevention (CDC). 2012. "Drought and Health." Accessed February 2017. http://www.cdc.gov/nceh/drought/.

Centers for Disease Control and Prevention (CDC). 2016. "Enterovirus D68". Accessed 2017. http://www.cdc.gov/non-polio-enterovirus/about/ev-d68.html.

Centers for Disease Control and Prevention (CDC). 2016a. "Non-Polio Enterovirus". Accessed 2017. https://www.cdc.gov/non-polio-enterovirus/.

Centers for Disease Control and Prevention (CDC). 2016b. "A History of Anthrax." Accessed 2017. http://www.cdc.gov/anthrax/resources/history/.

City of Dublin General Plan. 2014. "City of Dublin General Plan". Accessed 2017. http://dublin.ca.gov/171/General-Plan.

City of Dublin. 2017. "Drought Information." Accessed 2017. http://dublin.ca.gov/1503/Drought-Information.

City of Livermore General Plan. 2014. “City of Livermore General Plan”. Accessed 2017. http://www.ci.livermore.ca.us/citygov/cd/planning/general.asp.

City of Livermore. 2017. “Water Service”. Accessed May 2017. http://www.cityoflivermore.net/citygov/pw/public_works_divisions/wrd/service/default.asp.

City of Livermore. 2017a. “Why Conserve Water?” Accessed May 2017. http://www.cityoflivermore.net/citygov/pw/public_works_divisions/wrd/conserve/default.htm.

City of Pleasanton General Plan. 2015. “City of Pleasanton General Plan.” Accessed 2017. http://www.cityofpleasantonca.gov/gov/depts/cd/planning/general.asp.

City of Pleasanton. 2017. “City Newsletter and Annual Report Section”. Accessed May 2017. http://www.cityofpleasantonca.gov/gov/hottopics/newsletter.asp.

City of Pleasanton. 2017a. “Utility Billing” Accessed May 2017. http://www.cityofpleasantonca.gov/gov/depts/os/service/utlbilling.asp.

City-Data.com. 2017. “Residential Building Permits.” Accessed May 2017. http://www.city-data.com/

Danielson, T. 2015. “How to avoid the curse of ransomware.” Accessed April 2017. http://www.businessinsider.com/ransomware-is-everywhere-but-this-software-can-save-you-2015-10.

Disaster Mitigation Act of 2000 (DMA 2000). Public Law 106-390. 42 U.S.C. §§ 5121 note et seq. October 30, 2000.

Dublin San Ramon Services District. 2017. “Water, wastewater, recycled water”. Accessed May 2017. http://www.dsrsd.com/.

Federal Emergency Management Agency (FEMA). 1977. “Executive Order 11988 and 11990.” Accessed 2017. https://www.fema.gov/laws-executive-orders.

Federal Emergency Management Agency (FEMA). 1997. “FEMA’s Multi-Hazard Identification and Risk Assessment (MHIRA).” Accessed 2016. http://www.fema.gov/library/viewRecord.do?id=2214.

Federal Emergency Management Agency FEMA. 2001. *Understanding Your Risks; Identifying Hazards and Determining your Risks*. FEMA (386-2). August 2001

Federal Emergency Management Agency FEMA. 2002. *Getting Started; Building support for Mitigation Planning.* FEMA (386-1). September 2002

Federal Emergency Management Agency FEMA. 2003. *Developing the Mitigation Plan; Identifying Mitigation Actions and Implementing Strategies. FEMA* (386-3). April 2003

Federal Emergency Management Agency FEMA. 2003a. *Integrating Manmade Hazards Into Mitigation Planning*. FEMA (386-7). September 2003.

Federal Emergency Management Agency FEMA. 2004. *Using Hazus for Risk Assessment, How to Guide*. FEMA (433). August 2004

Federal Emergency Management Agency (FEMA). 2004a. *Federal Guidelines for Dam Safety*. Accessed 2017. http://www.fema.gov/media-library-data/20130726-1516-20490-7951/fema-333.pdf.

Federal Emergency Management Agency (FEMA). 2004b. *National Response Plan, Cyber Incident Annex.* https://www.fema.gov/media-library-data/20130726-1825-25045-8307/cyber_incident_annex_2004.pdf

Federal Emergency Management Agency (FEMA). June 2009. *Benefit Cost Analysis Reference Guide.* https://www.fema.gov/media-library-data/20130726-1736-25045-7076/bca_reference_guide.pdf.

Federal Emergency Management Agency (FEMA), Flood Insurance Study (FIS). 2009. "Flood Insurance Study for Alameda County and Incorporated Areas, CA."

Federal Emergency Management Agency (FEMA). 2010. "Wind Zones in the United States." http://www.fema.gov/safe-rooms/wind-zones-united-states.

Federal Emergency Management Agency (FEMA). 2013. "Why Dams Fail." Accessed 2017. http://www.fema.gov/why-dams-fail.

Federal Emergency Management Agency (FEMA). 2015. "Executive Order 13690 Federal Flood Risk Management Standard." Accessed 2017. https://www.fema.gov/federal-flood-risk-management-standard-ffrms.

Federal Emergency Management Agency (FEMA). 2016. "NFIP Community Rating System Communities and their Classes." Accessed March 2017. https://www.fema.gov/national-flood-insurance-program-community-status-book.

Federal Emergency Management Agency (FEMA). 2017. "Disaster Declarations-Open Government Dataset." Accessed May 2017. https://www.fema.gov/disasters.

Federal Emergency Management Agency (FEMA). 2017a. "Disaster Declarations-Open Government Dataset." Accessed May 2017. https://www.fema.gov/disasters.

Federal Emergency Management Agency (FEMA). 2017b. "Disaster Declarations-Open Government Dataset." Accessed May 2017. https://www.fema.gov/disasters.

Federal Emergency Management Agency (FEMA). 2017b "NFIP Community Status Book." Accessed April 2017. https://www.fema.gov/national-flood-insurance-program-community-status-book.

Federal Emergency Management Agency (FEMA). 2017c. "Policy and Claim Statistics for Flood Insurance." Accessed January 2017. https://www.fema.gov/national-flood-insurance-program-community-status-book.

Federal Emergency Management Agency (FEMA). 2017d. "Disaster Declarations-Open Government Dataset." Accessed May 2017. https://www.fema.gov/disasters.

Federal Emergency Management Agency (FEMA). 2017e. "Disaster Declarations-Open Government Dataset." Accessed May 2017. https://www.fema.gov/disasters.

Federal Emergency Management Agency (FEMA) Region IX. 2017. "Report of Repetitive Losses."

Federal Energy Regulatory Commission (FERC). 2016. "Engineering Guidelines for the Evaluation of Hydropower Projects." Accessed May 2017. https://www.ferc.gov/industries/hydropower/safety/guidelines/eng-guide.asp

Global Resilience Network. 2016. "The Sky is Falling: Space Weather EMP's, Solar Flares & Grid Resilience." Accessed 2017. http://static1.squarespace.com/static/55b670ece4b004b66c56e8ca/t/56c77bcb8259b508f2d01577/1455913932039/SpaceWeatherandGridResilience_ThomasPopik_01122016.pdf.

Intergovernmental Panel on Climate Change (IPCC). 2014. "Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Parts A, B and Annexes." Accessed 2017. http://www.ipcc.ch/report/ar5/wg2/.

Johnson, A. 2014. "East Bay Government Websites Affect by Global Cyber Attack." Patch San Leandro December 2. Accessed 2017. http://patch.com/california/sanleandro/east-bay-government-websites-affect-global-cyber-attack.

Keller, Edward A., and Robert H. Blodgett. *Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes*. Upper Saddle River, NJ: Pearson/Prentice Hall, 2008. Print.

Kostadinov, D. 2012. "Cyberterrorism Defined (as distinct from "Cybercrime")." Accessed 2017. http://resources.infosecinstitute.com/cyberterrorism-distinct-from-cybercrime/.

National Aeronautics and Space Administration (NASA). 2004. "NASA Earth Observatory News." Accessed 2017. http://earthobservatory.nasa.gov/Newsroom/view.php?id=25145.

National Aeronautics and Space Administration (NASA). 2016. "Solar Storm and Space Weather—Frequently Asked Questions." Accessed 2017. http://www.nasa.gov/mission_pages/sunearth/spaceweather/index.html.

National Aeronautics and Space Administration (NASA). 2016a. "Welcome to the Solar Flare Theory Education Web Pages." Accessed 2017. http://hesperia.gsfc.nasa.gov/sftheory/frame1.htm.

National Aeronautics and Space Administration (NASA). 2016b. "NASA, NOAA Data Show 2016 Warmest Year on Record Globally." Accessed 2017. https://www.nasa.gov/press-release/nasa-noaa-data-show-2016-warmest-year-on-record-globally.

National Aeronautics and Space Administration (NASA). 2017. "Global Climate Change: Vital Signs of the Planet." Accessed May 2017. http://climate.nasa.gov/vital-signs/carbon-dioxide/.

National Aeronautics and Space Administration (NASA). 2017a. "Global Climate Change: Vital Signs of the Planet." Accessed May 2017. http://climate.nasa.gov/vital-signs/carbon-dioxide/.

National Drought Mitigation Center (NDMC), Drought Impact Reporter. 2017. "Drought Impact Report for Alameda County." Accessed May 2017. http://drought.unl.edu/MonitoringTools/DroughtImpactReporter.aspx.

National Drought Mitigation Center (NDMC). 2017a. "Drought Affecting People." Accessed February 2017. http://drought.unl.edu/droughtbasics/ensoandforecasting.aspx.

National Climate Assessment (NCA). 2014. Third *National Climate Assessment Report for the United States.* Accessed May 2017. http://www.globalchange.gov/browse/reports/climate-change-impacts-united-states-third-national-climate-assessment-0.

National Climate Assessment (NCA). 2014a. "Climate Change Impacts in the United States." Accessed May 2017. http://nca2014.globalchange.gov/.

National Oceanic and Atmospheric Administration (NOAA). 2017. "National Centers for Environmental Information Storm Events Database (NCEI)." Accessed May 2017. https://www.ncdc.noaa.gov/stormevents/.

National Oceanic and Atmospheric Administration (NOAA). 2017a. "National Centers for Environmental Information Storm Events Database (NCEI)." Accessed May 2017. https://www.ncdc.noaa.gov/stormevents/.

National Oceanic and Atmospheric Administration (NOAA). 2017b. "National Centers for Environmental Information Storm Events Database (NCEI)." Accessed May 2017. https://www.ncdc.noaa.gov/stormevents/.

National Oceanic and Atmospheric Administration (NOAA). 2017c. "Space Weather Prediction Center (SWPC)." Accessed May 2017. http://www.swpc.noaa.gov/phenomena.

NOAA, National Weather Service (NWS). 2009. "National Weather Service Glossary." Accessed 2017. http://w1.weather.gov/glossary/.

NOAA, National Weather Service (NWS). 2009a. "National Weather Service Glossary." Accessed 2017. http://w1.weather.gov/glossary/.

NOAA, National Weather Service (NWS). 2016. "Introduction to Thunderstorms." Accessed 2017. http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.html.

NOAA, National Weather Service (NWS). 2016. Office of Climate, Water, and Weather Services. "Weather Fatalities." Accessed 2017. http://www.nws.noaa.gov/om/hazstats.shtml.

NOAA, NWS. 2017. "Climate Prediction Center, Palmer Crop Moisture Index." Accessed May 2017. http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml.

NOAA, NWS. 2017a. "Climate Prediction Center, Palmer Z Index." Accessed May 2017. http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml.

NOAA, NWS. 2017b. "Climate Prediction Center, Palmer Drought Severity Index." Accessed May 2017. http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml.

NOAA, NWS. 2017c. "Climate Prediction Center, Palmer Hydrological Drought Index." Accessed May 2017. http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml.

NOAA, NWS. 2017d. "Climate Prediction Center, Standard Precipitation Index." Accessed May 2017. http://www.cpc.ncep.noaa.gov/products/Drought/Monitoring/spi.shtml.

NOAA, NWS. 2017e. "Experimental NWS Potential Heat Risks." Accessed May 2017. https://www.wrh.noaa.gov/wrh/heatrisk/?wfo=lox#.

National Transportation Safety Board (NTSB). 2017. Aviation Accident Database & Synopses. Accessed 2017. http://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx.

Pipeline and Hazardous Materials Safety Administration (PHSMA). 2016. "Distribution, Transmission & Gathering, LNG, and Liquid Accident and Incident Data." Data & Statistics. Accessed 2017. http://www.phmsa.dot.gov/pipeline/library/data-stats/distribution-transmission-and-gathering-lng-and-liquid-accident-and-incident-data.

Pipeline and Hazardous Materials Safety Administration (PHSMA). 2017. "National Pipeline Mapping System." Accessed 2017. https://www.npms.phmsa.dot.gov/.

Ready.gov. 2016. "Chemical threats." Accessed 2017. https://www.ready.gov/chemical-threats.

Riley, P. 2012. "On the probability of occurrence of extreme space weather events." Accessed 2017. http://onlinelibrary.wiley.com/doi/10.1029/2011SW000734/abstract.

San Francisco CBS Local. 2016. Retrieved from CBS Local: http://sanfrancisco.cbslocal.com/2016/03/07/commuter-train-derails-in-niles-canyon/.

Smith, J. K. (n.d.). California Department of Conservation. “Hazards from Mudslides... Debris Avalanches and Debris Flows in Hillside and Wildfire Areas.” Accessed April 2017. http://www.conservation.ca.gov/cgs/information/publications/cgs_notes/note_33.

Stanford University National Performance of Dams Program. 2017. “NPDP Dams Database.” Accessed 2017. https://npdp.stanford.edu/dams_database.

Stewart, S. 2013. “Fire: The Overlooked Threat.” Accessed 2017. https://www.stratfor.com/weekly/fire-overlooked-threat.

Tilghman, A. 2015. “New Islamic State weapon: chlorine gas.” Accessed 2016. http://www.militarytimes.com/story/military/2015/03/18/chlorine-attacks/24914087/.

Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan. 2017. “Planning Process”. https://www.tri-valley-hmp.com/

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2015. “Chlorine Improvised Explosive Devices and Preventive Medicine Actions.” Accessed 2017. https://mesl.apgea.army.mil/mesl/account/EHFileDownload%3FfileString%3D/webu03/meslp/webUploads/EH/moduleI/59476N.pdf+&cd=12&hl=en&ct=clnk&gl=us.

U.S. Army Corps of Engineers (USACE). 1996. “*Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams.*”

U.S. Army Corps of Engineers (USACE). 2017. National Inventory of Dams. Accessed May 2017. https://catalog.data.gov/dataset/national-inventory-of-dams.

U.S. Census. 2010. http://censtats.census.gov/data/CA/05006081.pdf.

U.S. Census. 2016. “2011-2015 American Community Survey 5-Year Estimates.” Accessed 2017. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

U.S. Census. 2016a. “2011-2015 American Community Survey 5-Year Estimates.” Accessed 2017. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

U.S. Census. 2016b. “2011-2015 American Community Survey 5-Year Estimates.” Accessed 2017. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

U.S. Census. 2016c. “2011-2015 American Community Survey 5-Year Estimates.” Accessed 2017. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

U.S. Census. 2016d. “2011-2015 American Community Survey 5-Year Estimates.” Accessed 2017. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

U.S. Census. 2016e. “2011-2015 American Community Survey 5-Year Estimates.” Accessed 2017. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

U.S. Department of Agriculture (USDA), Farm Service Agency. 2017. “Disaster Resource Center.” Accessed May 2017. https://www.usda.gov/topics/disaster.

U. S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 2005. “Final Rule, 7 Code of Federal Rules Part 624. Emergency Watershed Protection Program.” Accessed May 2017. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/.

U.S. Department of Homeland Security. 2003. *National Strategy for the Physical Protection of Critical Infrastructure of Critical Infrastructure and Key Assets.*

U.S. Department of Homeland Security and National Academies. 2004. *Chemical Attack Fact Sheet: Warfare Agents, Industrial Chemicals, and Toxins.* Accessed 2017. https://www.dhs.gov/publication/chemical-attack-fact-sheet.

U.S. Environmental Protection Agency (EPA). 2016. "Climate Change Indicators in the United States." Accessed 2017. https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases.

U.S. Environmental Protection Agency (EPA). 2016a. "Toxics Release Inventory (TRI) Program." https://www.epa.gov/toxics-release-inventory-tri-program/learn-about-toxics-release-inventory.

U.S. Environmental Protection Agency (EPA). 2016b. "Climate Change Indicators in the United States." 2016. EPA 430-R-16-004. www.epa.gov/climate-indicators.

U.S. Environmental Protection Agency (EPA). 2017. "Surf Your Watershed." Accessed April 2017. https://cfpub.epa.gov/surf/county.cfm?fips_code=06013.

U.S. Environmental Protection Agency (EPA). 2017a. Envirofacts TSCA Info. https://www3.epa.gov/enviro/facts/tsca/tsca_search.html.

U.S. Environmental Protection Agency (EPA). 2017b. Retrieved from Envirofacts RCRA Info. https://www3.epa.gov/enviro/facts/rcrainfo/search.html.

U.S. Geological Survey (USGS). 1987. The Morgan Hill, California, Earthquake of April 24, 1984, U.S. Geological Survey Bulletin 1639.

U.S. Geological Survey (USGS). 1989. *The Severity of an Earthquake*. U.S. Government Printing Office: 1989-288-913. Accessed 2017. http://pubs.usgs.gov/gip/earthq4/severity_text.html.

U.S. Geological Survey (USGS). 1997. "*Summary Distribution of Slides and Earth Flows in the San Francisco Bay Region, California.*" Open-File Report 97-745 C. Assessed 2017. https://pubs.usgs.gov/of/1997/of97-745/sfbr-sef-dbdesc.pdf.

U.S. Geological Survey (USGS). 1997. "*Map showing principal debris-flow source areas in the San Francisco Bay region, California.*" Open-File Report 97-745 E. Accessed 2017. https://pubs.usgs.gov/of/1997/of97-745/sfbr-df-dbdesc.pdf.

U.S. Geological Survey (USGS). 2008. An Atlas of ShakeMaps for Selected Global Earthquakes. U.S. Geological Survey Open-File Report 2008-1236. Prepared by Allen, T.I., Wald, D.J., Hotovec, A.J., Lin, K., Earle, P.S. and Marano, K.D.

U.S. Geological Survey (USGS). 2010. "PAGER—Rapid Assessment of an Earthquake's Impact. U.S. Geological Survey Fact Sheet 2010-3036".

U.S. Geological Survey (USGS). 2014. "Global Seismographic Network." Earthquake Hazards Program. Accessed April 2017. http://earthquake.usgs.gov/monitoring/gsn/.

U.S. Geological Survey (USGS). 2014a. "Global Seismographic Network." Earthquake Hazards Program. Accessed April 2017. http://earthquake.usgs.gov/monitoring/gsn/.

U.S. Geological Survey (USGS). 2016. "Earthquake Outlook for the San Francisco Bay Region 2014-2043". Accessed 2017. http://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf.

U.S. Geological Survey (USGS). 2016a. "Earthquake Outlook for the San Francisco Bay Region 2014-2043". Accessed 2017. http://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf.

U.S. Geological Survey (USGS). 2016b. "Earthquake Outlook for the San Francisco Bay Region 2014-2043". Accessed 2016. http://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf.

U.S. Geological Survey (USGS). 2016c. "Earthquake Outlook for the San Francisco Bay Region 2014-2043". Accessed 2016. http://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf.

U.S. Geological Survey (USGS). 2016d. "Earthquake Outlook for the San Francisco Bay Region 2014-2043". Accessed 2016. http://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf.

U.S. Geological Survey (USGS). 2016e. "Earthquake Outlook for the San Francisco Bay Region 2014-2043". Accessed 2016. http://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf.

U.S. Geological Survey (USGS). 2017. "Soil Type and Shaking Hazard in the San Francisco Bay Area." Earthquake Hazards Program. Accessed 2017. https://earthquake.usgs.gov/regional/nca/soiltype/.

U.S. Geological Survey (USGS). 2017a. "Search Earthquake Archives." Earthquake Hazards Program. Accessed 2016. http://earthquake.usgs.gov/earthquakes/search/.

U.S. Geological Survey (USGS). 2017b. "The San Andreas and Other Bay Area Faults." Accessed April 2017. https://earthquake.usgs.gov/earthquakes/events/1906calif/virtualtour/bayarea.php.

U.S. Geological Survey (USGS). 2017c. "Landslides 101." Accessed April 2017. https://landslides.usgs.gov/learn/ls101.php.

U.S. Geological Survey (USGS). 2017. "California Drought." Accessed January 2017. https://ca.water.usgs.gov/data/drought/.

U.S. Geological Survey (USGS). 2017a. "Measuring Earthquakes FAQs." Accessed February 2017. https://www2.usgs.gov/faq/categories/9828/3357.

U.S. Geological Survey (USGS). 2017c. "Land Subsidence Monitoring Network." Accessed April 2017. https://ca.water.usgs.gov/land_subsidence/bay-delta-subsidence.html

U.S. Global Change Research Program (USGCRP). 2009. "Global Climate Change Impacts in the United States." Thomas R. Karl, Jerry M. Melillo and Thomas C. Peterson, (eds.). Cambridge University Press. Accessed 2016. https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

Waldron, K. 2011. "How Vulnerable is New Jersey to Cyber Terrorism?" Accessed 2016. http://nj1015.com/how-vulnerable-is-new-jersey-to-cyber-terrorism-audio/.

Washington Department of Ecology. (2014). "About Landslides." http://www.ecy.wa.gov/programs/sea/landslides/about/about.html.

Water-Wise Gardening Tri-Valley. 2017. "Gardening tips for drought conditions." Accessed May 2017. http://www.trivalleywaterwise.com/.

Western Regional Climate Center. 2017 "Temperature and Precipitation Summaries." Accessed April 2017.

Wilson and Clay. 2008. "Botnets, Cybercrime, and Cyber terrorism: Vulnerabilities and Policy Issues for Congress." http://www.fas.org/sgp/crs/terror/RL32114.pdf.

World Health Organization (WHO). 2014. "Geographic distribution of Ebola virus disease outbreaks in humans and animals." Accessed 2017. http://www.who.int/csr/disease/ebola/ebola-map-humans-animals-2014.png?ua=1.

Zone 7 Water Agency. (Zone 7). 2014. *2014 Annual Report.* Accessed May 2017. http://www.zone7water.com/publications-reports/reports-planning-documents.

Zone 7 Water Agency (Zone 7). 2015. *2015 Annual Report*. Accessed May 2017.

Zone 7 Water Agency (Zone 7). 2015. *2015 Urban Water Management Plan*. Accessed May 2017.

Zone 7 Water Agency (Zone 7). 2017. http://www.zone7water.com/.

GLOSSARY

ACRONYMS

ABAG—Association of Bay Area Governments

CCR—California Code of Regulations

CDBG-DR—Community Development Block Grant Disaster Recovery

CEQA—California Environmental Quality Act

CFR—Code of Federal Regulations

CIP—Capital Improvement Plan

CRS—Community Rating System

DFIRM—Digital Flood Insurance Rate Maps

DHS—Department of Homeland Security

DMA —Disaster Mitigation Act

DTSC—Department of Toxic Substances Control

DWR—Department of Water Resources

EMA—Emergency Management Agency (California state)

EPA—U.S. Environmental Protection Agency

ESA—Endangered Species Act

FEMA—Federal Emergency Management Agency

FERC—Federal Energy Regulatory Commission

FIRM—Flood Insurance Rate Map

FIS—Flood Insurance Study

FRA—Federal Responsibility Area

GIS—Geographic Information System

Hazus—Hazards, United States

HMA—Hazard Mitigation Assistance

HMGP—Hazard Mitigation Grant Program

IBC—International Building Code

IRC—International Residential Code

LRA—Local Responsibility Area

MM—Modified Mercalli Scale

NCA—National Climate Assessment

NEHRP—National Earthquake Hazards Reduction Program

NFIP—National Flood Insurance Program

NIMS—National Incident Management System

NOAA—National Oceanic and Atmospheric Administration

NWS—National Weather Service

OES—Office of Emergency Services

PDM—Pre-Disaster Mitigation Grant Program

PDI—Palmer Drought Index

PGA—Peak Ground Acceleration

PHMSA—Pipeline and Hazardous Materials Safety Administration

PHDI—Palmer Hydrological Drought Index

SEMS—Standardized Emergency Management System

SFHA—Special Flood Hazard Area

SPI—Standardized Precipitation Index

SRA—State Responsibility Area

USGCRP—U.S. Global Change Research Program

USGS—U.S. Geological Survey

WNV—West Nile virus

DEFINITIONS

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the “100-year” or “1% chance” flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as “watersheds” and “drainage basins.”

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events, and
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65 percent.

Disaster Mitigation Act of 2000 (DMA); The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community’s Flood Insurance Rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the Special Flood Hazard Area (SFHA).

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour (mph)) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard Loss Estimation Program (Hazus): Hazus is a GIS-based program used to support the development of risk assessments as required under the DMA. The Hazus software program assesses risk in a quantitative manner to estimate damage and losses associated with natural hazards. Hazus is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. Hazus has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a “bolt,” usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mass movement: A collective term for landslides, debris flows, sinkholes and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates are based on the methodology used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 100-107) was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974

(Public Law 93-288). The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion refers to the erosion, sloughing or undercutting of a river, stream or drain. It is natural for streams to meander through erosion processes. Generally, stream bank erosion is a problem where development has limited meandering, where streams have been channelized, or where stream bank structures (bridges, culverts, etc.) are in places where they can cause damage to downstream areas. Stabilizing these areas can help protect watercourses from sedimentation, prevent damage to adjacent lands, control unwanted meander, and improve fish and wildlife habitat.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33 percent.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damage, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

Tri-Valley Local Hazard Mitigation Plan

Appendix A. Public Outreach Materials

SURVEY, SURVEY RESULTS

1. Survey Introduction

Tri-Valley Hazard Mitigation Questionnaire

A range of natural and human-caused disasters can affect any community. The Cities of Livermore, Pleasanton and Dublin and their special district planning partners work diligently to mitigate threats and prepare for disasters. Natural disasters are those hazards that occur as a force of nature, such as a flood or earthquake. Non-natural disasters are those that occur as part of an intentional act or failure of technology. For the purpose of this plan, non-natural hazards also include health hazards, such as epidemics.

To maintain a high level of preparedness, we need your help to identify and plan for future disasters by completing this survey.

Thank you for taking the time to participate in the 2017 Hazard Mitigation Survey!

Tri-Valley Local Hazard Mitigation Plan Survey

2. Hazard Knowledge

First, this set of questions is about your experience and knowledge of natural hazards and steps your household has taken to prepare for disasters:

1. Which of the following natural hazard events have you experienced in the Tri-Valley planning area? (Check all that apply)

- ☐ Dam/Levee Failure
- ☐ Drought
- ☐ Earthquake
- ☐ Flood
- ☐ Landslide & Mass Movements (sinkholes, geologic hazards)
- ☐ Severe Weather (high wind, heavy rain, lightning, etc.)
- ☐ Wildfire
- ☐ None
- ☐ Other (please specify)

2. How concerned are you about the following natural hazards in the Tri-Valley planning area? (Please check one for each hazard)

	Not concerned	Somewhat concerned	Concerned	Very concerned	Extremely concerned
Dam/Levee Failure	○	○	○	○	○
Drought	○	○	○	○	○
Earthquake	○	○	○	○	○
Flood	○	○	○	○	○
Landslide & Other Earth Movements (sinkholes,geologic hazard)	○	○	○	○	○
Severe Weather (wind, lightning, fog, heavy rains, solar flare, etc.)	○	○	○	○	○
Wildfire	○	○	○	○	○
Other Natural Hazard	○	○	○	○	○

If you are concerned about a natural hazard not listed above, please specify.

3. How would you expect to be notified in case of an immediate threat caused by a local hazard.

Select all that apply.

- [ ] Television
- [ ] Twitter
- [ ] Public Notification System
- [ ] Radio
- [ ] Nextdoor
- [ ] Alameda County Alert
- [ ] Facebook
- [ ] Nixle
- [ ] Other (please specify)

4. Which of the following steps has your household taken to prepare for a local hazard event? (Check all that apply)

- [ ] Received first aid/CPR training
- [ ] Made a fire escape plan
- [ ] Designated a meeting place
- [ ] Identified utility shutoffs
- [ ] Prepared a disaster supply kit
- [ ] Installed smoke detectors on each level of the house
- [ ] Stored food and water
- [ ] Stored flashlights and batteries
- [ ] Stored a battery-powered radio
- [ ] Stored a fire extinguisher
- [ ] Stored medical supplies (first aid kit, medications)
- [ ] Registered to receive emergency alerts
- [ ] Purchased additional Insurance
- [ ] Other (please specify)

5. How prepared is your household to get along without electricity or natural gas for one to five days?

- ( ) Not at all prepared
- ( ) Somewhat prepared
- ( ) Very prepared

3. Location

Please tell us about where you live and work:

* 6. Where do you live?

- Dublin
- Pleasanton
- I do not live in the Tri-Valley Planning area
- Livermore
- Alameda County (Unincorporated)

If you live in Unincorporated County, please provide the name of your community.

7. Where do you work?

- Dublin
- Pleasanton
- I work outside of the Tri-Valley planning area
- Livermore
- Alameda County (Unincorporated)
- I am unemployed/retired

4. Location (continued)

Please tell us about where you live and if the potential impacts of natural or human-caused hazards influenced your decision:

8. Do you own or rent your place of residence?

- ○ Own
- ○ Rent

9. When you moved into your home, did you consider the impact a disaster could have on your home?

- ○ Yes
- ○ No

10. If you received real estate disclosure information when you moved into your current residence, did your real estate agent or landlord explain the implications of living in a hazard risk zone and did you understand the information presented?

- ○ Yes
- ○ No

11. Is your home located in any of the following hazard areas (check all that apply):

- ☐ FEMA Designated Floodplain
- ☐ Near an Active Fault (within 1 mile)
- ☐ Dam Failure Zone
- ☐ Wildfire Prone Area
- ☐ High Liquefaction Zone
- ☐ Landslide/Sinkhole Area
- ☐ Other (please specify)

12. Do you have hazard- specific insurance (check all that apply)?

- ☐ Flood Insurance
- ☐ Earthquake Insurance
- ☐ Not Sure
- ☐ Other Insurance (please specify)

5. About You

Please tell us about yourself. This information will aid the Local Hazard Mitigation Plan Workgroup in evaluating the responses to this questionnaire. The answers will be used only for the preparation of this Plan and will not be provided to any other group or interest.

13. Is English the primary language spoken in your home?

- ◯ Yes
- ◯ No (please specify)

14. Which of the following digital media outlets do you use and/or subscribe to receive news and information about the Tri-Valley Planning Area?

Select all that apply.

- ☐ Facebook
- ☐ Twitter
- ☐ Nextdoor
- ☐ Other (please specify)
- ☐ E-mail and/or text messages
- ☐ Nixle
- ☐ Local News

15. Please indicate how you feel about the following statement:

It is the responsibility of government (local, state and federal) to provide education and programs that promote citizen actions that will reduce exposure to the risks associated with natural hazards.

◯ Strongly Disagree ◯ Somewhat Disagree ◯ Neutral ◯ Somewhat Agree ◯ Strongly Agree

16. Please provide any additional comments you would like to share with the LHMP Steering Committee.

17. If you would like to receive information regarding upcoming public events, other participatory opportunities regarding hazard mitigation, or general preparedness information, please provide your email address below.

STEERING COMMITTEE MEETING SUMMARIES

MEETING SUMMARY

Date/Time of Meeting:	Tuesday – March 7, 2017; 9:00am to 11:00am
Location:	Regional Meeting Room, 100 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No.1
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance (See Attachment):	**Attendees:** Susan Frost, Cary Fukada, John Richards, Hazel Wetherford, Dan Stevenson, Mike Benzien, Julie Carter, John Lawrence, Tracy Hein, Lincoln Casimere, Shweta Bonn, Adam Weinstein Phoned in: Marla Blagg, Joe Testa, Bruce Bird **Planning Team:** Rob Flaner
Not Present:	N/A
Summary Prepared by:	Rob Flaner (3/20/2017)
Quorum – Yes or No	N/A – Steering Committee not finalized

Item	Action

Welcome and Introductions, Review Agenda

- Mr. Rob Flaner opened the meeting and facilitated group introductions.
- Distributed handouts included: Agenda; Draft Steering Committee Charter; Work Plan and timeline, Planning Partner expectations document
- The agenda was reviewed and no modifications were made.

Project Overview

After introductions, Mr. Flaner went through a PowerPoint presentation that provided an overview of the Disaster Mitigation Act (DMA) of 2000. He noted that per DMA 2000 requirements, hazard mitigation plans (HMP) are needed to be eligible for certain types of federal grant funding opportunities. He provided a history of hazard mitigation planning in the 3 cities and noted that this process represent a functional reset for the Cities and their planning partners. The presentation provided an overview of the 7-phase work plan that will follow the Community Rating System (CRS) planning script to maximize the CRS credit potential for participating Cities (Pleasanton and Livermore). The presentation concluded by introducing the role of the

Item	Action
Steering Committee and identified the next planning steps to be conducted. **Should We expand the Partnership?** Under the next segment of the agenda, Mr. Flaner presented to the SC the options for expansion of the coverage of the plan to include special purpose districts within the planning area. Mr. Flaner explained that section 201.4 of 44CFR redefined the definition of "local government" to include special purpose districts that have junior taxing authority. This puts districts in the same position as municipal governments in that they must have participated in the development of, and adopted a hazard mitigation plan to be eligible for pre/post disaster hazard mitigation grant funding.	
The topic of discussion transition to what special purpose districts would be likely candidates to participate in the Tri-Valley effort. Mr. Flaner explained the Dublin/San Ramon CSD had already expressed interest in this effort based on a referral from Contra Costa County. Mr. Flaner also explained that there would be no extra cost to the current contracts for this planning effort to expand, that responsibility to meet planning partner expectations would lie with each committed district. It was the general consensus of the group that the planning partnership should be expanded with the most like candidates being: the school districts, water/waste water service providers and the Livermore Area Parks and Recreation District. Mr. Flaner asked for members of the SC to provide him with contact information for the targeted districts so that he can send them an introductory e-mail along with the planning partner expectations package prior to the next SC meeting. This dissemination will establish a turn-around time for the Districts to commit to the process.	Planning Team to send out e-mail to districts targeted for expansion explaining the options available to participate in the Tri-Valley planning effort prior to next SC meeting.
The Steering Committee's Role Mr. Flaner turned attention to establishing the ground rules for the Steering Committee. He provided the group with a proposed draft Charter which they reviewed. Mr. Flaner requested that the group discuss the specific composition and rules of the HMP SC. He began by discussing who should be the Chair and Vice Chair. Ms. Hazel Wetherford from the City of Dublin volunteered to be the Chair and Mr. Adam Weinstein from the City of Pleasanton volunteered as Vice-chair. Other key components of the Charter approved by the SC include: • Hazel Wetherford will act as the spokesperson for the process • The quorum was established as 50%+1, or 12 members.	

Item	Action
• The proxy protocol will be followed for alternates • The reoccurring meeting date will be the 2nd Tuesday of every month from 9:00 AM to 11:00 AM • The meeting Location will be the Reginal Meeting Room at Dublin City Hall, 100 Civic Plaza, Dublin, CA 94568 • A public comment protocol will be followed that mirrors standard process for city council meetings. Mr. Flaner will finalize the Charter and will make available for public review via the website discussed below.	Planning Team to finalize the Charter based on direction from this meeting, and will post on the TVLHMP website.
Plan Review Mr. Flaner reiterated that this planning process was being viewed as a "functional reset" for those local governments that had prior coverage under the ABAG plan. Many planning components such as goals, objectives, public outreach strategy will be developed from scratch as hazard mitigation planning moves from a Bay Area regional focus to one specifically focused on the Tri-Valley panning area. The principal starting point for this process will be a review of The CA State Hazard Mitigation Plan. Section 2501.6 44CFR requires that Local Hazard Mitigation Plans integrate and be consistent with key planning goals identified in the State Hazard Mitigation Plan. The State mitigation plan should be used to frame the hazards of concern to be addressed by the Tri-Valley plan and the goals and objectives. To prepare for the next SC meeting that will be dedicated to goal setting and hazard identification, Mr. Flaner assigned homework to the SC. The homework involved a review of the CA State Hazard Mitigation Plan to gain a better understanding of: • The State's identified goals for Hazard mitigation • The hazards the State plan identifies the Tri-Valley Planning area is susceptible to.	The SC to review the CA State Hazard mitigation plan to identify: •The State's identified goals for Hazard mitigation •The hazards the State plan identifies the Tri-Valley Planning area is susceptible to.
Public Involvement Strategy Mr. Flaner expanded on earlier discussion regarding the requirement for public engagement throughout the entire planning process. This will be accomplished for this effort by the identification of a comprehensive public engagement strategy that will utilize multiple media within the existing capabilities of the assembled planning partnership. This strategy will be identified and approved by the SC via the panning process. The cornerstone of this strategy will be the development of a website that will house the plan and its support document. The website will be the "one-	

Item	Action
stop-shop" for all things hazard mitigation within the Tri-Valley planning area. The Planning team has already developed a site framework on the "WIX" platform that will become activated as soon as information becomes available to post.	

Action Items for Next Meeting

Action items identified for the next meeting include the following:

- Confirm hazards of Concern
- Identify a Vision/Mission
- Goal Setting
- Phase 1 Public Outreach

MEETING SUMMARY

Attachment: Sign-in Sheet

Tri-Valley Hazard Mitigation Plan-Update
March 7, 2017

Name	Representing	E-mail
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Shweta Bonn Adam Weinstein	City of Pleasanton "	sbonn@cityofpleasantonca.gov aweinstein@"

Tri-Valley Hazard Mitigation Plan-Update
March 7, 2017

Name	Representing	E-mail
MARL BLAGG	BART	PHONE IN
JOE TESTA	LPFD	" "
BRUCE BIRD	VOAD	" "

MEETING SUMMARY

Date/Time of Meeting:	Tuesday – April 11, 2017; 9:00am to 11:00am
Location:	Regional Meeting Room, 100 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No.2
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance (See Attachment):	**Attendees:** Susan Frost, Cary Fukada, John Richards, Hazel Wetherford, Dan Stevenson, Tracy Hein, Shweta Bonn, Adam Weinstein, Stan Kolodzie, Steve Stewart, Joe Testa Phoned in: None **Planning Team:** Rob Flaner
Not Present:	N/A
Summary Prepared by:	Rob Flaner (4/14/2017)
Quorum – Yes or No	Yes

Item	Action

Welcome and Introductions, Review Agenda

- Mr. Rob Flaner opened the meeting and facilitated group introductions.
- Distributed handouts included: Agenda; Meeting Summary, Final SC Charter, SB-379 Summary, Draft Press release, example survey, example vision/mission statements
- The agenda was reviewed and no modifications were made.
- The meeting summary was approved as amended.
- There were no members of the public present
- The final Charter was approved as amended.

Hazards of Concern

Rob Flaner facilitated discussion on which hazards of concern the plan should address. At the last SC meeting, the committee was asked to review the CA State Hazard mitigation Plan to see:

a. What hazards the state plan assessed
b. What hazards the state plan said the Tri-Valley planning area was susceptible to.

Rob explained that the first order of business was to decide whether the plan should include non-natural/human caused hazards. Section 201.6

Item	Action

44CFR states that local hazard mitigation plans "***shall"*** assess the risk from natural hazards within a planning area, and they ***"may***" assess other hazards of interest. So it is considered optional to include non-natural/human caused hazards in the risk assessments for local hazard mitigation plans. So Rob asked the committee to share their thoughts on this question.

Rob explained that he had done plans both ways over the years, but it is important to note that you cannot assess the 2 types of hazards in the same context. FEMA has defined "risk" as Probability x Impact. The probability of an event is the possible recurrence of an event based on historical record. The impact is based on the impact of a hazard on the people, property and economy of a planning area. The fundamental difference between assess risk on natural vs. non-natural hazards following this definition is probability. There is sufficient historical record of natural hazards events to assign recurrence intervals or probabilities based on historical record. These type of records do not exist for non-natural hazards. We know that a 100-year flood event is a flood that has a 1% chance of occurring in any given year. There is no such thing as a 100-year terrorism event.

So after discussion, there was consensus among the SC that the plan should include non-natural/human caused hazards. The principle driver for this decision was to acknowledge the potential exposure to these type events and to acknowledge the other plans and programs within the planning area that are specific to these type hazards. The plan will fully assess and rank the risk to the natural hazards of concern and will profile the other non-natural/human caused hazards of interest.

Next, the discussion shifted to which hazards the plan will include. For the natural hazards, the plan will assess and rank the following hazards:

- Dam Failure
- Drought
- Earthquake
- Flood
- Landslide
- Severe Weather
- Wildfire

Hazus will be used to model the impacts from the Dam Failure, Earthquake and Flood hazards. Multiple event scenarios will be modeled for each of these hazards as follows:

- Dam Failure- Del Valle and san Antonio reservoirs

Item	Action
• Earthquake- a “Haywired”, Greenville, Southern Calaveras, Mt. Diablo and San Andreas fault scenarios from shakemaps provided by USGS. • Flood-10, 100 and 500-year flood events. For non-natural/human caused hazards, the SC determined that the plan should profile the following hazards: • Terrorism-Including Cyber and Agricultural terrorism • Hazardous Materials- both rail and Highway • Pipeline hazards (oil and gas, natural gas) • Oil and Gas mining • Human Health-including pandemic • Jails- both County and federal • Transportation- Airport	
<u>Public Involvement Strategy</u>	
Rob in formed the SC that the website was up and running. The website address is: https://www.tri-valley-hmp.com/ . Rob previewed the site and asked all jurisdictions to link to the site on their individual web sites. Rob also stated that he would like to get a press release out ASAP to advertise the planning process and the website. Rob asked the group who would be good public information offices to work through. Hazel Weatherford from Dublin recommended their PIO, Lori Taylor, and Stan Kolodzie from DSRCSD recommended their PIO, Sue Stevenson. It was recommended by the group that Lori had a well-established network of PIO’s within the planning area and that she would be able to lead the coordination of all press releases. Hazel asked Rob if he could provide a “word” version of the draft press release so that it could be put in to the proper city format.	Planning partners to link to the LHMP website on their individual websites Rob to send copy of “word” version of the press release to Hazel
Next, Rob presented a draft copy of a hazard mitigation survey that is currently being used in the Contra Costa County planning effort. Rob explained to the EC that surveys are a good way to gauge the public’s perception of risk and will be an integral part of the public engagement strategy for the Tri-Valley planning effort. As homework, Rob asked for the SC to review the draft survey and to mark up any changes the SC would like to see made. The SC will finalize a Tri-Valley survey as an action item at their May SC meeting	Homework: SC to review draft survey and be prepared to finalize a Tri-Valley survey at the next SC meeting.
<u>Goal Setting</u> Rob explained to the SC that it is required under section 201.6 44CFR for LHMP’s to have a clearly defined set of goals. Rob explained that many planning efforts expand on this requirement and include a vision or	

Item	Action
mission statement and a set of measurable objectives. While not required, these planning components can add depth and versatility to a LHMP. Rob explained that it is Tetra Tech's recommendation that the Tri-Valley plan include: a vision/mission statement, goals and objectives. These would be linear planning components that each would stand on their own merit and would be selected based upon their ability to support the upper tier component. So, for example, once a vision/mission statement was determined, goals would be identified that define that vision/mission. Then objectives would be identified on the basis of their ability to support multiple goals. Then actions would be identified and prioritized based on their ability to meet multiple objectives. The SC agreed with this approach for the Tri-Valley plan.	
Rob provided the SC with a handout that provided 11 example vision/mission statements from other planning efforts around the country. The SC was asked to review the statements to identify what type of vision/mission statement they wanted for the Tri-Valley Plan. It was determined that there was not sufficient time at this meeting to confirm a vision/mission statement for the plan, so the SC was given homework to review and refine recommendations for a vision/mission statement. It was also suggested that these statements be reviewed for consistency with to vision/mission statements of the general plans for the 3 cities. To expedite this process, Rob asked for the SC to provide their recommendations to Rob via e-mail by close of business, Friday April 21, 2017.	SC to provide Rob their recommendations for vision/mission statements via e-mail by Friday April 21, 2017.
Rob explained that the next step after confirming a vision/mission statement would be to identify to goals for the plan. This will be done by the completion of a goal setting exercise using Survey Monkey, where the SC will review a catalog of goals statements and each member of the SC will chose 5 statements they feel should be in the plan. Those goal statements that receive the most votes will be the basis for the goals selected for the plan. Rob explained that it is imperative that all SC members complete the exercise so that the goals selected for consideration can be based on a quorum consensus.	
Rob stated that he would really like to have goals identified for the plan before the phase 1 public meetings. So to meet this objective, Rob will	Rob to deploy the goal setting exercise prior to May SC meeting

Item	Action
deploy the goal setting exercise prior to the May SC meeting so that the goals can be confirmed at that meeting.	

Action Items for Next Meeting

Action items identified for the next meeting include the following:

- Confirm hazard mitigation survey
- Confirm vision/mission statement
- Confirm Goals
- Define critical facilities/infrastructure
- Introduce objectives exercise

MEETING SUMMARY

Attachment: Sign-in Sheet

Tri-Valley Hazard Mitigation Plan-Update
April 11, 2017

Name	Representing	E-mail
John Richards ✓	LLNL	richards6@llnl.gov
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Cary Fukada ✓	Pleasanton Resident	cfukada@hotmail.com

1

FINAL MEETING SUMMARY

Date/Time of Meeting:	Tuesday – May 16, 2017; 9:00am to 11:00am
Location:	Regional Meeting Room, 100 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No.3
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance (See Attachment):	**Attendees:** Susan Frost, John Richards, Julie Carter, Shweta Bonn, Adam Weinstein, Stan Kolodzie, Joe Testa, Marla Blagg (phone in), Lincoln Casimere (phone in) Phoned in: None **Planning Team:** Rob Flaner
Not Present:	N/A
Summary Prepared by:	Rob Flaner (6/1/2017)
Quorum – Yes or No	No

Item	Action

Welcome and Introductions, Review Agenda

- Mr. Rob Flaner opened the meeting and facilitated group introductions.
- There was not sufficient attendance for a quorum.
- Distributed handouts included: Agenda; Meeting Summary, example mission/vision statements, sample critical facility definitions, goal setting exercise
- The agenda was reviewed and no modifications were made.
- Approval of meeting summary was tabled until the next meeting due to lack of a quorum.
- There were no members of the public present
- Lori Taylor from the City of Dublin is retiring and will need to be replaced as PIO for this planning effort. It was recommended by the SC that Lori Dunne from the City of Pleasanton would assume the role as public information coordinator for this process.

Goal Setting

The confirmation of a vision mission statement for the plan was tabled at the last meeting for further discussion at this meeting. The SC reviewed the example statements and recommended the following:

Item	Action
Through community partnerships, establish a plan to reduce the vulnerability to hazards in order to protect the health, safety, welfare, environment and economy of the planning area.	
Due to the lack of a quorum, confirmation of this mission/vision statement was tabled until the June meeting.	
Prior to the meeting, Rob had sent out a goal setting exercise to the Committee. Hard copies of the exercise were provided at the meeting. Rob explained that the purpose of the exercise was to review a catalog of goal statements. The SC was asked to identify at least 5 of the goal statements that they feel best support the mission/vision that had been identified for the plan. Members in attendance that had not completed the exercise on-line were given time to complete the exercise at the meeting. Six surveys were completed at the meeting the results of the survey will be presented at the next meeting with the intent to finalize the goals for the plan by a quorum vote.	Planning team to tabulate goal setting exercise results for review at next meeting.
Rob then explained that the next step after goal confirmation would be to identify a series of objectives that will meet multiple goals. This will be done by survey in the same context as goal setting.	
Public Involvement Strategy	
Rob reiterated that the website was up and running and asked if the individual planning partners had in fact created links to the website. Not all planning partners had yet established links to the website. Rob ask that this be confirmed before the next meeting. A press release on the planning process had been distributed and there was some response to the release. The "Independent" published a piece on the planning process on May 4th as did the Dublin Patch on May 18th. Rob stressed that any and all press coverage of the plan and the process is a good thing and asked that the SC continue to get the word out.	
The proposed hazard survey was reviewed once again by the committee and additional edits were made. However, due to the lack of a quorum, the final survey could not be approved. Approval and deployment of the final survey was tabled until the next meeting in June.	Planning team to revise survey prior to next SC meeting and distribute to SC prior to next meeting for their review.
Critical Facilities	
Rob explained that one of the principle objectives for the Disaster Mitigation acts is to make the nation's critical facilities and infrastructure more resilient. He explained that it is a principle objective for hazard mitigation grants to show how a proposed project will benefit identified critical facilities and infrastructure. The planning requirements for DMA compliant plans specify that planning efforts "define" what are	

Item	Action
critical facilities and infrastructure specific to a defined planning area. So the next step for the SC is to define critical facilities and infra-structure for the planning area. Rob provided a handout that provided examples of critical facility/infrastructure definitions from across the country. Discussion then ensued on variations of the examples that best suited the Tri-Valley planning area. It was decided that the following definition would be appropriate for this planning effort:	

A Critical Facility is infrastructure or a facility that is critical to the health and welfare of the population. These become especially important after any hazard/natural disaster event occurs. For the purposes of the Tri-Valley Planning Area Hazard Mitigation Plan, Critical Facilities include:

- ***Essential Facilities:***
    - *Medical and Shelter Facilities—Facilities likely to be used as a sheltering or community assembly location, and structures likely to contain occupants who may not be sufficiently mobile to avoid death or injury during and after a hazard/natural disaster event including but not limited to: Hospitals, schools, skilled nursing facilities, board and care homes, pharmacies, clinics, fairgrounds, community centers, ambulance services, and veterinary hospitals.*
    - *Emergency Response—Public and private facilities that are needed for response and recovery activities before, during, and after a hazard/natural disaster event including but not limited to: Emergency Operations Centers, public safety answering points, police stations, fire stations, local, state and federal resource agencies, and emergency response staging sites.*
    - *Recovery facilities—debris clearing and disposal, car rentals, buses, financial institutions, survival and building supplies*
    - *Utilities and Infrastructure—Public and private utility facilities and essential services that are vital to maintaining or restoring normal services to impacted areas before, during, and after a hazard/natural disaster event including but not limited to: All transportation infrastructure, municipal water pumps and wells, water treatment plants, water storage, sewage treatment facilities, lift stations, water and sewer mainlines, substations, electric power*

Item	Action

generating and transmission infrastructure, retail and wholesale fuel transmission infrastructure and transport and storage facilities, telecommunications, repeater stations, radio stations and towers, airport services, standby power-generating equipment, public works corporation yards and grocery stores.

- ***Hazardous Facilities:***
  - *Major Dams and Levees*
  - *Risk Management Plan (RMP) Hazmat Sites—Hazmat sites are structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water-reactive materials. This includes all RMP Hazmat sites including but not limited to facilities that use, or store acutely hazardous materials as defined by California Code of Regulations Title 19, Division 2, Chapter 4.5, Section 2770.5.*
  - *Additional Hazmat Sites—Hazmat sites may additionally include: Nuclear materials storage sites, wholesale fuel facilities, hazardous materials yards, industrial facilities .*

Once again, this definition could not be approved due to the lack of a quorum and its approval was tabled until the next meeting.

National Policy Briefing

Rob provide the SC a briefing on some national policy changes that he had learned about at a national flood conference he attended 2 week prior to this meeting. These points are summarized as follows:

- *FMA Hazard Mitigation Assistance program*: Due to the continuing resolution extending the national budget, there will be congressional appropriations for the Pre-disaster mitigation grant program (PDM and the Flood Mitigation Assistance (FMA) grant programs. PDM has been authorized for $100 million and FMA was authorized for $175 million. This is good news as both of these programs had been cut in the President’s proposed budget. This may be the last time these programs are funded for a while.
- *Disaster deductible concept for Public Assistance*: There is a lot of political support for a major overhaul of the “Public Assistance (PA) program. The current model is based on a damage threshold that is population based. There is a lot of support for a “disaster deductible” concept that established a deductible for each state that

Item	Action

can be bought down by tracking successful mitigation actions that have reduced risk. This concept puts a premium on being able to identify and track successful mitigation projects. This would have a large impact on states like CA that would have very high deductibles due to its population.

- *NFIP reauthorization*: Reauthorization of the National Flood Insurance Program (NFIP) is slated for October 2017. The current administration is very heavily supporting of the concept of privatizing the NFIP. The NFIP in is current state is significantly flawed. There are many who feel that these flaws could be corrected by privatizing the program. But what about the programmatic aspects of the NFIP? Is the private sector going to monitor compliance with the programmatic aspects of the NFIP? Are those programmatic aspects even needed? The answers to these questions could have a significant impact on the way the nation's floodplains and managed.
- *Moonshots 2023*: The Flood Insurance and Mitigation Administration (a branch of FEMA referred to as FIMA) has a new mission. It has been termed "Moonshots 2023". The ultimate goal of Moonshots 2013 is to double the flood insurance coverage of the nation by 2023, regardless of who is managing the program. This program will built upon innovation with 3 cornerstones, explore, build and finish. It has established very ambitious goals for flood risk management and mitigation as a whole over the next 6 years.

Action Items for Next Meeting

Action items identified for the next meeting include the following:

- Approve Mission/Vision
- Approve Goals
- Approve Critical Facilities definition
- Approve final survey
- Introduce objectives exercise
- Set round 1 public meeting schedule

FINAL MEETING SUMMARY

Attachment: Sign-in Sheet

Tri-Valley Hazard Mitigation Plan-Update
May 16, 2017

Name	Representing	E-mail
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Shweta Bonn ✓	Pleasanton	sbonn@...
MARLA BLAGG	BART	PHONED IN
LINCOLN	ACFD	PHONE IN
STAN KOCODZIE	DSRCSD	

FINAL MEETING SUMMARY

Date/Time of Meeting:	Tuesday – June 13, 2017; 9:00am to 11:00am
Location:	Regional Meeting Room, 100 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No. 4
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance: **(See Attachment):**	Shweta Bonn, Susan Frost, Cary Fukada, Tracy Hein, Stan Kolodzie, John Richards, Adam Weinstein, Hazel Wetherford Phoned in: None **Planning Team:** Rob Flaner, Tommie Jean Valmassy
Summary Prepared by:	Tommie Jean Valmassy
Quorum – Yes or No	Yes

Item	Action
Welcome and Introductions, Review Agenda • Rob Flaner opened the meeting and facilitated group introductions. • There were not enough steering committee members present for a quorum. • Distributed handouts included: Agenda, Meeting Summary #3, Risk Assessment Data Dictionary for Spatial Analysis, Goal Exercise Results, Draft Community Survey. • The agenda was reviewed and no modifications were made.	
Planning Process	
There was not sufficient attendance for a quorum. There have been several meetings without a quorum, preventing approval and progress on project milestones. Mr. Flaner said the quorum was established as 50% of planning members plus 1, which means 10 attendees are needed for a quorum. This is the fourth meeting and some members have yet to attend. It was determined that the quorum should be 50% plus 1 jurisdictional member. There are four jurisdictions, so a quorum is now three of the four jurisdictions. Based on the change, there is now a quorum for the meeting.	New Quorum is set at three.
Since a quorum was established, the group provided some minor edits to the notes from Meeting No. 3, and approved them as final pending incorporation of edits.	Update and finalize the notes from meeting No. 3.

Item	Action
Once a quorum was established, the group voted to approve the Mission and Vision statements, as presented in the notes from meeting No. 3.	Mission and Vision are approved for the plan. A clean copy will be provided to the group.

Risk Assessment Update

Mr. Flaner reviewed the Risk Assessment Data Dictionary for Spatial Analysis. This includes a description and data source for general building stock, critical facilities, flood, earthquake, landslide, dam and reservoir failure, wildfire, demographics, and current/future land use.

The costs associated with hazards will be costs to repair or replace, not a current assessed value. There is a formula that includes square footage and occupancy, and factors in anticipated down time for a building or structure.

Mr. Flaner said the risk assessment will include five different earthquake scenarios because fault and magnitude variances will make a difference in risk.

Item	Action
For wildfire scenarios, Tetra Tech is using Cal Fire Fire and Resource Assessment Program (FRAP) data, which is limited because it focuses on resource planning areas. Mr. Flaner asked Tracy Hein if she is aware of a community wildfire protection plan (CWPP). Ms. Hein is not aware of one but will ask.	Tracy Hein will find out if there is a CWPP
In relation to flood data, FEMA tracks repetitive losses. A repetitive loss is a property with two or more losses worth over $1,000 since 1978. Because the Tri-Valley does not have a lot of flood issues, there likely are not repetitive loss properties.	
For landslides, Tetra Tech will use data from the Association of Bay Area Governments (ABAG), unless any communities have their own landslide data.	If your jurisdiction has landslide data provide it to Mr. Flaner.

Demographic data will be gathered through the American Community Survey (ACS). The U.S. Census Bureau only completes a full census every ten years, so the most recent data is 2010. Tetra Tech will use ACS data because it is more recent.

Mr. Flaner said Buildable Lands is vacant land that, based on zoning, could be built. He asked if any of the Tri-Valley planning departments have

Item	Action
buildable lands data. Vacant land is also easy to define. More ambiguous is "underutilized land." Mr. Flaner said Tetra Tech needs whatever data is available, but will not do an analysis to confirm the correct category of land.	
<u>Goal Setting</u> See handout for the top ten goals, established based on steering committee members completing a survey. Typically plans have five to seven goals. The team went through the goals and created the following final list: 1.) Ensure that hazards are identified and considered in land use decisions. 2.) Improve local emergency management capability. 3.) Promote community awareness, understanding, and interest in hazard mitigation policies and programs. 4.) Incorporate hazard mitigation as an integrated public policy and standard practice. 5.) Reduce community exposure and vulnerability to hazards where the greatest risk exists. 6.) Increase resilience of infrastructure and critical facilities. 7.) Promote an adaptive and resilient planning area that responds proactively to future conditions. 8.) Develop and implement mitigation strategies that identify the best alternative to protect natural resources, promote equity, and use public funds in an efficient and cost-effective manner.	Goals are approved as final and will be included in the plan.
<u>Critical Facilities</u> A definition was prepared during the May meeting. The team reviewed the text and made minor adjustments. The definition was approved. Mr. Flaner shared a copy of the HAZUS hazard zone data. This is default data and not accurate. He will email the spreadsheet to the committee and needs responses with updated information about hazard zones. This data will be combined with the critical facilities inventory so the plan can focus on critical facilities within hazard zones.	The definition for critical facilities was approved as final pending incorporation of minor edits, and will be included in the plan.
<u>Public Involvement Strategy</u> Mr. Flaner provided a draft community survey. This is a key element in FEMA required public involvement. Surveys should be completed before phase I outreach meetings are held later this summer.	

Item	Action
The team reviewed the survey and provided minor edits. Mr. Flaner will finalize the survey today and distribute a weblink to the steering committee. It is important that the group get as many survey responses as possible. Each city and agency should share the link through all of their social network accounts and share with anyone they know who lives or works in the Tri-Valley. Other public involvement will include meetings or workshops. If there are established meetings taking place in late July or early August, it will be beneficial to get on their docket or agenda.	Mr. Flaner will email a link to the final community survey. All cities and agencies should share the survey with the community as broadly as possible, as soon as possible.
Next Steps The next meeting will be Tuesday, July 11, 2017. The meeting was adjourned at 11:00 a.m.	Identify opportunities to hold a workshop in conjunction with an established meeting, or get on the agenda of an established meeting. Report back at the July steering committee meeting.

Attachment: Sign-in Sheet

Tri-Valley Hazard Mitigation Plan-Update
June 13, 2017

Name	Representing	E-mail
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CARY FUKADA	Citizen	cfukada@hotmail.com

MEETING SUMMARY

Date/Time of Meeting:	Tuesday – July 11, 2017; 9:00am to 11:00am
Location:	Dublin Public Library Program Room, 200 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No. 5
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance: **(See Attachment):**	Shweta Bonn, Brian Fritz, Cary Fukada, Stan Kolodzie, John Richards, Joe Testa, Adam Weinstein, Hazel Wetherford Phoned in: Lincoln Casimere **Planning Team:** Rob Flaner, Tommie Jean Valmassy
Summary Prepared by:	Tommie Jean Valmassy
Quorum – Yes or No	Yes

Item	Action
Welcome and Introductions, Review Agenda • Rob Flaner opened the meeting and facilitated group introductions. • Distributed handouts included: Agenda; Meeting Summary #4; Objectives Exercise Results; Risk Rankings for floods, wildfires, and landslides; and Instructions for Completing Municipality Annex. • The agenda was reviewed and no modifications were made.	
Planning Process Notes from meeting #4 were approved pending incorporation of comments provided prior to this meeting by Ms. Wetherford.	Update and finalize the notes from meeting No. 4.
Risk Assessment Update Mr. Flaner presented the risk data for risks including 100 year flood, 500 year flood, wildfire, and landslides. The earthquake risk data are still being run. A new “shake map” from the US Geological Survey was recently made available, so that will be used to run scenarios for five scenarios, including the Hayward fault. This risk data will be used to rank risk hazards in each jurisdiction. Mr. Flaner said risk is a calculation of probability multiplied by impact. This data estimates the impact to people and the economy.	Ms. Valmassy will email the spreadsheet with full risk data to the planning committee.

Item	Action
It was noted the flood data does not include dam failure scenarios, and is based on the Federal Emergency Management Agency (FEMA) floodplain areas. Mr. Flanner said wildfire hazard data will need to be updated. For example, Tilden Park is a park so it is not included in the Fire Resources and Assessment Program (FRAP) data. However, wildland urban interface (WUI) can be added to FRAP data to ensure such areas are considered. Mr. Flaner said there are no standards for landslide risk, so that is difficult to map and model. There can be some significant possible impacts from landslides, so he will likely recommend including actions related to that hazard in the hazard mitigation plan.	
Objective Setting Mr. Flaner presented the results of the survey about objectives. He noted only five people took the survey. Meeting attendees went through the draft list of objectives. They were removed, combined, and reduced to a final list of 12 objectives. The updated list was emailed to the steering committee during the meeting, and will be voted on during the August meeting.	Review the updated objectives list and be prepared to vote on it at the next meeting.
Jurisdictional Annex Process An email was sent with the template for the jurisdictional annex section of the plan. Please review the instructions and complete the section for your jurisdiction.	Complete the jurisdictional template that was emailed on July 11, 2017. Send completed form to Mr. Flaner.
Public Involvement Strategy To-date, 211 surveys have been completed, primarily from Pleasanton residents. There is currently no end date for the survey. The goal is to gather as many completed surveys as possible before the team starts preparing their plans. The team requested Mr. Flaner resend the link for the survey so they can share it on social media outlets. The Tetra Tech team will be at the Dublin Farmer's Market on July 27 to conduct outreach and encourage participation in the survey. A press release about the plan and the public survey should be issued. Mr. Flaner will coordinate that with Tracy Hein. Cary Fukada suggested Tetra Tech attend the First Wednesday event in Pleasanton. His Community Emergency Response Team (C.E.R.T.) has a table with space that can be made available.	Mr. Flaner will re-send the public survey link. Committee members will share it broadly.

Item	Action

Plan Maintenance Schedule

Progress reporting is not required, however, you will received credit for conducting progress reports during your next required update of the hazard mitigation plan. Mr. Flanner said many jurisdictions conduct annual updates, while others conduct mid-term updates, typically during year three of the plan.

Mr. Flaner said updates can include reviewing the action list and making updates on a website or to a city council about what has been accomplished. The benefits to updating the plan including identifying grant opportunities while conducting the update, keeping communication open between various jurisdictions, making the mandatory 5-year full updates easier, and keeping the play dynamic.

Committee members said annual progress reports are not feasible for their resources, but mid-term updates make sense. Mr. Flaner will write the plan maintenance strategy to include a mid-term update.

Next Steps

The next meeting will be Tuesday, August 8, 2017. The meeting was adjourned at 11:00 a.m.

MEETING SUMMARY

Attachment: Sign-in Sheet

Tri-Valley Hazard Mitigation Plan - Update

Tuesday, July 11, 2017

Name	Representing	Email
Tommie Jean Valmassy	Tt	tommie.jean.valmassy@tetratech.com
John Richards	LLNL	richards6@llnl.gov
Joe Testa	LPFD	N. A
Stan Kolodzie	DSRSD	kolodzie@DSRSD.com
Hazel Wetherford	City of Dublin	hazel.wetherford@dublin.ca.gov
Adam Weinstein	City of Pleasanton	aweinstein@cityofpleasantonca.gov
BRIAN FRITZ	Dublin Unified	fritzbrian@dublinusd.org
Shweta Bonn	City of Pleasanton	sbonn@cityofpleasantonca.gov
Steve Stewart	City of Livermore	scstewart@cityoflivermore.net
CARY FUKADA	CITIZEN	cfukada@hotmail.com

FINAL MEETING SUMMARY

Date/Time of Meeting:	Tuesday – August 8, 2017; 9:00am to 11:00am
Location:	Dublin Public Library Program Room, 200 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No. 6
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance:	Colter Andersen, Shweta Bonn, Brian Fritz, Cary Fukada, Tracy Hein, Stan Kolodzie, Steve Riley, Joe Testa, Adam Weinstein, Hazel Wetherford Phoned in: Caryn Thornburg, Stanford Health Care **Planning Team:** Rob Flaner, Tommie Jean Valmassy
Summary Prepared by:	Tommie Jean Valmassy
Quorum – Yes or No	Yes

Item	Action

Welcome and Introductions, Review Agenda

- Rob Flaner opened the meeting and facilitated group introductions.
- Distributed handouts included: Agenda; Meeting Summary #5; Risk Assessment Update; Plan Maintenance Strategy; Instructions for Completing Municipality Annex and District Annex; Loss matrix.
- The agenda was reviewed and no modifications were made.

Planning Process

Approval of notes from meeting #5 was postponed until the next meeting. The objectives for the plan were sent out after the previous meeting, and there was no further input. The committee voted to approve the objectives as final.

Risk Assessment Update

Mr. Flaner said the risk assessment is complete. For the earthquake data, results are presented as an aggregate. The full spreadsheet was emailed to the steering committee, and each fault has a separate tab so you can view each scenario separately. The information for all of the risks will be put into a risk ranking model, and presented in the hazard mitigation plan

Item	Action

by ranking. This will help you focus on developing actions to mitigate the hazards that pose the greatest risk to your city or district. Mr. Flaner said many actions in the plan will be multi-objective, meaning they address multiple risk scenarios. Theoretically, when the plan is updated in five years, the risks should be lower because of mitigation activities.

Cary Fukada (citizen) asked if it is possible to make future improvements to the model that is used for the risk ranking. Mr. Flaner said his team will give the model to someone selected by the steering committee and show them how to use it. Mr. Flaner said the plan must be dynamic to capture actions taken. FEMA will move to a system where you can buy-down your deductible for FEMA funding by quantifying the impact of your actions. All FEMA-approved actions must include a cost/benefit analysis, and the benefit must outweigh the cost.

Draft Plan Maintenance Strategy

Mr. Flaner presented a draft of the plan maintenance strategy, to be included in the hazard mitigation plan, based on the discussion at the last steering committee meeting. He noted that Pleasanton and Livermore are part of the "Community Ready" system, which requires annual progress reporting. So regardless of what is in this hazard mitigation plan, they must complete annual progress reports. However, for this plan, the steering committee agreed to mid-term progress reporting. What is currently missing is language about who will coordinate the mid-term progress reporting. After some discussion, it was agreed that the Livermore/Pleasanton Fire District will be responsible for initiating the progress report. However, actually completing the report will be the responsibility of the partners. A progress report template will be included in the plan. Other events may trigger an update of the plan, such as a large disaster. Those will also be noted in the plan.

The progress reports are reviewed by the state and by FEMA. One requirement of the plan is ongoing public involvement. A mechanism to meet that requirement is to talk about the plan with your city council. Include the plan on the city council agenda so the public is aware of the topic, and provide updates on progress during your meetings.

Another way to include public outreach is maintaining and updating the website that has been created for this project. After some discussion, Adam Weinstein said the City of Pleasanton will coordinate the website.

Action:

Complete the jurisdictional template that was emailed on July 11, 2017. Send completed form to Mr. Flaner.

Mr. Flaner will re-send the public survey link. Committee members will share it broadly.

Review your capital improvement plans. If any of the projects mitigate risks identified in this plan, make sure to include them in the action list.

The plan maintenance strategy will be finalized and included in the hazard mitigation plan.

Item	Action
There were some other minor edits to the plan maintenance strategy, and it was approved pending incorporation of those updates and edits. Mr. Flaner noted FEMA provides disaster funding for pre-disaster actions as well as post-disaster actions. The purpose of the plan is pre-disaster actions to mitigate a disaster before it happens. Your capital improvement plans (CIP) are likely already funded. However, they should be included in the plan because they may mitigate risks we have identified. If a CIP repairs something that is vulnerable, make sure you include it in your action list. You will be completing some actions even if you do not receive a FEMA grant for them. But you should still track them as part of the plan, because they are mitigating risk. For post-disaster actions, the event does not necessarily have to have directly impacted your area. If an event has impacted the state, then you may be able to receive funding. California has declared a disaster for the past eleven years running. Each of those declarations comes with funding for the state.	
<u>Jurisdictional Annex Process</u>	
The hazard mitigation plan will be two volumes. Volume I is applicable to all of the partners. Volume II is separated into sections for each jurisdiction. It is the individual risk rankings, assessment of core capabilities, and actions. The instructions for preparing Volume II were distributed at this meeting. When you are preparing your section of Volume II, do NOT do it alone! Work with other departments, carefully read the instructions, and reach out to the Tetra Tech contact provide on the instructions, Kristin Gelino, with any questions you have. Mr. Flaner noted that to be eligible for a FEMA grant, you must be compliant with the National Flood Insurance Program (NFIP). If your flood prevention code is older than 2004, you are likely not in compliance. Work with your planning department to get this information. Updating your flood prevention code may be one of the key actions you include in this plan.	Complete your jurisdictional annex for Volume II. Work with as many departments as possible to ensure good information, staff familiarity with the plan, and ease the workload.
<u>Public Involvement Strategy</u>	
To date, 413 surveys have been completed: 119 for Dublin; 27 for Livermore; 267 for Pleasanton. Push it out on social media as much as possible. The goal is to have a total of at least 1,000 surveys completed. The link is: https://www.surveymonkey.com/r/Tri-ValleyHMP	Share the survey via social media. Encourage co-workers, family, and friends in your

Item	Action
	jurisdiction to complete it as well.
The Tetra Tech team was at the Dublin Farmer's Market on July 27 to conduct outreach and encourage participation in the survey. A HAZUS station to run earthquake risk was run for individuals who provided their address. The team ran approximately 13 HAZUS reports and handed out information the on survey to 93 people. Mr. Flaner said his team may be able to attend another event between now and the end of September. The event would ideally have a power source so a HAZUS station could be run. Ideas offered included the Livermore Farmer's Market or a station at the library; the Pleasanton Farmer's Market, the Dublin Splatter event, and the Pleasanton Fire Expo (held in October). Mr. Flaner will work to confirm two of the events for his team.	The Tetra Tech team will work to support outreach at two additional community events before the end of September.
<u>Next Steps</u>	
The committee needs to determine how this plan falls under the California Environmental Quality Act (CEQA). Several planning partners said they prefer categorical exemption. Mr. Flaner said that is what he would recommend, as well. Partners should confer with the CEQA decision-makers in their jurisdiction and confirm categorical exemption is acceptable.	Discuss CEQA categorical exemption with your decision-makers and let Mr. Flaner know if that is acceptable for this hazard mitigation plan.
The timeline includes plan submittal by the end of October; public comment needs to begin in early October. It should be taken to the city councils for approval AFTER it is conditionally approved by FEMA. Share information with your city council in advance; do whatever leg work is necessary now to make approval easy.	Discuss the plan with your city council now so they know what to expect and can easily approve it.
The next meeting will focus on the strengths, weaknesses, opportunities, obstacles (SWOO) analysis. Invite your planning and public works department representatives, or anyone else who can help with the SWOO brainstorming. The meeting will be Tuesday, September 12, 2017.	Invite other departments to the next steering committee meeting to help brainstorm strengths, weaknesses, opportunities, obstacles.
The meeting was adjourned at 11:00 a.m.	

Attachment: Sign-in Sheet

Tri-Valley Hazard Mitigation Plan-Update Steering Committee Sign-in Sheet
August 8, 2017

Name	Representing	E-mail
Tommie Jean Valmassy	Tetra Tech	
Colter Andersen	Zone 7	candersen@Zone7water.com
Tracy Hein	LPFD	thein@lpfire.org
CARY FUKADA	CITIZEN	cfukada@hotmail.com
Joe Testa	LPFD	
Hazel Wetherford	City of Dublin	hazel.wetherford@dublin.ca.gov
Stan Kolodzie	DSRSD	kolodzie@dsrsd.com
BRIAN FRITZ	Dublin Unified School Dist	fritzbrian@dublinusd.org
Shweta Bonn	City of Pleasanton	sbonn@cityofpleasantonca.gov
Adam Weinstein	" "	aweinstein@ . .
Steve Riley	City of Livermore	spriley@[illegible] cityoflivermore.net

FINAL

MEETING SUMMARY

Date/Time of Meeting:	Tuesday – September 12, 2017; 9:00am to 11:00am
Location:	Dublin Civic Center Regional Meeting Room, 200 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No. 7
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance:	Martha Battaglia, Shweta Bonn, Susan Frost, Cary Fukada, Pamela Lung, John Richards, Cheri Sheets, Joe Testa, Caryn Thornburg, Adam Weinstein, Hazel Wetherford, Shannon Young
	Planning Team: Rob Flaner, Tommie Jean Valmassy
Summary Prepared by:	Tommie Jean Valmassy
Quorum – Yes or No	Yes

Item	Action
Welcome and Introductions, Review Agenda • Rob Flaner opened the meeting and facilitated group introductions. • Distributed handouts included: Agenda; Meeting Summary #6. • The agenda was reviewed and no modifications were made. • There were no public comments.	
Planning Process Meeting notes from meeting #5 and meeting #6 were approved as final.	Minutes for meetings #5 and #6 will be finalized.
Risk Assessment Update Mr. Flaner said his team is still compiling the critical facilities data. Technical difficulties require the team to re-run the facility hazards data for multiple scenarios. Mr. Flaner will email it, but noted it is protected information and is confidential and for internal use only. Cary Fukada (citizen) asked about the capability to update information in the future. Mr. Flaner said projects in the plan require a benefit/cost analysis (BCA) that can include things like avoiding lost time. Because the BCA has to be done using FEMA's software, it requires expertise to ensure your project shows a benefit. Mr. Flaner noted that Contra Costa County has several individuals trained to do BCA with FEMA software, and they support the entire county. It may be advisable to do the same in the Tri-Valley. Mr. Flaner added that the state of California may provide BCA	Mr. Flaner will email the updated risk assessment data, which should be kept confidential, when it is available.

Item	Action
assistances, and BCA preparation costs are often reimbursable when applying for a grant. Mr. Flaner noted that new information about risk and vulnerability can be added to the plan via plan maintenance. For example, the FEMA flood maps are outdated, but they were the best available data at the time. Zone 7 is paying to have maps updated, but they will not be ready for use in this plan.	Livermore will share its draft updated flood map information when it is available.
Jurisdictional Annex Process While all three cities participating in the plan have provided their information for Volume II, Tetra Tech has not received any updates from the districts. Please reach out to Kristin Gelino (Tetra Tech, not present) if you have questions about how to complete the information. Mr. Flaner noted the information that is being requested and the comments Tetra Tech provides are based on recent FEMA reviews. He added that their reviews can be inconsistent, so Mr. Flaner's team are doing their best to address everything to avoid numerous FEMA comments on the draft hazard mitigation plan.	
Public Involvement Strategy Tommie Jean Valmassy (Tetra Tech) will attend the Pleasanton and Livermore Farmer's markets in September. She will host a Hazus station, which is a FEMA program that estimates potential losses from earthquakes, floods, and other disasters. In addition, the community will be encouraged to take the public survey. To date, 472 surveys have been completed. The goal is to have a total of at least 1,000 surveys completed. The survey will be available through the public comment period on the draft plan, and the survey link is: https://www.surveymonkey.com/r/Tri-ValleyHMP	Continue to share the survey via social media. Encourage co-workers, family, and friends in your jurisdiction to complete it as well.
Strengths, Weaknesses, Obstacles, Opportunities (SWOO) The committee discussed and prepared a SWOO list. The list will be presented in the hazard mitigation plan under mitigation actions.	
Next Steps The meeting will be Tuesday, October 10, 2017. The meeting was adjourned at 11:00 a.m.	

Item	Action

Tri-Valley Hazard Mitigation Plan-Update Steering Committee Sign-in Sheet
September 12, 2017

Name	Representing	E-mail
Tommie Jean Valmassy	Tetra Tech	tommiejean.valmassy@tetratech.com
Caryn Thornburg	Stanford Health Care ValleyCare	cthornburg@stanfordhealthcare.org
Susan Frost	City of Livermore	smfrost@cityoflivermore.net
CARY FUKADA	Citizen	cfukada@hotmail.com
Martha Battaglia	City of Dublin	martha.battaglia@dublin.ca.gov
Cheri Sheets	City of Livermore	crsheets@cityoflivermore.net
Joe Testa	LPFD	No Δ
John Richard	LLNL	Richards6@llnl.gov
Shannan Young	City of Dublin	shannan.young@dublin.ca.gov
Hazel Wetherford	City of Dublin	hazel.wetherford@dublin.ca.gov
Shweta Bonn	City of Pleasanton	sbonn@cityofpleasantonca.gov
Adam Weinstein	" "	aweinstein@ " "
Pamela Lung	City of Livermore	pglung@cityoflivermore.net

FINAL MEETING SUMMARY

Date/Time of Meeting:	Tuesday – October 10, 2017; 9:00am to 11:00am
Location:	Dublin Civic Center Regional Meeting Room, 200 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No. 8
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance:	Shweta Bonn, Susan Frost, Cary Fukada, Obaird Khan, Stan Kolodzie, John Richards, Cheri Sheets, Joe Testa, Caryn Thornburg, Adam Weinstein, Hazel Wetherford, Shannon Young **Planning Team:** Rob Flaner, Tommie Jean Valmassy
Summary Prepared by:	Tommie Jean Valmassy
Quorum – Yes or No	Yes

Item	Action
Welcome and Introductions, Review Agenda • Hazel Wetherford called the meeting to order and initiated group introductions. • Distributed handouts included: Agenda; Meeting Summary #7, Mitigation Best Practices Catalog, Risk Ranking Results, and Survey Results Data. • The agenda was reviewed and no modifications were made. • There were no public comments.	
Planning Process Meeting notes from meeting #7 were approved as final.	Minutes for meeting #7 will be finalized and put on the website.
Strengths, Weaknesses, Obstacles, Opportunities (SWOO) Rob Flaner reviewed the Mitigation Best Practices Catalog, which contains the SWOO results from the previous steering committee meeting. This catalog will be presented in Chapter 18 of the Hazard Mitigation Plan. If you identify a risk and need an action to address it, look at the SWOO list. It is organized by who can take the action (government, private sector, individuals.) This list provides broad-scale actions that can be taken; you can make them more specific for your plan.	Review the SWOO list and contact Mr. Flaner if you have additions.

Item	Action
Jurisdictional Annex Process It is time to begin phase 3. You need to have completed phases 1 and 2. Kristin Gelino (Tetra Tech) will send you your phase 3 template, and it will include all of the information you provided for phases 1 and 2. Please address any yellow highlighted items. The level of detail that Mr. Flaner and his team request from you is based on direct experience trying to get other plans approved by the state of California and by FEMA. There are embedded comments in the Word file you will get that instruct that you MUST add information, or you SHOULD add information. If you must, it is required by the state or FEMA. If it is suggested, please try. Use the comment box to let Mr. Flaner and his team know if you addressed a comment. Mr. Flaner reviewed the phase 3 template for jurisdictions and for municipalities. The instructions are long, but will answer most questions so review them thoroughly before you reach out for help. However, definitely reach out for help if you are having difficulties. Some specific details to include: • For hazard event history, you will have to do some investigating. Google the local newspaper to find out dates and impact of events. • If you had to close a road or respond in any way to an event, that was an impact. • Do NOT send back an empty Natural Events table. • If you had an active fire season do not list the date of each fire. You can do a calendar year line item, such as 13 fires in 2014. • Damage assessment is an optional field, but if you can complete it, please do. You should have numbers for recent events that were declared. Mr. Flaner reviewed the risk ranking portion of the hazard mitigation plan. The ranking uses a formula defined by FEMA and includes quantitative data. The highest possible risk is 54. The data is weighted, such that risk to people and life safety is multiplied by a factor of 3. If you have evidence that an event has happened more frequently than is modeled here, then you can change the risk. However, you need to note why you changed the risk and be prepared to show backup. Sometimes events in other jurisdictions can cause impact to you. For example, if a dam fails, that could cause flooding. However, if the dam is not in your area, you cannot show risk from dams. You can show potential flooding or landslides as a risk if that is relevant.	Complete Phase 3 when you receive it. Use the full instructions and toolkit provided and see the tips in these notes. Start right away and identify those who will help you with different sections and input. This must be a team effort for your city/jurisdiction.

Item	Action
Mr. Flaner reviewed the Mitigation Action Plan portion of the document. For any risk that is ranked as medium or high, you must show at least 1 action and list what hazards it addresses. DO NOT COMPLETE THIS ALONE. Use your planners, police and fire, public works, and even reach out to citizens and homeowners groups if applicable. Keep track of all of your resources and information sources.	Assess the status of your phase 3 document by November 3, 2017. Report to Mr. Flaner how far you are and how you will complete it by November 17, 2017.
Public Involvement Strategy Since the last meeting, Tommie Jean Valmassy (Tetra Tech) attended two public events: • 9/16 Pleasanton Farmers Market: Ran 40 Hazus Reports, Handed out 85 survey flyers • 9/21 Livermore Farmers Market: Ran 35 Hazus Reports, Handed out 45 survey flyers	
Start comment period Monday, November 27 at the latest. That will allow for submittal to the state by December 15. Comment period would end December 8. There will be 2 public meetings during that time. ACTION: Check your council meeting dates. Susan Frost and Stan Kolodzie each said they may be able to get a plan presentation on their agendas. Mr. Flaner handed out the survey results. These will be included in the plan.	Check your council meeting dates to see if there will be a meeting between November 27 and December 8.
Volume 1 Internal Draft Review Volume 1 of the plan will be ready for internal review on October 20, 2017. Please review it by November 14. It is almost 400 pages long, so review the parts you are most interested in. Many of the sections you have already seen because they have been crafted and shared at these steering committee meetings. You will receive a Word file so you can easily review and track changes. This one will not include maps.	

Next Steps

The next meeting will be Tuesday, November 14, 2017. This is Ms. Wetherford’s last meeting before she is on maternity leave. The committee thanked her for her hard work. She will have a replacement attending meetings in her absence.

The meeting was adjourned at 11:05 a.m.

October 10, 2017

Name	Representing	E-mail
Tommie Jean Valmassy	Tetra Tech	
Caryn Thornburg	Stanford Health Care Valley Care	cthornbu@stanfordhealthcare.org
CARY FUKADA	CITIZEN	cfukada@hotmail.com
Cheri Sheets	Livermore	crsheets@cityoflivermore.net
Joe Testa	LPFD	jtesta@lpfire.org
Obaid Khan	Dublin, P.W	obaid.khan@dublin.ca.gov
John Richard	LLNL	richards6@llnl.gov
Stan Kolodzie	DSRSD	kolodzie@DSRSD.com
Susan Frost	Livermore	smfrost@cityoflivermore.net
Shannan Young	Dublin	shannan.young@dublin.ca.gov
Shweta Bonn	Pleasanton	sbonn@cityofpleasantonca.gov

Name	Representing	E-mail
Hazel Wetherford	City of Dublin	hazel.wetherford@dublin.ca.gov

MEETING SUMMARY

Date/Time of Meeting:	Tuesday – November 14, 2017; 9:00am to 11:00am
Location:	Dublin Civic Center Regional Meeting Room, 200 Civic Dr., Dublin, CA 94568
Subject:	Steering Committee No. 8
Project Name:	Tri-Valley Multi-Jurisdiction Hazard Mitigation Plan
In Attendance:	Shweta Bonn, Julie Carter, Susan Frost, Cary Fukada, Joe Testa, Caryn Thornburg,
	Planning Team: Rob Flaner, Tommie Jean Valmassy
Summary Prepared by:	Tommie Jean Valmassy
Quorum – Yes or No	Yes

Item	Action
Welcome and Introductions, Review Agenda • Julie Carter called the meeting to order and initiated group introductions. • Distributed handouts included: Agenda; Meeting Summary #8, and the template for the Area-Wide Action Plan and Implementation. • The agenda was reviewed and no modifications were made. • There were no public comments. • Meeting notes from meeting #8 were approved as final.	Minutes for meeting #8 will be finalized and put on the website.
Planning Process Rob Flaner said the deadline for participants to submit Phase III for incorporation into the Hazard Mitigation Plan is this Friday, November 17. He noted several districts, including two school districts, submitted letters of intent to participate, but have yet to turn in phase I or phase II. Mr. Flaner has reached out to designated contacts, but has had no response. If someone does not turn in their sections, the steering committee will have to decide whether to move forward without them. It was agreed that if those districts do not submit their portions of the plan on time, the group will move forward without them to avoid unnecessary delay in the process.	Review the SWOO list and contact Mr. Flaner if you have additions.

Item	Action
When preparing actions a debris management plan is a great action and is applicable to most hazards. Consider adding this to your action plan if you do not already have it included. Talk to your public works department about their plans; roads, bridges, stormwater projects are all eligible. With the recent wildfires, it is worth considering projects related to that as well.	Incomplete Volume I figures will be updated and resent for review.
Volume I Review Rob Flaner said Volume I was delivered for review via Dropbox. There are two files; one is in Microsoft Word, and reviewers should provide edits in track changes, then save the file with your last name at the end. The second file is a PDF and includes figures. It was noted that some of the figures in Volume I are incomplete. They will be updated and resent for review. Any comments must be sent by November 24.	Submit comments on Volume 1 no later than November 24.
Area Wide Actions Mr. Flaner provide a template of area-wide actions from another jurisdiction. The committee used those to determine the following area-wide actions summarized below. 1. Maintain a project website. [To be hosted by City of Pleasanton on the Wix platform.] 2. Support Livermore/Pleasanton Community Emergency Response Team (C.E.R.T.) 3. Coordinate mitigation planning, and designation a point of contact (POC) for each partner. 4. [Item 4 in the template will not be part of the Tri-Valley area-wide actions because it is in the individual action plans.] 5. Continue to update hazard mapping. Designate a POC for each partner. 6. Coordinate on hazard mitigation planning. The team would like to list Alameda County Office of Emergency Services (OES) as the lead for this action. Ms. Carter will ask their permission. 7. Maintain this steering committee outside of plan maintenance. 8. Create an action that each jurisdiction will coordinate and share information as the plan is being prepared. Can give you a regionalized concept that can be deployed individually.	Mr. Flaner will determine the final public comment period on the draft Hazard Mitigation Plan once the status of phase III submittals is assessed. Julie Carter will ask Alameda County OES to be the lead on coordinating hazard mitigation efforts between jurisdictions.
Public Involvement Strategy The public survey is still open, but there have been no additional responses since the last meeting.	

Item	Action
Mr. Flaner reviewed the timeline, which is to begin the public comment period Monday, November 27 at the latest. That will allow for submittal to the state by December 15. Comment period would end December 8. There will be 2 public meetings during that time. If participants need more time to complete their phase III submittals, those dates may slip. It was determined that everyone will submit what they have on November 17, and Mr. Flaner will determine whether it is adequate for state approval, or if the deadline needs to be extended in order to gather more information. Susan Frost said she has presentation of the plan on her City Council meeting for December 11. If the dates for public comment period slips, presenting to her council may not be possible within an adjusted public comment period. For any meeting, Mr. Flaner will provide a PowerPoint presentation and talking points.	

Next Steps

Mr. Flaner said this is the final scheduled Steering Committee meeting. This Hazard Mitigation Plan will be regionalized and specific, and a useful document. He thanked all of the members for their participation and cooperation, and noted his team will continue to work with them until the plan reaches final state and FEMA approval. Please reach out to the team with any questions.

The meeting was adjourned at 11:00 a.m.

PUBLIC MEETING SUMMARIES

PUBLIC COMMENT SESSION

DUBLIN SAN RAMON SERVICES DISTRICT BUILDING

DEC. 22, 2017 6:00 – 7:00 PM

1 Comment was received and is summarized below:

Respondent was Mike Grant of Dublin CA

This Tri-Valley resident was concerned that the Plan did not list the Nielsen Elementary School at 7500 Amarillo Blvd. as a post-disaster shelter. He suggested that the Nielsen Elementary School be retrofit to strengthen the structure for post-disaster shelter. This resident said he was involved in task forces doing post-disaster planning for human-caused disasters throughout Alameda County. The gentleman also asked which agency was responsible for the prevention of floods from the creek through Dublin.

Rob Flaner of Tetratech responded that the LHMP is a pre-disaster mitigation tool that identifies risk from natural disasters; and reduces losses in property damage and human lives through identifying and funding projects to correct deficiencies before natural disasters. As such, listing post-disaster emergency shelters is somewhat outside the boundaries of the LHMP. However, the suggestion to use Nielsen Elementary School as a post-disaster emergency shelter will be included in the public comments. In response to the question which agency responsible for flood protection in Dublin; Zone 7 Water Agency of Alameda County is responsible for maintaining the stream beds and stream banks in Dublin to prevent floods.

Livermore City Council, January 8, 2017 regular meeting.

Agenda Item 6.01. Discussion and Direction regarding the update to the 2017 Tri-Valley Hazard Mitigation Plan

There we about 20 members of the public present.

Susan Frost, Special Projects Coordinator, gave a presentation on the draft 2017 TVHMP. There were no questions from the Council regarding the draft plan. The Council commented that we should be encouraging other agencies in the planning area, such as the school district and park district, to participate in the plan since it provides greater opportunities for coordination and grant eligibility. This is important given the damage the City experienced from flooding last winter of almost $12 million. However, there are fewer FEMA grant opportunities than previously. The information provided in Volume 1, Planning Process and Community Profile, provides a lot of interesting and useful information about the area.

No comments were received from the public.

Motion to accept the 2017 Tri-Valley Hazard Mitigation Plan by Councilmember Carling, seconded by Councilmember Spedowfski, approved 5-0.

ARTICLES PUBLISHED BASED ON PRESS RELEASES

May 4, 2017 • The Independent 3

VALLEY ROUNDUP

Modernize Congress

U.S. Representatives Eric Swalwell (CA-15), with Republicans Steve Pearce (NM-02), and Rick Crawford (AR-01), have reintroduced a resolution aimed at modernizing congressional committee and voting procedures to bring Congress into the 21st Century and allow Members more time to connect with their constituents. The bipartisan H. Res. 278, Members Operating to Be Innovative and Link Everyone (MOBILE) Resolution would strengthen the ability of Members to participate virtually in committee hearings and vote remotely on suspension bills.

The MOBILE Resolution would require that Members and invited witnesses be allowed to participate in committee hearings remotely, via video conferencing or related technologies, which would count toward rules on quorum. It also would direct the creation of a secure voting system that would allow Members to vote remotely on suspension bills, which are generally less-controversial legislation requiring a two-thirds vote to pass.

Swalwell, Pearce, and Crawford also reintroduced a resolution directing the House Administration Committee to investigate best practices and establish procedures and rules for conducting House of Representatives business in a virtual setting, such as the consideration of legislation.

"Across the nation we see the development of new, innovative ways of conducting business to improve communication and connectedness. It's time for Congress to learn to be more mobile and adapt to the times in which we live," said Swalwell. "The American people want to see an efficient Congress that works directly for the people. Letting Members of Congress participate in committee hearings and vote on some items remotely is an essential step toward giving constituents more time with their elected representatives and forcing Congress to work more efficiently on consequential legislation."

Freeze on Tuition

In the wake of the Auditor's report on the University of California Office of the President, Assemblywoman Catharine Baker requested an immediate freeze of any increases in UC tuition, and UC Office of the President's salaries and benefits. She also requested a legislative subpoena for all financial records and correspondence related to the undisclosed $175 million maintained by the University of California Office of the President.

Additionally, the Assemblywoman requested an independent forensic audit to determine if UC administrators engaged in criminal activity in interfering with the audit.

"It is unfair to increase student tuition and ask again for California families to pay more in UC when the Office of the President holds this kind of money," said Assembly Higher Education Committee Vice Chair Catharine Baker (R-San Ramon). "An independent review to unearth what really happened is the only way to restore people's trust in the UC. California families deserve no less."

Hazard Mitigation Planning

The Cities of Dublin, Livermore, and Pleasanton, Dublin San Ramon Services District, and other local government stakeholders in the TriValley planning area are collaborating on the development of the Tri-Valley Hazard Mitigation Plan, pursuant to State and Federal requirements.

Responding to Federal mandates in the Disaster Mitigation Act of 2000, the planning partnership was formed to pool resources and create a uniform hazard mitigation strategy that can be consistently applied to the Tri-Valley planning area.

During this process, citizens will be asked to contribute by sharing local knowledge of an area's vulnerability to hazards based on past occurrences. Public involvement will be solicited via a multi-media campaign that will include public meetings, web-based information, questionnaires, and updates on the plan's progress via the news media. This process will be overseen by a Steering Committee made up of stakeholders from within the planning area. This Steering Committee will meet as needed on the 2nd Tuesday of every month throughout the planning process. These meetings will typically run from 9:00 a.m. to 11:00 a.m. and are open to the public. Meetings will be held at Dublin City Hall - Regional Meeting Room, 100 Civic Plaza, Dublin, California.

An informational website on the plan and the purposes for planning has been established at www.tri-valley-hmp.com/. This website will serve as the primary means for the public to gain information on the plan and ways that they can participate in the planning process. Information on the public meetings and the Steering Committee meetings can also be found on this website.

Any questions or comments regarding this process are encouraged and can be directed to Hazel Wetherford at (925) 833-6650 or hazel.wetherford@dublin.ca.gov.

Transportation Survey

Beginning May 8, Pleasanton residents may be contacted via telephone to participate in the City's 2017 residential commute survey. Approximately every three or four years, the City of Pleasanton conducts an employer and residential transportation survey to monitor the successes of and any challenges related to the City's transportation systems management program.

The survey provides the City with up-to-date information to assist with ongoing efforts that help shape the strategies and programs to encourage alternative commute habits, which may result in improved traffic flow and air quality.

In addition to residents, Pleasanton companies will also be surveyed later in May. The results will be provided to the Alameda County Transportation Commission to support annual funding requests under the Bay Area Air Quality Management District's Transportation Fund for Clean Air.

The final report will be available later this summer. To view the 2013 Employer and Residential Transportation Survey report, visit the Employer Commute Services section on the City's Economic Development department page of the City's website at cityofpleasantonca.gov

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Community Corner

Tri-Valley Planning Area Collaborates For Hazard Mitigation Plan

In response to Federal mandates, the partnership was formed to create a hazard mitigation plan that is consistent with the planning area.

By Damita Thomas (Patch Staff) - Updated May 18, 2017 12:07 pm ET

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From The City of Dublin: The Cities of Dublin, Livermore, and Pleasanton, Dublin San Ramon Services District, and other local government stakeholders in the Tri-Valley planning area are collaborating on the development of the Tri-Valley Hazard Mitigation Plan, pursuant to State and Federal requirements.

Responding to Federal mandates in the Disaster Mitigation Act of 2000 (Public Law 106- 390), the planning partnership was formed to pool resources and create a uniform hazard mitigation strategy that can be consistently applied to the Tri-Valley planning area.

During this process, citizens will be asked to contribute by sharing local knowledge of an area's vulnerability to hazards based on past occurrences. Public involvement will be solicited via a multi-media campaign that will include public meetings, web-based information, questionnaires and updates on the plan's progress via the news media. This process will be overseen by a steering committee made up of stakeholders from within the planning area. This Steering Committee will meet as needed on the 2nd Tuesday of every month throughout the planning process. These meetings will typically run from 9:00 a.m. to 11:00 a.m. and are open to the public. Meetings will be held at Dublin City Hall - Regional Meeting Room, 100 Civic Plaza, Dublin, California.

An informational website on the plan and the purposes for planning has been established at: https://www.tri-valley-hmp.com/. This website will serve as the primary means for the public to gain information on the plan and ways that they can participate in the planning process. Information on the public meetings and the steering committee meetings can also be found on this website. The public is encouraged to provide input on all phases of the plan's development.

Any questions or comments regarding this process are encouraged and can be directed to Hazel Wetherford at (925) 833-6650 or hazel.wetherford@dublin.ca.gov.

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NEWS

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Uploaded: Wed, Dec 20, 2017, 2:21 pm

Comments sought for draft Tri-Valley hazard mitigation plan

Pleasanton teaming with Dublin, Livermore, DSRSD on regional preparation

by Jeremy Walsh / Pleasanton Weekly

Pleasanton officials, along with those in Dublin and Livermore, are working to gather public input on the region's draft Tri-Valley Multi-Jurisdictional Hazard Mitigation Plan.

Now is the time to submit comments, as the 14-day review period closes on Tuesday. There is also a public meeting to solicit feedback Friday evening from 6-7 p.m. at the Dublin San Ramon Services District (7051 Dublin Blvd.), which is also a partner in the planning effort.

The draft plan aims to help the Tri-Valley agencies prepare for and lessen the impacts of specified natural hazards within the region.

People can comment via the plan's website, www.tri-valley-hmp.com. Comments and questions can also be sent to Rob Flaner of Tetra Tech, Inc., at rob.flaner@tetratech.com or 208-939-4391.

Tri-Valley Local Hazard Mitigation Plan

Appendix B. Risk Assessment Mapping Methodology

B. RISK ASSESSMENT MAPPING METHODOLOGY

DAM INUNDATION MAPPING

The Del Valle dam inundation area data are provided by the City of Pleasanton, GIS Division. These data originate from the California Office of Emergency Services.

EARTHQUAKE MAPPING

Liquefaction Susceptibility

Liquefaction susceptibility data are provided by the Association of Bay Area Governments and originate from the U.S. Geological Survey as Open-File Report 2006-1037. The report presents a map and database of Quaternary deposits and liquefaction susceptibility for the urban core of the San Francisco Bay region. Much of the land adjacent to the Bay and the major rivers and streams is underlain by unconsolidated deposits that are particularly vulnerable to earthquake shaking and liquefaction of water-saturated granular sediment. The mapping uses geomorphic expression, pedogenic soils, inferred depositional environments, and geologic age to define and distinguish the map units. The report is the product of cooperative work by the National Earthquake Hazards Reduction Program (NEHRP) and National Cooperative Geologic Mapping Program of the U.S. Geological Survey, William Lettis and & Associates, Inc. (WLA), and the California Geological Survey. (USGS, 2006)

National Earthquake Hazard Reduction Program (NEHRP) Soils

Soil classification data provided by the California Department of Conservation. The data is based on surficial geology published at a scale of 1:250,000. The surficial geologic units were grouped into composite units with similar average shear wave velocity to 30 meters depth (Vs30) values. This data was prepared as part of the Probabilistic Seismic Hazard Map of California (Petersen et. al., 1999)

Susceptibility to Deep-Seated Landslides

Landslide susceptibility data provided by the California Geological Survey.

The map, and associated data, show the relative likelihood of deep-seated landsliding based on regional estimates of rock strength and steepness of slopes. On the most basic level, weak rocks and steep slopes are most likely to generate landslides. The map uses detailed information on the location of past landslides, the location and relative strength of rock units, and steepness of slope to estimate susceptibility to deep-seated landsliding (0 to X, low to high). The USGS 2009 National Elevation Dataset (NED) with 10-m grid size was used as the basemap. This landslide susceptibility map is intended to provide infrastructure owners, emergency planners and the public with a general overview of where landslides are more likely to occur. (Wills, et. al., 2011)

Shake Maps

A shake map is designed as a rapid response tool to portray the extent and variation of ground shaking throughout the affected region immediately following significant earthquakes. Ground motion and intensity maps are derived from peak ground motion amplitudes recorded on seismic sensors (accelerometers), with interpolation based on both estimated amplitudes where data are lacking, and site amplification corrections. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. For this plan, shake maps were prepared for five earthquake scenarios:

- An earthquake on the Calaveras (North Central South) fault with the following characteristics:
  - Magnitude: 7.0
  - Epicenter: N37.74 W121.95
  - Depth: 6 km
- An earthquake on the Northern San Andreas fault with the following characteristics:
  - Magnitude: 7.8
  - Epicenter: N39.16 W123.83
  - Depth: 10 km
- An earthquake on the Greenville fault with the following characteristics:
  - Magnitude: 7.0
  - Epicenter: N37.51 W121.55
  - Depth: 12 km
- An earthquake on the Hayward fault with the following characteristics:
  - Magnitude: 7.05
  - Epicenter: N37.81 W122.18
  - Depth: 8 km
- An earthquake on the Mount Diablo fault with the following characteristics:
  - Magnitude: 6.7
  - Epicenter: N37.82 W121.81
  - Depth: 14 km

FLOOD MAPPING

Flood hazard areas are mapped as depicted on the effective FEMA Digital Flood Insurance Rate Maps published March 8th, 2016 (effective date August 3rd, 2009) with last Letter of Map Revision incorporated December 11, 2015. There were no repetitive loss claims for the Tri-Valley area, so no data were acquired.

LANDSLIDE MAPPING

See Susceptibility to Deep-Seated Landslides data description under earthquake mapping.

WILDFIRE MAPPING

Fire Hazard Severity Zones in State Responsibility Areas data were provided by the California Department of Forestry and Fire Protection. Public Resources Code 4201-4204 direct the CAL FIRE to map fire hazard within State Responsibility Areas, based on relevant factors such as fuels, terrain, and weather. These statutes were passed after significant wildland-urban interface fires; consequently these hazards are described according to their potential for causing ignitions to buildings. These zones referred to as Fire Hazard Severity Zones(FHSZ), provide the basis for application of various mitigation strategies to reduce risks to buildings associated with wildland fires. The zones also relate to the requirements for building codes designed to reduce the ignition potential to buildings in the wildland-urban interface zones. These maps have been created by CAL FIRE's Fire and Resource Assessment Program (FRAP) using data and models describing development patterns, estimated fire behavior characteristics based on potential fuels over a 30-50 year time horizon, and expected burn probabilities to quantify the likelihood and nature of vegetation fire exposure to new construction. The zones were adopted by CAL FIRE on November 7, 2007.

REFERENCES

Petersen, M., D. Beeby, W. Bryant, T. Cao, C. Cramer, J. Davis, M. Reichle, G. Saucedo, S. Tan G.,Taylor, T. Toppozada, J. Treiman, and C. Wills. 1999. Seismic Shaking Hazard Maps of California: California Division of Mines and Geology Map Sheet 48.

Intermap Technologies, Inc., 2003, Intermap product handbook and quick start guide: Intermap NEXTmap document on 5-meter resolution data, 112 p.

National Atmospheric and Oceanic Administration (NOAA), 2004, Interferometric Synthetic Aperture Radar (IfSAR) Digital Elevation Models from GeoSAR platform (EarthData): 3-meter resolution data.

U.S. Geological Survey, 1993, Digital Elevation Models: National Mapping Program, Technical Instructions, Data Users Guide 5, 48 p.

USGS. 2006. Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California. Open-File Report 2006-1037. Version 1.1. U.S. Geological Survey in cooperation with the California Geological Survey.

Wills C.J., Perez, F., Gutierrez, C. 2011. Susceptibility to deep-seated landslides in California: California Geological Survey Map Sheet 58.

Appendix C. Plan Adoption Resolutions from Planning Partners

RESOLUTION NO. 93 – 18

A RESOLUTION OF THE CITY COUNCIL
OF THE CITY OF DUBLIN

* * * * * * * * *

ADOPTING IN ITS ENTIRETY VOLUME I AND THE RELEVANT PORTIONS OF VOLUME II INCLUDING THE INTRODUCTION, CITY OF DUBLIN ANNEX AND APPENDICES, OF THE TRI-VALLEY HAZARD MITIGATION PLAN

WHEREAS, all of the Tri-Valley area has exposure to natural hazards that increase the risk to life, property, environment and the City and County's economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, the federal Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Tri-Valley Cities and Special Districts with like planning objectives has been formed to pool resources together and create consistent mitigation strategies within the Tri-Valley area; and

WHEREAS, the coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating and revising this strategy.

NOW THEREFORE, BE IT RESOLVED that the City Council of the City of Dublin does hereby:

1. Adopts in its entirety, Volume I and the relevant portions of Volume II including the Introduction, City of Dublin Annex and Appendices, of the Tri-Valley Hazard Mitigation Plan (HMP) attached hereto as **Exhibit A**.

2. Will use the adopted and approved portions of the Tri-Valley HMP to guide pre- and post-disaster mitigation of the hazards identified.

3. Will coordinate the strategies identified in the Tri-Valley HMP with other planning programs and mechanisms under its jurisdictional authority.

4. Will continue its support of the Steering Committee and continue to participate in the Planning Partnership as described by the Tri-Valley HMP.

5. Will help to promote and support the mitigation successes of all Tri-Valley HMP Planning Partners.

PASSED, APPROVED AND ADOPTED this 17th day of July 2018, by the following vote:

AYES: Councilmembers Gupta, Hernandez, Thalblum and Mayor Haubert

NOES:

ABSENT: Councilmember Goel

ABSTAIN:

Mayor

ATTEST:

City Clerk

IN THE CITY COUNCIL OF THE CITY OF LIVERMORE, CALIFORNIA

A RESOLUTION AUTHORIZING ADOPTION OF THE 2017 TRI-VALLEY HAZARD MITIGATION PLAN UPDATE

All of the Tri-Valley area has exposure to natural hazards that increase the risk to life, property, environment and the City and County's economy. Pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property.

The federal Disaster Mitigation Action of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs.

A coalition of Tri-Valley Cities and Special Districts with like planning objectives has been formed to pool resources and create consistent mitigation strategies within the Tri-Valley area. The coalition has completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objections, and creates a plan for implementing, evaluating and revising this strategy.

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Livermore adopts in its entirety, Volume I, and the relevant portions of Volume II including the Introduction, City of Livermore Annex and Appendices, of the Tri-Valley Hazard Mitigation Plan ("Plan"). Full copies of the adopted Plan can be found in the Planning Division of the Community Development Department, 1052 S. Livermore Avenue, Livermore, California.

BE IT FURTHER RESOLVED that the City Council of the City of Livermore will use the adopted and approved portions of the Plan to guide pre- and post-disaster mitigation of the identified hazards, coordinate the strategies identified in the Plan with other planning programs and mechanisms under its jurisdictional authority, continue its support of the Steering Committee and continue to participate in the Planning Partnership as described in the Plan, and help to promote and support the mitigation successes of all Planning Partners.

On motion of Council Member Carling, seconded by Vice Mayor Woerner, the foregoing resolution was passed and adopted on June 11, 2018, by the following vote:

AYES:	Council Members Carling, Coomber, Spedowfski, Vice Mayor Woerner, Mayor Marchand
NOES:	None
ABSENT:	None
ABSTAIN:	None

ATTEST:

Sarah Bunting
City Clerk

Date: June 12, 2018

APPROVED AS TO FORM:

Catrina Fobian
Assistant City Attorney

RESOLUTION NO. 2018-080

RESOLUTION NO. 18-1039

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF PLEASANTON ADOPTING THE 2017 TRI-VALLEY LOCAL HAZARD MITIGATION PLAN

WHEREAS, the Tri-Valley area has exposure to natural hazards that increase the risk to life, property, environment and the economy; and

WHEREAS, pro-active mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, the federal Disaster Mitigation Act of 2000 (Public Law 106-390) established requirements for pre- and post-disaster hazard mitigation programs;

WHEREAS, the cities of Pleasanton, Dublin, Livermore, and the Dublin San Ramon Services District (Planning Partners) have collaborated to draft the 2017 Tri-Valley Local Hazard Mitigation Plan (LHMP); and

WHEREAS, the Planning Partners have completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating and revising this strategy.

NOW, THEREFORE BE IT RESOLVED THAT THE CITY COUNCIL OF THE CITY OF PLEASANTON DOES RESOLVE, DECLARE, DETERMINE AND ORDER THE FOLLOWING:

SECTION 1. Adopts in its entirety Volume I and the Introduction and Pleasanton Annex (Chapter 3), and the appendices of Volume II of the 2017 Tri-Valley Local Hazard Mitigation Plan.

SECTION 2. City Clerk shall certify to the passage of this resolution and enter it into the book of original resolutions.

PASSED, APPROVED AND ADOPTED by the City Council of the City of Pleasanton at a regular meeting held on August 21, 2018.

I, Karen Diaz, City Clerk of the City of Pleasanton, California, certify that the foregoing resolution was adopted by the City Council at a regular meeting held on the 21st of August, 2018, by the following vote:

Ayes: Councilmembers Brown, Narum, Olson, Mayor Thorne
Noes: None
Absent: Councilmember Pentin
Abstain: None

for Karen Gonzales
Karen Diaz, City Clerk

Dated: 8-24-18

APPROVED AS TO FORM:

Daniel G. Sodergren
Daniel G. Sodergren, City Attorney

RESOLUTION NO. 22-18

RESOLUTION OF THE BOARD OF DIRECTORS OF DUBLIN SAN RAMON SERVICES DISTRICT ADOPTING THE JANUARY 2018 TRI-VALLEY HAZARD MITIGATION PLAN

WHEREAS, the Tri-Valley Area, made up of the Cities of Dublin, Pleasanton, Livermore, and San Ramon, and the Dublin San Ramon Services District (DSRSD) Service Area, has exposure to natural hazards that increase the risk to life, property, environment and economy of Alameda County and Contra Costa County economy; and

WHEREAS, proactive mitigation of known hazards before a disaster event can reduce or eliminate long-term risk to life and property; and

WHEREAS, the Disaster Mitigation Act of 2000 (Public Law 106-390) established new requirements for pre- and post-disaster hazard mitigation programs; and

WHEREAS, a coalition of Tri-Valley Area cities consisting of the Cities of Dublin, Pleasanton, and Livermore, and DSRSD with common planning objectives has been formed to pool resources and create consistent mitigation strategies within the Tri-Valley Area; and

WHEREAS, the Cities of Dublin, Pleasanton, and Livermore, and DSRSD have completed a planning process that engages the public, assesses the risk and vulnerability to the impacts of natural hazards, develops a mitigation strategy consistent with a set of uniform goals and objectives, and creates a plan for implementing, evaluating and revising this strategy; and

WHEREAS, the Cities of Dublin, Pleasanton, and Livermore, and DSRSD, have completed the preparation of the *January 2018 Tri-Valley Hazard Mitigation Plan*, a local hazard mitigation plan, attached as Exhibit "A," *a copy of which is available for inspection in the District Office,* in conformance with Disaster Mitigation Act of 2000.

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF DUBLIN SAN RAMON SERVICES DISTRICT, a public agency located in the Counties of Alameda and Contra Costa, California, as follows:

1. Dublin San Ramon Services District adopts the *January 2018 Tri-Valley Hazard Mitigation Plan*, referenced herein and incorporated as Exhibit "A."
2. Dublin San Ramon Services District shall use the approved *January 2018 Tri-Valley Hazard Mitigation Plan* to guide pre- and post-disaster mitigation of the hazards identified.
3. Dublin San Ramon Services District shall coordinate the strategies identified in the *January 2018 Tri-Valley Hazard Mitigation Plan* with other planning programs and mechanisms

under its jurisdictional authority.

4. Dublin San Ramon Services District shall assist to promote and support the mitigation successes of all *January 2018 Tri-Valley Hazard Mitigation Plan* partners, including the Cities of Dublin, Pleasanton, and Livermore.

ADOPTED by the Board of Directors of Dublin San Ramon Services District, a public agency in the State of California, Counties of Alameda and Contra Costa, at its regular meeting held on the 15th day of May, 2018, and passed by the following vote:

AYES: 5 - Directors Richard M. Halket, Madelyne A. Misheloff, Edward R. Duarte, D.L. (Pat) Howard, Georgean M. Vonheeder-Leopold

NOES: 0

ABSENT: 0

Georgean M. Vonheeder-Leopold

Georgean M. Vonheeder-Leopold, President

ATTEST: Nicole Genzale

Nicole Genzale, District Secretary

U.S. Department of Homeland Security
1111 Broadway, Suite 1200
Oakland, CA. 94607-4052

FEMA

June 25, 2018

Tracy Hein
Emergency Preparedness Manager
Livermore-Pleasanton Fire Department
3560 Nevada Street
Pleasanton, CA 94566

Dear Ms. Hein:

We have completed our final review of the *2018 Tri-Valley Hazard Mitigation Plan*, officially adopted by the City of Livermore and Dublin San Ramon Services District respectively on June 11, 2018 and May 15, 2018, and found the plan to be in conformance with Title 44 Code of Federal Regulations (CFR) Part 201.6 *Local Mitigation Plans.* A list of the status of participating jurisdictions is enclosed with this letter.

The approval of this plan ensures Tri-Valley's continued eligibility for project grants under FEMA's Hazard Mitigation Assistance programs, including the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program. All requests for funding, however, will be evaluated individually according to the specific eligibility, and other requirements of the particular program under which applications are submitted.

Also, approved hazard mitigation plans are eligible for points under the National Flood Insurance Program's Community Rating System (CRS). Additional information regarding the CRS can be found at https://www.fema.gov/national-flood-insurance-program-community-rating-system or through your local floodplain manager.

FEMA's approval of the *2018 Tri-Valley Hazard Mitigation Plan* is for a period of five years, effective starting the date of this letter. Prior to June 25, 2023, the City of Livermore and the Dublin San Ramon Services District and all participating jurisdictions are required to review and revise the plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval in order to continue to be eligible for mitigation project grant funding. The enclosed plan review tool provides additional recommendations to incorporate into the plan during the plan maintenance process.

If you have any questions regarding the planning or review processes, please contact Alison Kearns, Senior Community Planner, at (510) 627-7125 or by email at alison.kearns@fema.dhs.gov.

Sincerely,

Juliette Hayes
Director
Mitigation Division
FEMA, Region IX

Enclosure

cc: Julie Norris, Mitigation and Dam Safety Branch Chief, California Governor's Office of Emergency Services
Jennifer Hogan, State Hazard Mitigation Officer, California Governor's Office of Emergency Services

Status of Participating Jurisdictions as of June 25, 2018

Jurisdictions – Adopted and Approved

#	Jurisdiction	Date of Adoption
1	Dublin San Ramon Services District	5-15-2018
2	Livermore, City of	6-11-2018

Jurisdictions – Approvable Pending Adoption

#	Jurisdiction
1	Dublin, City of
2	Pleasanton, City of

Appendix D. Progress Report Template

D. PROGRESS REPORT TEMPLATE

Reporting Period: *(Insert reporting period)*

Background: The Cities of Dublin, Livermore and Pleasanton, and participating local jurisdictions, developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating planning partners organized resources, assessed risks from natural hazards, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

INSERT LINK

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2017, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before ______, 2022. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted __ hazard mitigation actions to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of __ actions (__%) reported ongoing action toward completion.
- __ out of __ actions (__%) were reported as being complete.
- __ out of __ actions (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of the planning partners. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Hazard Mitigation Plan Steering Committee: The Hazard Mitigation Plan Steering Committee, made up of planning partners and other stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 2018. It was determined through the plan's development process that a steering committee would remain in service to oversee maintenance of the plan. At a minimum, the Steering Committee will provide technical review and oversight on the development of the annual progress report.

It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Steering Committee membership is as indicated in Table 1.

Table 1. Steering Committee Members

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- ______________________________
- ______________________________

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each action. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each action and the prioritization process.

Address the following in the "status" column of the following table:

- Was any element of the action carried out during the reporting period?
- If no action was completed, why?
- Is the timeline for implementation for the action still appropriate?
- If the action was completed, does it need to be changed or removed from the action plan?

Table 2. Action Plan Matrix

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				
Action #__—____________________[description]				

Completion status legend:
✓= Project Completed
O = Action ongoing toward completion
X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets. The report is posted on the Tri-Valley Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here