CLOVERDALE

City of Cloverdale General Plan

Background Report
Chapter 10: Public Health and Safety

October 2021

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CHAPTER 10. PUBLIC HEALTH AND SAFETY

10.1 OVERVIEW

This chapter describes potential hazards specific to Cloverdale and relates these hazards to human health and safety. These hazards include drought, earthquake, flooding, geological hazards, health epidemics or pandemics, and wildfire, as described in the City's Local Hazard Mitigation Plan. The chapter also hazardous materials and transportation-related safety concerns.

10.1.1 Legal Basis and Requirements

California Government Code Section 65302(g) requires that the General Plan include a "safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche and dam failure; slope instability leading to mudslides and landslides; subsidence, liquefaction and other seismic hazards identified pursuant to Chapter 7.8 of the Public Resources Code, and other geologic hazards known to the local legislative body; flooding; and wildland and urban fires. The safety element shall include mapping of known seismic and other geologic hazards. It shall also address evacuation routes, peakload water supply requirements and minimum road widths and clearances around structures, as those items relate to identified fire and geologic hazards." The law also includes additional specifications for content related to flood hazards, fire hazards, climate adaptation and resiliency, and emergency evacuation routes. With these additional requirements, the law has also established a linkage to the housing element cycle and the federally-mandated hazard mitigation planning cycle. That is, local governments must "review and, if necessary, revise the safety element upon each revision of the housing element or local hazard mitigation plan, but not less than once every eight years, to identify new information relating to flood and fire hazards and climate adaptation and resiliency strategies applicable to the city or county that was not available during the previous revision of the safety element."

10.1.2 Methodology and Sources

Information for this section was derived mainly from material produced for the City's 2021 Local Hazard Mitigation Plan (LHMP). This includes the discussions of drought, earthquake hazards, flooding, geological hazards, public health concerns (i.e., epidemic, pandemic, vector-borne disease), and wildfire. For subjects not covered by the LHMP (e.g., hazardous materials, transportation safety), the descriptions relied on a variety of City and County sources.

10.1.3 Hazard Profiles

The hazard profiles in this chapter provide a baseline definition and description for each of the priority hazards in Cloverdale. For each hazard, the profiles include a general description of the hazard, as well as the following details concerning the nature of the hazard in Sonoma County generally and Cloverdale specifically:

- Plans, Policies, and Regulatory Environment
- Past Events
- Location
- Frequency/Probability of Future Occurrences
- Severity and Extent
- Warning Time
- Secondary Hazards
- Vulnerability Assessment

10.2 EMERGENCY MANAGEMENT FRAMEWORK

The City of Cloverdale collaborates with Sonoma County and other public, private, and nonprofit stakeholders to address the full range of emergency services required to keep the people and property of Cloverdale safe. The activities in which the City engages to do so are part of the four-phase emergency management cycle, as depicted in Figure 10-1 and described in Table 10-1. As indicated, the phases in the cycle, (1) mitigation, (2) preparedness, (3) response, and (4) recovery occur at various times relative to the occurrence of hazardous events or emergencies.

The City's 2021 Local Hazard Mitigation Plan (LHMP) was prepared and adopted to address the first phase of the emergency management cycle.

FIGURE 10-1: EMERGENCY MANAGEMENT CYCLE

TABLE 10-1: EMERGENCY MANAGEMENT CYCLE

1. Mitigation *Preventing future emergencies or minimizing their effects*	▪ Activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. ▪ Wildland-urban interface (WUI) fuel reduction is a mitigation activity. ▪ Mitigation activities take place **before** and **after** emergencies.
2. Preparedness *Preparing to handle an emergency*	▪ Plans or preparations made to save lives and to help response and rescue operations. ▪ Evacuation plans and stocking food and water are both examples of preparedness. ▪ Preparedness activities take place **before** an emergency occurs.
3. Response *Responding safely to an emergency*	▪ Actions taken to save lives and prevent further property damage in an emergency situation. Response is putting your preparedness plans into action. ▪ Seeking shelter from a tornado or turning off gas valves in an earthquake are both response activities. ▪ Response activities take place **during** an emergency.
4. Recovery *Recovering from an emergency*	▪ Actions taken to return to a normal or an even safer situation following an emergency. ▪ Recovery includes getting financial assistance to help pay for the repairs. ▪ Recovery activities take place **after** an emergency.

The City has committed to the final three phases of the emergency management cycle through its various institutional partnerships. This includes the Resilient Cloverdale Steering Committee, which focuses primarily on community preparedness. Launched in the aftermath of the 2019 Kincade Fire, Resilient Cloverdale is the largest cross-sector readiness initiative in Cloverdale's history. Led by the City Manager's office in partnership with the Mayor, City Council, the Citrus Fairgrounds, the Senior Center, CERT, Kiwanis and Lyons Service Clubs and Latino Unidos and more, Resilient Cloverdale is a locally-managed year round initiative. The goals of the organization are as follows:

- Advance overall readiness of the City by investing in systems, relationships and resources to ensure any future response to disasters is done in an equitable and inclusive manner regardless of operating conditions (like a global pandemic).
- Increase the level of readiness of the Cloverdale Citrus Fairgrounds to respond to the surges in demand for care and shelter.
- Establish a local COAD (Community Agencies Active in Disaster) to support Cloverdale's readiness and response goals encompassing all populations in the community.

In terms of response, the City participates in the Standardized Emergency Management System (SEMS), which manages responses to multi-agency and multi-jurisdiction emergencies in California. SEMS requires emergency response agencies to use basic principles and components of emergency management, including the Incident Command System, the Master Mutual Aid Agreement, existing aid systems, the operational area concept, and involving the coordination of agencies of all levels. The City of Cloverdale, along with other cities and special districts in Sonoma County, participates in the Operational Area Organization and System for Coordination and Communication. The Sonoma County Department of Emergency Services-Emergency Management Division has the lead responsibility for SEMS implementation and planning and administers the County's Operational Area Emergency Plan for the planned response to extraordinary emergency situations associated with natural disasters, technological incidents, and national security emergencies within or affecting the County. It establishes a framework for implementation of the SEMS, focusing on organization and operation in the event of a significant emergency or disaster and during the recovery process, as well as policies, responsibilities and procedures required to protect the health and safety of Sonoma County communities, public and private property, and the environment.

10.3 CRITICAL FACILITIES

Critical facilities are of particular concern when it comes to understanding the nature of risk in a community. A critical facility is a structure or other improvement that, because of its function, size, service area, or uniqueness, has the potential to cause disruption of vital socioeconomic activities if it is destroyed, damaged, or functionally impaired. To ensure accurate accounting for the critical facilities in Cloverdale, the City compiled inventory data from a variety of sources, including City, County, State, Federal, and private industry datasets. This data became part of the critical infrastructure spatial database used to translate critical facilities information into georeferenced points and lifelines as part of the vulnerability analysis described conducted for the City's 2021 LHMP, as described in the profiles presented sections 0 through 0 of this chapter.

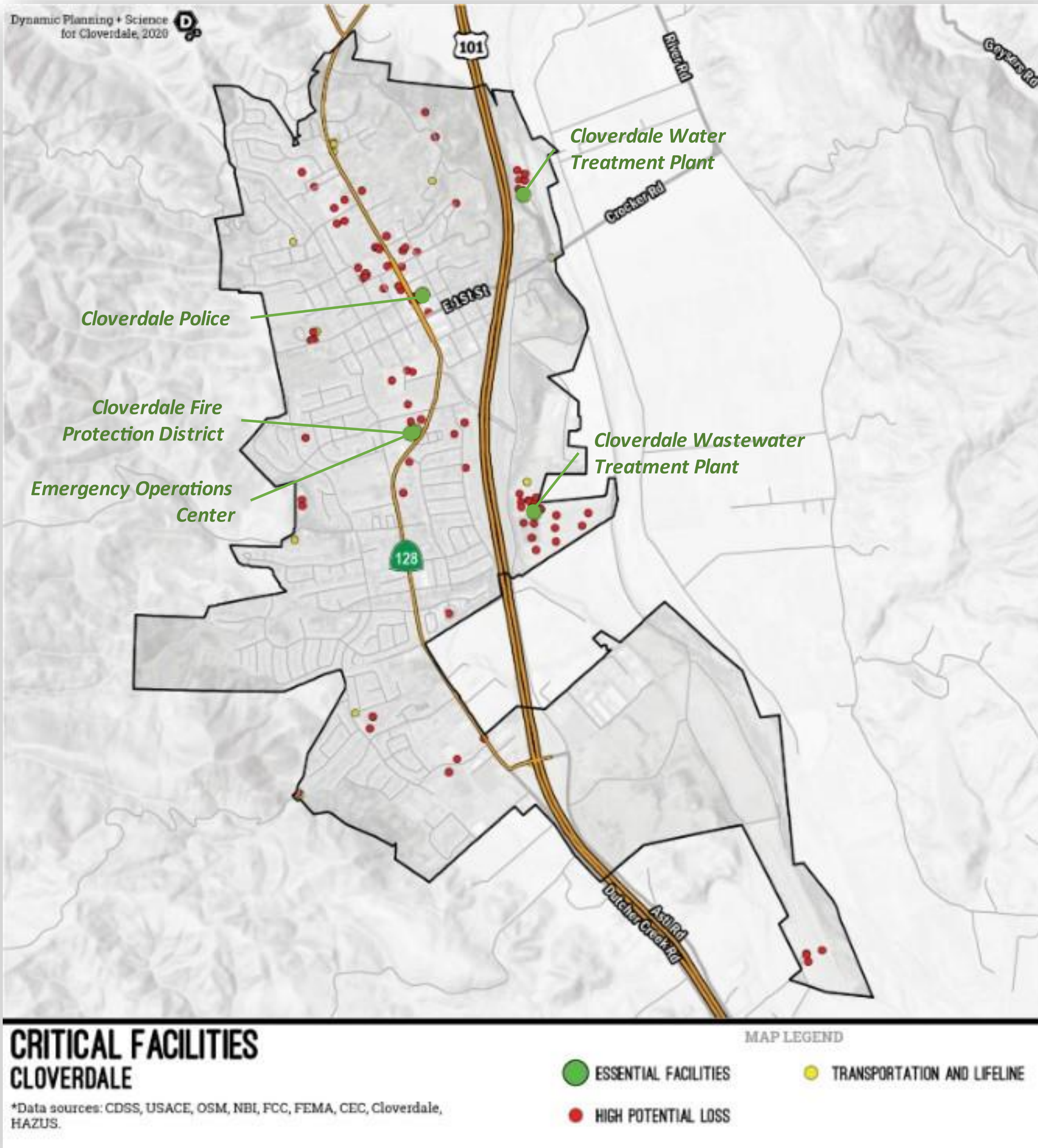
10.3.1 Critical Infrastructure

A key element of the vulnerability analyses presented in sections 10.5 through 0 of this chapter is the identification of critical infrastructure that could be subject to damage from Cloverdale's highest priority hazards. Table 10-2 shows the type and number of critical infrastructure facilities in the city, including mileage of critical lifeline facilities. Figure 10-2 shows the location of these and other critical facilities in Cloverdale. Note that the location of some privately-owned lifeline facilities is proprietary, so they have not been mapped and are not included in Table 10-2 and Figure 10-2.

TABLE 10-2: CRITICAL INFRASTRUCTURE

Facility Type	Number	Facility Type	Number
Essential Facilities		**Transportation and Lifeline**	
Fire	1	Bridge	7
Police	2	Substation	1
EOC	1	Airport	1
Subtotal	**4**	Water Tank	3
High Potential Loss		Park	4
Child Care Center	6	Pump House	4
School	9	**Subtotal**	**20**
Library	2	**Linear Infrastructure Type**	**Miles**
Residential Elder Care Facility	1	Levee	1.66
Historic Building	4	Natural Gas Pipeline	2.88
Home Care Organization	1	Transmission Line	0.43
Family Child Care Home	4	Railroad	2.89
City-Owned Asset	46	**Streets/Roadways**	
Airport	1	Alley	0.14
Vulnerable Housing	10	Cul-de-sac	0.1
Park	4	Driveway	0.43
Mobile Home Park	1	Interstate	4.67
Wastewater Treatment	2	Local road	37.79
Corp Yard	1	Primary Highway	3.2
Healthcare Center	5	Ramp	1.97
Affordable Housing	1	State/County highway	1.55
Evacuation Center	1	**Subtotal**	**49.85**
Communications Tower	3	**Total**	**57.71**
City Hall	2		
Town Hall	1		
Senior Center	2		
Water Treatment	2		
Subtotal	**109**		

FIGURE 10-2: CRITICAL FACILITIES



10.3.2 City Utilities

Among the most important considerations in ensuring sufficient mitigation against the effects of natural hazards is the resilience of community utility infrastructure. This includes water supply, treatment, and distribution systems and wastewater collection, treatment, and disposal systems. Through its system master planning and capital improvement programming, the City of Cloverdale periodically evaluates the status of its facilities to ensure that they are in good repair and resilient enough to withstand hazardous conditions. In conjunction with its periodic rate studies, the City also ensures that revenues are aligned with system improvement needs. Of particular importance is the City's ongoing program to replace older water and wastewater system components to mitigate against the effects of age and to ensure resilience. Following are descriptions of several ongoing projects that will enhance resilience as of January 2021.

- **New Water Well:** The Cloverdale Water Treatment Plant operates and maintains a series of shallow wells (7) along the Russian River. As wells age, their production capacity and reliability begins to drop off. As part of its Capital Improvement Program (CIP), the City has developed plans for the replacement or redevelopment of aged wells. The next proposed well is scheduled to be designed and constructed within the next two fiscal years. The proposed well site is on the eastern bank of the Russian River on a city-owned lot in what is believed to be a water-rich site. In order to get the water to the water treatment plant, the well pumps will need about ½ to 1 mile of pipeline, depending on the preferred route.
- **Ritter Reservoir No. 1:** This bolt-together tank was installed in 1988 and is showing signs of deterioration. The plan is to replace it with a more-reliable welded steel tank. The interior coating is failing, and the bolt-together structure is leaking at about a dozen locations.
- **Water Treatment Plant Chlorine Contact Tank Addition:** The Cloverdale WTP currently has one contact tank that has been in continuous operations since it was constructed in 2001. A redundant tank is needed to assure continuous operations when one tank is removed from service.
- **Water Main Replacement Program:** The City's water distribution system consist of pumps, pipes, and reservoirs (tanks). A key component of keeping the distribution system resilient and reliable is to replace older pipelines to avoid degrading water service, increasing water service disruptions, and increasing expenditures for emergency repairs. The funding level of the City's program would replace approximately 200 feet of water mains per year.
- **Sewer Replacement Program:** This program addresses the sewer collection system renewal for older pipelines or undersized pipelines.
- **Sewer Rehabilitation Program:** This program identifies pipelines that have sufficient capacity but need extensive repair. Sewer lining allows the city to extend the service life of a sewer.
- **Wastewater Treatment Plant Upgrade:** Cloverdale's wastewater treatment plant was built in 1980 and has not had any renewals/upgrades. The entire plant will need to be replaced within 10 to 20 years.

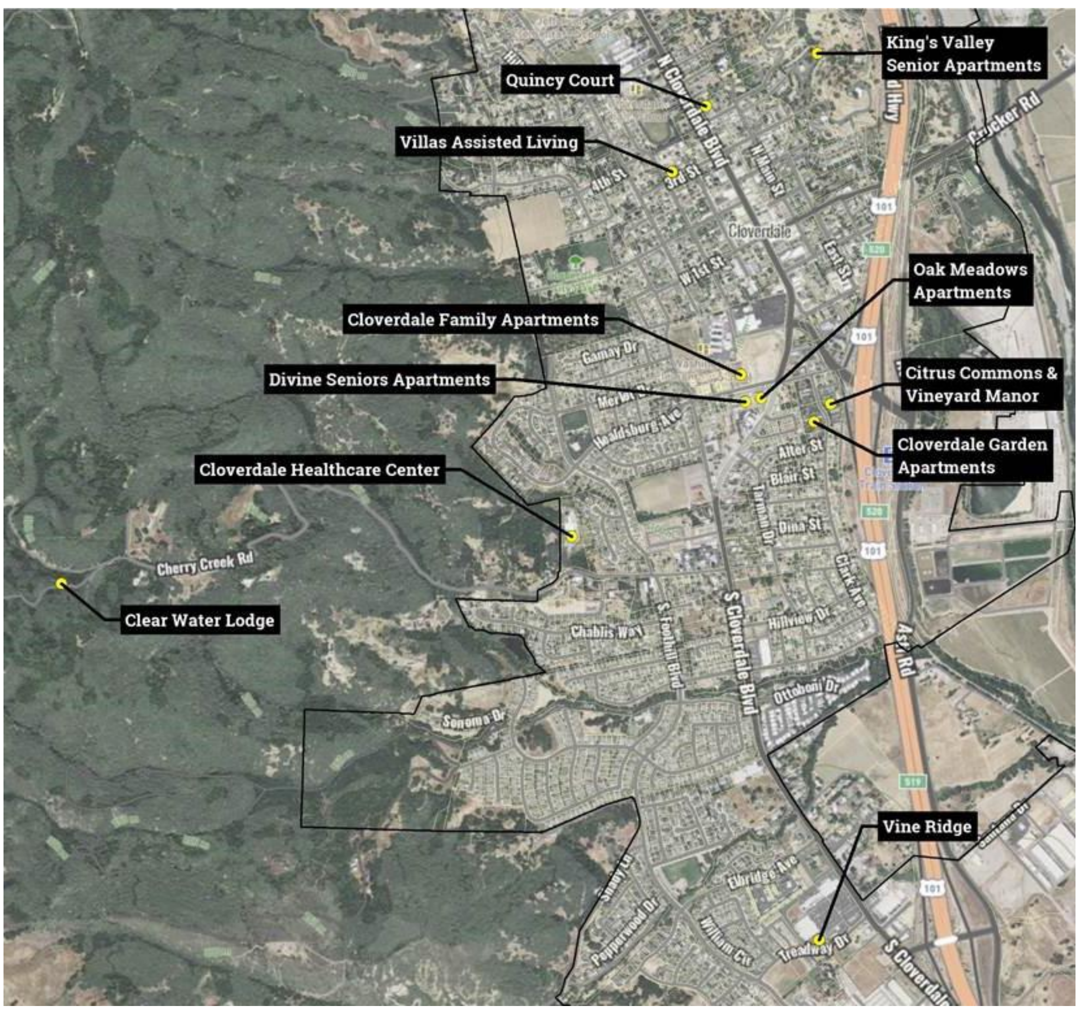
10.3.3 Housing for Vulnerable Residents

Facilities that provide housing vulnerable residents are a special concern because these residents are at particularly high risk during and following emergencies. This includes seniors, the disabled, farmworkers, and others needing assistance. Table 10-3 lists facilities housing vulnerable residents in Cloverdale and Figure 10-3 shows their locations. These facilities are also included in Figure 10-2.

TABLE 10-3: FACILITIES HOUSING VULNERABLE RESIDENTS

Name	Address	Type	Units
Citrus Commons	133 Healdsburg Avenue	Senior Housing	34
Clear Water Lodge (outside city)	611 Cherry Creek Road	Assisted Living	15
Cloverdale Family Apartments	100 Healdsburg Avenue	Farmworker Housing	32
Cloverdale Garden Apartments	18 Clark Avenue	Senior Housing	70
Cloverdale Healthcare Center	300 Cherry Creek Road	Seniors/Disabled General Care	76
Divine Senior Apartments	141 Healdsburg Avenue	Assisted Living	32
King's Valley Senior Apartments	100 Kings Circle	Senior Housing	99
Oak Meadows Apartments	121 Healdsburg Avenue	Assisted Living	2
Quincy Court	408 N. Cloverdale Blvd	Assisted Living	2
Villas Assisted Living	214 W 3rd Street	Assisted Living	6
Vine Ridge	247 Treadway Drive	Assisted Living	58
Vineyard Manor	101 Clark Avenue	Affordable Family	36

FIGURE 10-3: FACILITIES HOUSING VULNERABLE RESIDENTS



10.4 CLIMATE CHANGE AND ITS EFFECTS ON PUBLIC HEALTH AND SAFETY

As explained in the 2018 California State Hazard Mitigation Plan (SHMP), climate change caused by increases in greenhouse gas (GHG) concentrations is an increasingly important consideration for all aspects of emergency management. Climate change has the effect of intensifying the effects of many natural hazards, adding to concerns otherwise addressed in hazard mitigation planning. Accordingly, rather than addressing climate change as a standalone hazard, the City's LHMP describes its relationship to Cloverdale's vulnerability to other hazards addressed (e.g., drought, extreme weather, flooding, wildfires). To set the stage for these hazard-specific discussions, this section explains key considerations concerning the general relationships between climate change and hazard mitigation.

10.4.1 What is Climate Change?

Climate change refers to changes in conditions that result from increased atmospheric greenhouse gas (GHG) concentrations, which is linked to an increase in average global temperature. These increases in global temperature and GHG are resulting in a series of changes to the global climate (e.g., shifts in seasonal temperature patterns; altered precipitation timing, amount, and location; sea-level rise; ocean acidification due to increased carbon dioxide (CO2) absorption; and altered wind and storm event frequency, severity, and location). These outcomes interact, and their potential consequences are the result not only of the shifts in global climate but the variety of characteristics that define biophysical systems and human development.

10.4.2 Potential Impacts of Climate Change on Hazards

Climate change alters the frequency, severity, and location of many hazard events and should be accounted for in hazards planning. The potential impacts and associated risks of climate change have been detailed in several state reports including the 2009 California Climate Adaptation Strategy, updated as the Safeguarding California Plan: 2018 Update and the 2012 California Adaptation Planning Guide built on the findings of California's Climate Change Assessments. Climate change exacerbates hazards already experienced in California and introduces new hazards. In addition to increasing global average temperature, climate change results in an increase in variance of climate patterns. The increase in variance means that extreme events may exhibit changes in severity, frequency, and location. For example, the increased variance in climate patterns will result in more frequent incidence of severe events, such as extreme rainfall, wind, wildfire, extreme heat, and extended drought. The increased variance therefore creates challenges for hazards planning, which previously used historic recurrence rates to predict future events, and now must incorporate changes to frequency, severity, and location due to climate change influences.

At the local level, in 2016, the Sonoma County Regional Climate Protection Authority (RCPA) completed Climate Action 2020 and Beyond as the County's climate action plan and greenhouse gas reduction implementation program. RCPA was formed in 2009 to provide a formal collaborative structure on climate protection for the county's nine cities, including Cloverdale, and multiple countywide agencies. The RCPA helps its stakeholders work collaboratively to set goals, pool resources, and create partnerships. It is governed by a board of 12 elected officials — nine representing cities and three from the County Board of Supervisors — and provides an invaluable forum for in-depth discussions on climate planning, program management, and project delivery. In 2016, in addition to completing Climate Action 2020, RCPA produced a set of Climate Adaptation forums to educate and broaden support for building resilience and created Shift Sonoma County (transportation greenhouse gas reduction).

Climate Action 2020 identified several ways that changes in the climate could affect the Cloverdale Area:

- **Higher Average Temperature and More Extreme Heat Events:** Summer high temperatures are expected to increase by 1 to 2°F by 2100, even with successful programs to reduce carbon emission. Without such programs, average summer high temperatures could increase by to 9 to 11°F.
- **Fewer Winter Nights that Freeze:** Projected winter low temperatures are also expected to increase through the end of the century. The coast, ridges, and mountain peaks will experience the most significant warming, while valley bottoms are projected to warm less dramatically. Winter low temperatures are expected to increase by 1 to 2°F, even with successful programs to reduce carbon emission. Without such programs, average winter lows are projected to increase by to 7 to 9°F.
- **More Frequent and Intense Droughts:** By 2100, climate change-caused evapotranspiration could result in 10 to 20 percent drier soil conditions in the summer months, regardless of whether there is more or less rainfall. Conditions would be worse with extended periods without rainfall.
- **More Frequent and Intense Wildfire**: Risk of fire is likely to continue to rise due to increased dryness of vegetation, compounded by productivity of plants in the spring (which creates more fuel for dry season wildfires). By 2100, the chances of one or more fires during a 30-year period are projected to increase from 15 to 20 percent to 25 to 33 percent in the mountainous areas of the county.
- **Increased Risk of Extreme Floods:** Increased seasonal variability of precipitation, runoff, and stream flows for Sonoma County, along with increased likelihood of extreme precipitation and drought events, are expected to result from changes in the climate. This will cause more years with more frequent storm events and storms of unprecedented strength, as well as longer storm seasons. These circumstances will combine to result in more frequent and more severe flooding.

10.4.3 Climate Vulnerability in Sonoma County

As described in Climate Action 2020 and Beyond, Sonoma County's people, property, and natural environment are all subject to increased vulnerability as a result of changes in the climate. The plan describes these vulnerabilities in terms of "people and social systems, built systems, and natural and working lands," as explained below.

- **People and Social Systems:** These systems include residents and visitors, households, neighborhoods, cities, economic activities, social services, food systems, education, business, emergency services, public safety, and law enforcement. These communities and community systems have varying abilities to prepare for, respond to, and recover from climate hazards. In particular, disparities in health, education, and income levels will make certain populations and communities more vulnerable to climate change. The social systems that help support basic needs for people (e.g., food, water, shelter, transportation, and healthcare) are also vulnerable to breakdown from climate-related crises.
- **Built Systems:** These include residential and non-residential buildings and facilities, and the infrastructure associated with providing water, sanitation, drainage, communications, transportation, and energy. These systems are necessary for maintaining a healthy and well-functioning society and represent a huge capital investment by both private and public entities. Many built systems and structures are at increased risk of failure due to age and deferred maintenance. These risks are magnified when multiple systems fail at the same time (flood and fire, for example), resulting in cascading impacts throughout the built environment.
- **Natural and Working Lands:** Natural lands include public and private natural and open space areas and the ecosystems these lands support, including wildlife, streams and wetlands, and sensitive species and habitats. Working lands include agricultural lands (e.g., vineyards, farms, ranches, and timberlands).

10.5 DROUGHT

California's water resources have been stressed by periodic drought cycles and—in some places—overuse, creating the need for unprecedented restrictions in water diversions in recent years. While the durations of droughts are always uncertain and unpredictable, California will continue to be impacted by droughts. Drought has impacted almost every county in California at one time or another, causing more than $5.1 billion in damage, according to the State of California Hazard Mitigation Plan (2018). Droughts exceeding three years have been relatively rare in Northern California, the source of much of the state's water supply. The 1929-1934 drought established the criteria commonly used in designing storage capacity and yield for large Northern California reservoirs. The driest single year in California's measured hydrologic history was 1977.

History shows that drought impacts in California are felt first by those most dependent on annual rainfall: agencies fighting wildfires, agricultural operations (e.g., farms, ranches, orchards, vineyards), rural residents relying on wells in low-yield rock formations, or small water systems lacking a reliable water source.

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, the water year tends 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, these annual totals can fall to as little as one half, or even one third of these amounts.

The City of Cloverdale diverts water from the Russian River using seven shallow wells along the west bank of the river near the City's water treatment plant (WTP). Under ideal conditions, not all seven wells need to operate simultaneously to provide sufficient supply, allowing the wells to be rotated and their operational life extended. The City has also taken measures to reduce the maximum day demand by instituting water conservation measures during the peak water demand months and construction of additional well capacity to compensate for reduction in well yield in times of low flow. Reduced yield is not currently a serious threat to water supply.

Flow in the Russian River is maintained by mandatory releases of water from Lake Mendocino as part of fisheries maintenance. The City of Cloverdale's minimum available water supply is based on a combination of natural water flow and this mandated release. As the flow is reduced, the City's supply may become constrained. Extended drought conditions could affect flow, as could changes in PG&E's Potter Valley Project, which is a hydroelectric project that diverts Eel River water into Lake Mendocino via the East Fork of the Russian River. According to the City's Urban Water Management Plan (UWMP), based on current reservoir management practices, the City's water reliability is not expected to be affected due to already completed water supply projects (including additional wells).

The Russian River has been deemed an impaired water body due to excessive sedimentation and excessive temperature, but the impairments are not expected to have a major impact on the water quality for the City's supply because of the treatment provided at the WTP.

While droughts have occasionally impacted Cloverdale, its reliable supply and aggressive conservation programs in drought conditions have combined to minimize potential impacts associated with drought-related supply reductions. For example, the City has been able to reduce its water usage by upwards of 25 percent with programs such as the "Cash for Grass" rebate and high-efficiency fixture installation. Sonoma County has also successfully implemented urban conservation programs, but like other parts of California, has seen some agricultural land fallowed during periods of extended drought.

10.5.1 Plans, Policies, and Regulatory Environment

California Sustainable Groundwater Management Act

On September 16, 2014, Governor Brown signed into law a package of bills (SB 1168, AB 1739 and SB 1319) collectively called the Sustainable Groundwater Management Act (SGMA). SGMA requires local governments and water agencies with high and medium priority groundwater basins to halt overdraft and bring basins into sustainable levels of pumping and recharge. For each basin, local agencies are required to form new groundwater sustainability agencies (GSAs) and prepare groundwater sustainability plans (GSPs) with quantifiable objectives for achievement of sustainability within 20 years. In Sonoma County, there are three GSAs (Santa Rosa Plain, Sonoma Valley, and the Petaluma Valley), none of which cover the Cloverdale area, since Cloverdale groundwater and wells are connected to the Russian River. While Cloverdale does not rely directly on groundwater and is not subject to SGMA, groundwater is an important source for agricultural, industrial, and domestic water supply throughout Sonoma County, including unincorporated areas surrounding the City of Cloverdale.

Statewide Emergency Water Conservation Regulations

In 2016, the State Water Resources Control Board (Water Board) adjusted emergency water conservation regulations in recognition of the differing water supply conditions and ongoing drought across the state to comply with the Governor's Executive Order declaring a drought emergency. Executive Order B-37-16, Making Water Conservation a California Way of Life, updates temporary emergency water restrictions and transitions to permanent, long-term improvements in water use by:

- Providing for wiser water use
- Eliminating water waste
- Strengthening local drought resilience
- Improving agricultural water use efficiency and drought planning

In April 2017, a new Executive Order lifted the drought emergency, but retained many of the conservation requirements. Most regulations are still in effect with except for water supply "stress test" requirements and conservation standards for urban water suppliers. The temporary restrictions established a baseline of the types of benefits that are possible from water conservation requirements. The Executive Orders are found at:
https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/executive_orders.html

California Water Plan

The California Water Plan presents strategic plan elements including a vision, mission, goals, guiding principles, and recommendations for current water conditions, challenges, and activities. The plan includes future uncertainties and climate change impacts, scenarios for 2050, and a roadmap for improving data and analytical tools needed for integrated water management and sustainability. The California Water Plan was updated most recently in 2018. See:
https://water.ca.gov/Programs/California-Water-Plan

10.5.2 Past Events

California experienced massive changes over the course of the twentieth century as evidenced by dramatic population increases and land use conversion. The California Department of Water Resources (DWR) has state hydrologic data back to the early 1900s. The hydrologic data show multi-year droughts from 1912 to 1913, 1918 to 1920, 1922 to 1924, 2007 to 2009, and 2014 to 2016.

In January 2014, with California facing water shortfalls in the driest year in recorded state history, Governor Jerry Brown declared a drought state of emergency. In his declaration, Governor Brown directed state officials to assist farmers and communities that are economically impacted by dry conditions and to ensure the state can respond if Californians face drinking water shortages. The Governor also directed state agencies to use less water, hire more firefighters, and initiate a greatly expanded water conservation public awareness campaign. On April 17, 2017, Brown issued Executive Order B-40-17, officially ending the drought state of emergency in all California counties except Fresno, Kings, Tulare, and Tuolumne.

The National Drought Monitor provides drought data and maps nationally and on a localized, watershed scale. The National Drought Monitor is the product of eleven agencies, from the NDMC, NOAA and USDA, and is available at http://droughtmonitor.unl.edu/. The National Drought Monitor categorizes the level of drought from D0 through D4, with D4 being the highest “exceptional drought.” Table 10-4 describes each of drought classifications and their potential consequences in California.

TABLE 10-4: DROUGHT CLASSIFICATIONS AND POTENTIAL CONSEQUENCES FOR CALIFORNIA

Severity	Potential Consequences
D0 Abnormally Dry	▪ Soil is dry; irrigation delivery begins early ▪ Dryland crop germination is stunted ▪ Active fire season begins ▪ Winter resort visitation is low; snowpack is minimal
D1 Moderate Drought	▪ Dryland pasture growth is stunted; producers give supplemental feed to cattle ▪ Landscaping and gardens need irrigation earlier; wildlife patterns begin to change ▪ Stock ponds and creeks are lower than usual
D2 Severe Drought	▪ Grazing land is inadequate ▪ Producers increase water efficiency methods and drought-resistant crops ▪ Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff ▪ Wine country tourism increases; lake- and river-based tourism declines; boat ramps close ▪ Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase ▪ Water temperature increases; programs to divert water to protect fish begin ▪ River flows decrease; reservoir levels are low and banks are exposed
D3 Extreme Drought	▪ Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements ▪ Fruit trees bud early; producers begin irrigating in the winter ▪ Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive ▪ Dairy operations close ▪ Marijuana growers illegally tap water out of rivers ▪ Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented ▪ Ski and rafting business is low, mountain communities suffer ▪ Orchard removal and well drilling company business increase; panning for gold increases ▪ Low river levels impede fish migration and cause lower survival rates ▪ Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less ▪ Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs ▪ Wells and aquifer levels decrease; homeowners drill new wells ▪ Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase ▪ Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted
D4 Exceptional Drought	▪ Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small ▪ Fire season is very costly; number of fires and area burned are extensive ▪ Many recreational activities are affected ▪ Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear ▪ Policy change; agriculture unemployment is high, food aid is needed ▪ Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise ▪ Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor

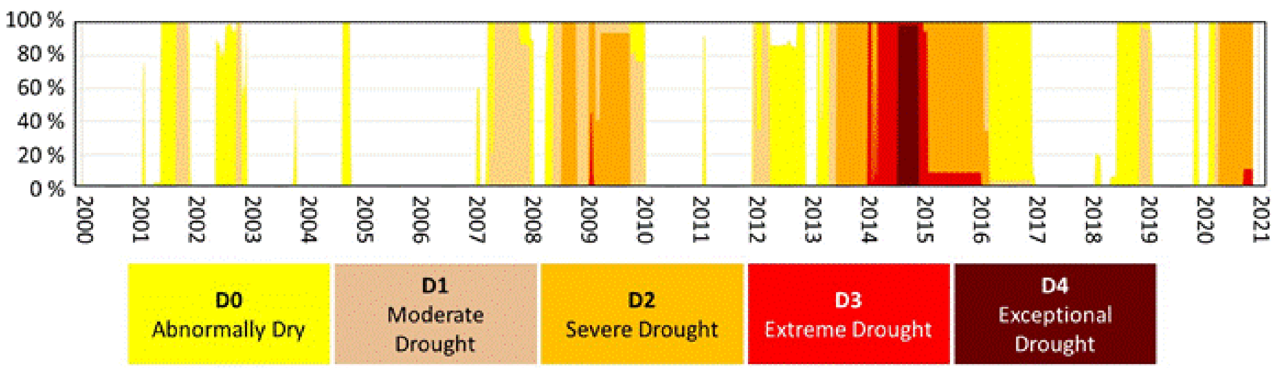
Table 10-5 shows the extent of drought conditions in California and Sonoma County as of the end of 2020. It indicates both the percentage of the area covered by each classification and the cumulative percentage of the area experiencing drought. As the table shows, 89.4 percent of Sonoma County was experiencing severe drought conditions and 10.6 percent was experiencing extreme drought.

TABLE 10-5: DROUGHT SEVERITY IN CALIFORNIA AND SONOMA COUNTY AS OF 12/29/2020

	California		Sonoma County	
Severity	% of Area	Cumulative	% of Area	Cumulative
D0: Abnormally Dry	4.8%	100.0%	0.0%	100.0%
D1: Moderate Drought	20.8%	95.2%	0.0%	100.0%
D2: Severe Drought	40.6%	74.3%	89.4%	100.0%
D3: Extreme Drought	32.6%	33.8%	10.6%	10.6%
D4: Exceptional Drought	1.2%	1.2%	0.0%	0.0%

Figure 10-4 shows a time series of the level of drought in Sonoma County from 2000 to 2020 according to the National Drought Monitor as well as the watersheds in Sonoma County. The National Drought Monitor also classifies drought on a watershed scale (according to hydrologic units established by the US Geological Survey). The participating jurisdiction annexes for those jurisdictions that prioritized drought hazards depict the past twenty years of droughts within applicable watersheds.

FIGURE 10-4: SONOMA COUNTY DROUGHT SEVERITY TIMELINE (2000 TO 2021)



10.5.3 Location

By its nature, the effects of drought are geographically pervasive and difficult—if not impossible—to isolate at a jurisdictional level. This particularly the case with a community as small as Cloverdale.

10.5.4 Frequency/Probability of Future Occurrences

There is currently no data on the probability of drought akin to data for predicting earthquakes or flood probability. 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 often produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

There is high probability of droughts continuing to affect Sonoma County and Cloverdale. As Figure 10-4 shows, Sonoma County has been in some form of drought for about half of the period from 2000 to 2020, with the frequency increasing in the latter years.

10.5.5 Severity and Extent

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. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly.

Agricultural production effects are often the clearest indicator of the location-specific nature of drought impacts, since they are felt earliest by those relying on unmanaged water supplies. Impacts to irrigated land depend on the source and nature of the irrigation water supply, whether it be local groundwater, local surface water, or imported surface water, and any water rights or contractual provisions that may be associated with the source. The extent to which producers may mitigate water shortage impacts depends on multiple factors but is heavily influenced by economic considerations. Factors involved in making decisions about mitigating irrigation water shortages include availability and costs of pumping groundwater, price of alternative surface water sources, capital investments associated with maintaining permanent plantings, and the status of international crop markets. (California Drought Contingency Plan, 2010)

Unlike most hazards, droughts normally occur slowly but last a long time. On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between $6 billion and $8 billion annually in the United States and 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.

Drought eventually affects groundwater sources but generally not as quickly as surface water supplies; 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. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

A drought directly or indirectly impacts all people in affected areas. A drought can result in farmers not being able to plant crops or the failure of planted crops. This results in loss of work for farm workers and those in food processing and wine making jobs. Other water-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them.

10.5.6 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 over a long time scale. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

10.5.7 Secondary Hazards

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

10.5.8 Vulnerability Assessment

All people, property, and natural environments in the Cloverdale area could be exposed to the impacts of moderate to extreme drought conditions to some degree. Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area directly experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought vulnerability of any particular activity depends on its reliance on water, how the demand for water is met, and what water supplies are available to meet the demand.

As described above, the City of Cloverdale relies on wells under direct influence of surface water from the Russian River, per its pre-1914 water rights, as its sole water source. The City's Water Master Plan addresses its increasing population and development and evaluates the sufficiency and reliability of the Russian River as its source. The City's pre-1914 water rights are expected to be sufficient to meet all foreseeable demand, regardless of water year type (e.g., average year, single dry year, multiple dry years). While the City has assessed potential alternative supplies, none of them have been deemed necessary to meet demand.

Although the City's water rights position it well to meet any future demands, the City has enacted plans for future water conservation programs, ordinances, and changes to the Municipal Code that would reduce its drought vulnerability. These measures should keep total water use relatively stable even as the population grows. Furthermore, the City's Urban Water Management Plan (~~2016~~2021) includes a Water Shortage Contingency Plan that lays the foundation for the City's response to reductions in water availability. Additionally, the City's demand management measures, which are in place regardless of water supply availability, are presented in the Urban Water Management Plan.

Cloverdale's Russian River water supply is affected by several factors, including impoundment in Lake Mendocino of water connected with PG&E's Potter Valley Project, a hydroelectric project that diverts Eel River water into Lake Mendocino via the East Fork of the Russian River. PG&E's Federal Energy Regulatory Commission (FERC) license for Potter Valley Project facilities and operations expires in 2022. Changes in these facilities and operations could adversely affect the City's access to Russian River supply, which could, in turn, affect the City's drought vulnerability. The possibility of such changes could be affected by a change in ownership of the facilities, and—in 2018—PG&E commenced with an auction process, stating the Potter Valley Project "no longer serves as an economical source of electricity generation for its customers." In January 2019, PG&E filed a notice of withdrawal of its intent to transfer and sell the Project. The following month, PG&E withdrew from the relicensing process.

In response to PG&E's withdrawal from the relicensing process, FERC released a solicitation seeking other interested applicants. In June 2019, with the intent of reducing uncertainty regarding the fate of the Project after PG&E's withdrawal, a coalition consisting of Sonoma Water, the Mendocino County Inland Water and Power Commission, California Trout, Inc., and the County of Humboldt filed its intent to apply for a new license for the Project. Shortly thereafter the Round Valley Indian Tribes joined the coalition and entered into a collaborative planning agreement to advance a "two-basin solution" that meets the shared objectives of stakeholders in both the Eel and Russian river basins. The first stated objective of the participating parties is "Minimizing or avoiding adverse impacts to water supply reliability, fisheries, water quality, and recreation in both basins."

In accordance with the FERC-approved Study Plan, the relicensing application is supported by a series of field studies, analyses, and technical reports. These studies along with the final license application are scheduled to be completed by April 2022.

Following are discussions of Cloverdale's vulnerabilities to drought for population, property, and critical facilities. These vulnerabilities are characterized in terms of qualitative exposure because drought effects cannot be isolated geographically in a manner that allows for GIS-based quantitative analysis. For the same reason and because FEMA's Hazus model does not address drought, property damage/loss was not estimated.

Population

Given the City's secure supply of surface water from the Russian River, Cloverdale's population, even with projected growth, is not expected to be vulnerable water supply limitations due to drought conditions and drought is not expected to hinder growth. Also, no significant life or health impacts are anticipated as a result of drought. As described above, however, unforeseen changes in the operation of the Potter Valley Project could affect the City's water supply and its vulnerability to drought conditions.

Property

Because of the City's reliance on secure Russian River supply, no property in the city will be directly affected by drought conditions, although some structures in the wildland-urban interfaces in and surrounding Cloverdale may become more vulnerable to the wildfires that are more likely following years of drought. While droughts can also have significant impacts on landscape quality, these impacts are not considered critical in planning for impacts from the drought hazard.

Critical Facilities

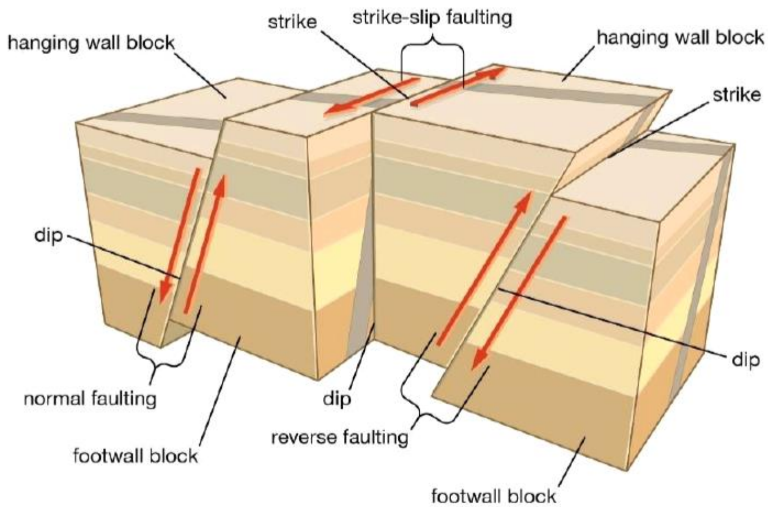
Critical facilities, as described in Section 10.3 of this plan, will continue to be operational during periods of drought. The City would, however, benefit from additional storage (e.g., tanks, reservoirs, aquifer) to ensure secure water supply during reduced flow in the Russian River resulting from drought.

10.6 EARTHQUAKE

An earthquake is the sudden shaking of the ground caused by the passage of seismic waves through earth's rocks. Seismic waves are produced when some form of energy stored in earth's crust is suddenly released, usually when masses of rock straining against one another suddenly fracture and "slip." Earthquakes associated with this type of energy release are called tectonic earthquakes. The energy also can be released by elastic strain, gravity, chemical reactions, or even the motion of massive bodies. Earthquakes occur most often along geologic faults, narrow zones where rock masses move in relation to one another.

Earthquakes have different properties depending on the type of fault that causes them (see Figure 10-5). The usual fault model has a "strike" (that is, the direction from north taken by a horizontal line in the fault plane) and a "dip" (the angle from the horizontal shown by the steepest slope in the fault). The lower wall of an inclined fault is called the footwall. Lying over the footwall is the hanging wall. When rock masses slip past each other parallel to the strike, the movement is known as strike-slip faulting. Movement parallel to the dip is called dip-slip faulting. In dip-slip faults, if the hanging-wall block moves downward relative to the footwall block, it is called "normal" faulting; the opposite motion, with the hanging wall moving upward relative to the footwall, produces reverse or thrust faulting. As a fault rupture progresses along or up the fault, rock masses are flung in opposite directions and thus spring back to a position where there is less strain.

FIGURE 10-5: EARTHQUAKE FAULTING



Earthquake Classifications: Magnitude and Intensity

Earthquakes are typically classified in one of two ways: (1) the amount of energy released, measured as **magnitude**, or (2) the impact on people and structures, measured as **intensity**.

The most common method for measuring earthquakes is magnitude, which measures the strength of earthquakes. The Richter scale is the most publicly-known measurement for magnitude, but the majority of scientists currently use either the moment magnitude (Mw) Scale or Modified Mercalli Intensity (MMI) Scale. The magnitude of an earthquake is related to the total area of the fault that ruptured, as well as the amount of offset (displacement) across the fault. As shown in Table 10-6, there are seven earthquake magnitude classes, ranging from "great" to "micro," in decreasing level of severity. A magnitude class of "great" can cause tremendous damage to property and structures, including infrastructure, compared with a "micro" magnitude, which results in minor damage.

TABLE 10-6: MOMENT MAGNITUDE (MW) SCALE

Magnitude Class	Magnitude Range (M = Magnitude)	Description
Great	M > 8	Tremendous damage
Major	7 <= M < 7.9	Widespread heavy damage
Strong	6 <= M < 6.9	Severe damage
Moderate	5 <= M < 5.9	Considerable damage
Light	4 <= M < 4.9	Moderate damage
Minor	3 <= M < 3.9	Rarely causes damage.
Micro	M < 3	Minor damage

The effects of an earthquake in a particular location are measured by intensity. Earthquake intensity decreases with increasing distance from the epicenter of the earthquake. The MMI value assigned to a specific site after an earthquake is a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects experienced at a tangible location. The lower numbers of the intensity scale generally reflect the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above. Table 10-7 is an abbreviated description of the levels of Modified Mercalli intensity.

TABLE 10-7: MODIFIED MERCALLI INTENSITY LEVEL DESCRIPTIONS

Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by people at rest, especially on upper floors of buildings.
III	Weak	Felt noticeably by people indoors, especially on upper floors of buildings. Many do not recognize it as 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 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	Negligible damage in buildings of good design and construction; slight to moderate damage in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Slight damage in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse; great damage in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Considerable damage in specially designed structures; well-designed frame structures thrown out of plumb. Great damage 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.
Source: USGS, Abridged from The Severity of an Earthquake, USGS General Interest Publication 1989-288-913		

Ground Motion

Earthquake hazard assessment may also be based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then adding the annual probabilities over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. 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 10-8 lists damage potential and perceived shaking by PGA factors, compared with the Mercalli scale.

TABLE 10-8: MERCALLI SCALE AND PEAK GROUND ACCELERATION (PGA)

MMI Scale	Shaking	Resistant Structures	Vulnerable Structures	Estimated PGA
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%

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

10.6.1 Plans, Policies, and Regulatory Environment

Alquist-Priolo Earthquake Fault Zoning Act and Seismic Hazards Mapping Act (1972)

The 1971 San Fernando Earthquake resulted in the destruction of numerous structures built across its path. This led to passage of the Alquist-Priolo Earthquake Fault Zoning Act in 1972. This Act prohibits the construction of buildings for human occupancy across active faults in the State of California. Similarly, extensive damage caused by ground failures during the 1989 Loma Prieta Earthquake focused attention on decreasing the impacts of landslides and liquefaction. This led to the creation of the Seismic Hazards Mapping Act, which increases construction standards at locations where ground failures are probable during earthquakes. Figure 10-6 shows the location of quaternary faults in and around Sonoma County, as well as earthquake fault zones as identified by the California Geological Survey.

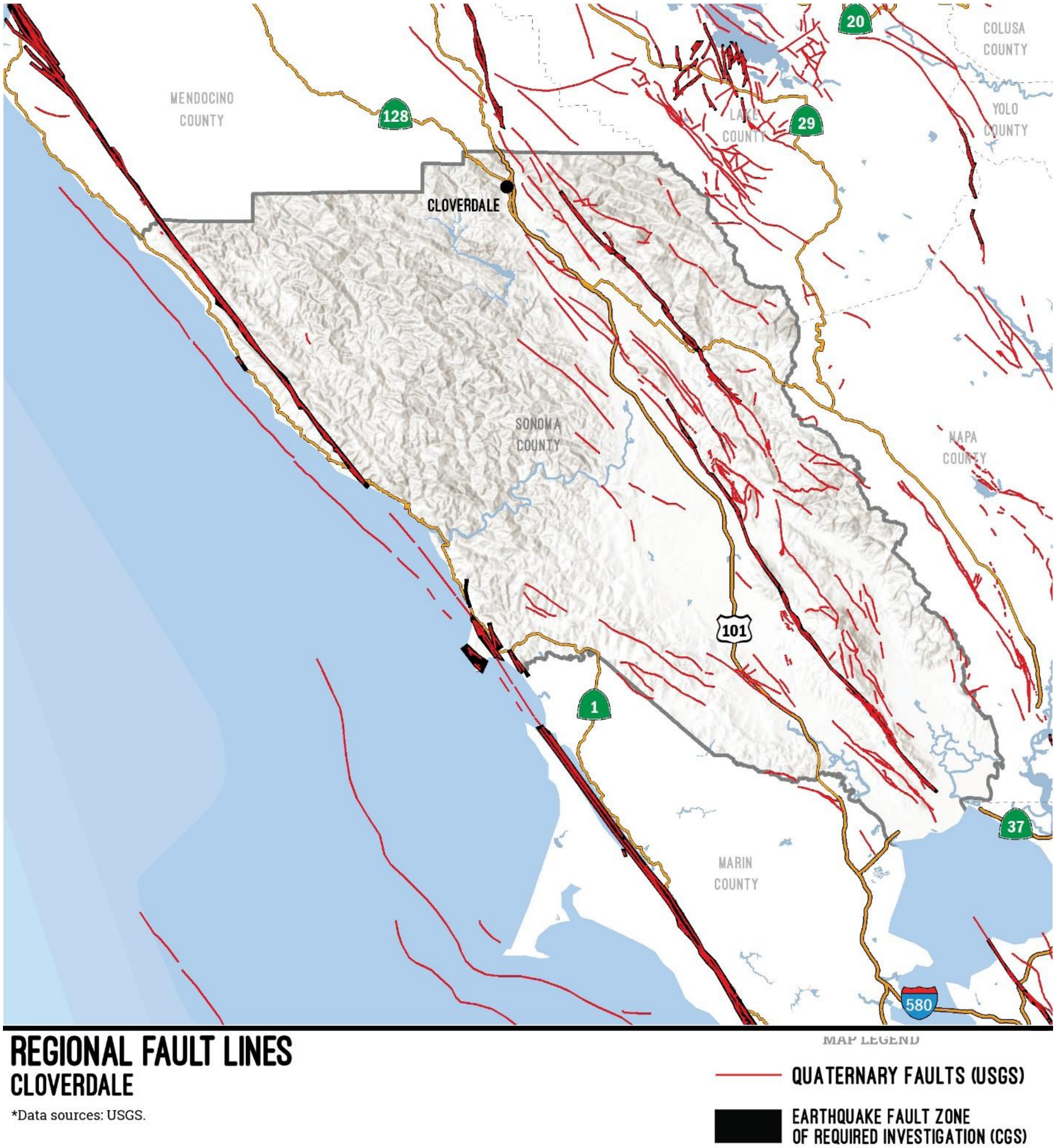
2019 Building Standards Code

The California Building Standards Code (CBSC) (California Code of Regulations, Title 24) is a compilation of three types of building standards from three different origins:

- 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 national model codes to address California's ever-changing conditions; and
- Building standards, authorized by the California legislature, that constitute amendments not covered by national model codes, that have been created and adopted to address particular California concerns.

The CBSC specifies materials requirements, construction methods, and maintenance standards for earthquake protection and resiliency. All building occupancies in California are subject to national model codes adopted into the CBSC, and occupancies are further subject to amendments adopted by State agencies. State law also authorizes local governments to enact ordinances making building standards amendments to the CBSC to address local conditions. The law includes specific requirements for the basis for a local amendment, how the amendment language and documents must be prepared, and how the amendment must be filed with either the California Building Standards Commission, the California Department of Housing and Community Development, or other state agencies as required. In January 2020, City of Cloverdale adopted the 2019 CBSC, without amendments.

FIGURE 10-6: QUATERNARY FAULTS AND EARTHQUAKE FAULT ZONES



10.6.2 Past Events

Pre-1900 Earthquakes

The Bay Area has experienced significant, well-documented earthquakes. Since 1855, more than 140 earthquakes have been felt in the Santa Rosa area. Although earthquake records prior to the year 1900 are difficult to interpret, seven earthquakes are believed to have caused damage to structures in Sonoma County during the 19th century. For the most part, damage from these earthquakes indicates a Modified Mercalli Intensity (MMI) ranging from VI-VIII. The MMI scale is based on observed damage, which indicates that damage from most earthquakes was limited to broken glass, cracked walls, and falling chimneys (Table SH-1). Two earthquakes are of note: the 1868 M7.2 earthquake on the Hayward Fault, and the 1898 M6.7 earthquake believed to have occurred on the Rodgers Creek Fault. Although damage from these two events was limited due to the area's sparse population at the time, a recurrence of either of these events could result in significant damage to today's widespread and varied infrastructure and building stock.

1906 San Francisco Earthquake

The April 18, 1906, M8.3 earthquake on the northern segment of the San Andreas Fault, known for devastating San Francisco, caused major damage in Santa Rosa, Sebastopol, Healdsburg, Petaluma and other communities. As reported in the Reveille, "Cloverdale did not suffer seriously from the seismic disturbance," with no one injured and property loss below $5,000. Santa Rosa, only 20 miles from the San Andreas Fault, is said to have suffered more damage proportionally to its size than any other Bay Area city. The population of Santa Rosa at the time was about 6,000. The only reported casualties in Sonoma County were in the City of Santa Rosa, where 65 persons died and 12 remained missing. The shaking lasted for about fifty seconds. The Santa Rosa Courthouse was totally destroyed by the shaking and ensuing fire, as were approximately eight blocks of commercial buildings. It was reported that almost all non-wood buildings were destroyed by the shaking alone. The amount of fire damage was attributed to insufficient firefighters and equipment, and a delay in getting the fire equipment out of the fire house, where falling debris blocked the entrance.

The California Earthquake Investigation Commission postulated that, in part, the damage was exacerbated by the high ground water level in the alluvial fan the City of Santa Rosa was built upon. In April, the ground was still saturated from the spring rains. This likely amplified and contributed to the length of ground shaking that occurred. As a result of the damage, new building regulations were adopted in May 1906, and amended in May 1907. They included requirements for brick buildings to be reinforced with steel and that cement mortar be used, in place of the former practice of using weaker lime mortar.

1969 Rodgers Creek / Healdsburg Fault Earthquake

The last major earthquakes epicentered in Sonoma County occurred on October 1, 1969. Two earthquakes of Magnitudes 5.6 and 5.7 originated near the juncture of the Rodgers Creek and Healdsburg Fault, approximately two miles north of Santa Rosa. There was no reporting of damage in Cloverdale in the Reveille. Damage was concentrated in Santa Rosa, and principally confined to the partial collapse or near collapse of unreinforced masonry buildings and wood frame buildings with substandard foundations or inadequate bracing. In all, ninety-nine structures were significantly damaged, approximately half in the business district and half in residential areas. Nearly half of all significantly damaged buildings were demolished. Total building damage was estimated at $6 million, with dwelling contents losses at $1.25 million. Several County buildings suffered damage, including the Library, Post Office, and Veterans Memorial Building. There was more than expected damage to the newly constructed two-story Sonoma County Social Services Building at the County Administration

Center. There was significant damage to the Fremont Elementary School, a two-story unreinforced masonry building that had recently been identified as failing Field Act standards for school structural safety, but was still in active use. Santa Rosa Memorial Hospital incurred approximately $240,000 in damage, of which only $40,000 was attributable to building damage. The more serious damage was caused by a fire, which was ignited in a chemical laboratory after the second shock. The fire was extinguished quickly because a fire truck had been dispatched, per the emergency plan, immediately following the first shock.

Electric power and telephone communications were disrupted for a short period of time. Although the Mayor of the City of Santa Rosa sought state and federal disaster assistance, there was not enough damage to public facilities to warrant a declaration. Small Business Administration loans were made available to commercial and residential property owners at a three percent interest rate. Fortunately, there was no loss of life from the earthquakes, which can be attributed to the limited structural damage that occurred and the earthquakes striking in the evening hours, when most residents were at home.

1989 Loma Prieta Earthquake

This M6.9 magnitude earthquake, which occurred on October 17,1989, was caused by slip along the San Andreas Fault. Though the damage in Sonoma County from the quake was very minor (only 5 dwellings were yellow tagged), with no damage reported in Cloverdale, the quake killed 63 people and injured 3,757 throughout Northern California. It caused a total of over 16,700 housing units to be uninhabitable throughout the Monterey and San Francisco Bay Areas and left some 3,000-12,000 people homeless. The earthquake caused severe damage in some very specific locations in the San Francisco Bay Area, most notably on unstable soil in San Francisco and Oakland, where some 12,000 homes and 2,600 businesses were damaged. In Santa Cruz, close to the epicenter, 40 buildings collapsed. Many homes were dislodged that were not bolted to their foundations.

The worst disaster of the earthquake was the collapse of the two-level Cypress Street Viaduct of Interstate 880 in West Oakland. The failure of support columns along a 1.25-mile (2.0 km) section of the viaduct, also known as the "Cypress Structure" killed 42 and injured many more. This stretch of Interstate 880 was a double-deck freeway section built in the 1950s of non-ductile reinforced concrete that was constructed above and astride Cypress Street in Oakland. The quake caused an estimated $6 billion ($11 billion in current value) in property damage, becoming one of the most expensive natural disasters in U.S. history at the time. It was the largest earthquake to occur on the San Andreas Fault since the great 1906 San Francisco earthquake.

2014 South Napa Earthquake

On August 24, 2014, a M6.0-earthquake shook Napa, Solano, and Sonoma County. The epicenter was located about 4.2 miles northwest of American Canyon, six miles southwest of the City of Napa and nine miles southeast of the city of Sonoma, according to the USGS. The earthquake occurred on the West Napa Fault, a fault that was not mapped under the Alquist-Priolo earthquake fault hazard zone. The earthquake was the largest event in the Bay Area since the 1989 Loma Prieta Earthquake, lasting 10 to 26 seconds, depending on location, and causing 8 miles of surface rupture (with up to 18 inches of offset). At least twelve aftershocks followed, including one of M3.9. 257 people were injured during the quake and one person was killed. 163 structures, many in downtown Napa, were severely damaged and red-tagged by Inspectors. Several structures in eastern Sonoma County were also severely damaged. An additional 3,517 structures were inspected, of which 1,749 were identified as being moderately damaged. Several older commercial buildings in downtown Napa showed signs of extensive external damage even though they had undergone seismic retrofit.

Napa and Solano Counties experienced minor damages to several roads, water mains, and gas line breaks. Napa, Solano, and Sonoma County experienced electrical and water service disruptions.

Due to the extensive damages, Governor Brown issued an emergency proclamation on August 24, 2014 for the State of California. President Obama declared the incident a major disaster on September 11, 2014. The total economic loss was estimated at $400 million. State and federal disaster assistance totaled more than $30 million for people and businesses affected by the earthquake. Of that total, $8.8 million where in grants from the Federal Emergency Management Agency (FEMA) and the California Governor's Office of Emergency Services (Cal OES), and $21.2 million in low-interest disaster loans from the Small Business Administration (SBA).

Sonoma County Earthquakes Since 2000

As Table 10-9 shows, there have been only four earthquakes with epicenters in Sonoma County since 2000. Three of those were located in between 6 and 11 miles east of Cloverdale, with magnitudes ranging from 4.6 to 5.0. While these earthquakes could be felt in Cloverdale, they did not cause any damage.

TABLE 10-9: EARTHQUAKES 4.5 MAGNITUDE OR HIGHER IN SONOMA COUNTY 2000-2020

Date	Location/Epicenter	Magnitude	Intensity in Cloverdale
1/11/2000	6.1 miles southeast of Cloverdale	4.6	IV, light shaking
8/3/2006	6.3 miles east of Rohnert Park	4.5	I, not discernible
1/12/2014	10.9 miles east of Cloverdale	4.7	III, weak shaking
12/14/2016	9.5 miles east of Cloverdale	5.0	IV, light shaking
Source: USGS			

10.6.3 Location

According to the United States Geological Survey (USGS) and the California Geological Survey (CGS), several faults cross Sonoma County, including three that run through the entire county (see Figure 10-6). The Northern Segment of the San Andreas Fault crosses Sonoma County at Bodega Bay and continues northward offshore before crossing again at Fort Ross and continuing through to the county's northern border. At its nearest point, the San Andreas Fault is 22 miles southwest of Cloverdale. The Rodgers Creek-Healdsburg Fault, the northern extent of which is located approximately three miles south of Cloverdale, connects southward to other faults that merge into the San Andreas Fault. The Maacama Fault lies to the east of the Rodgers Creek-Healdsburg Fault and continues northward, passing approximately three miles east of Cloverdale. Other locally known faults include the Chianti Fault, Hunting Creek-Berryessa Fault, Collayomi Fault, Geyser Peak Fault, and the Mercuryville Fault. All of these faults are right lateral strike-slip faults, meaning that the land on the western side of the fault moves northward in an earthquake. Seismic activity along other active regional faults or unknown faults in the area could also affect Sonoma County.

10.6.4 Frequency / Probability of Future Events

This plan utilizes two mapping tools for understanding the frequency and probability of an earthquake occurring at different faults near Cloverdale: (1) the Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) and (2) the Earthquake Shaking Potential based on the USGS National Seismic Hazard Model. These probabilistic mapping tools, which are described in more detail below, were used to determine the earthquake scenario used for the vulnerability analysis. In the case of Cloverdale, both tools pointed to the Maacama Fault, and specifically to the Maacama-Garberville M7.4 scenario, because it is the scenario with the highest likelihood of severe shaking within 30 years.

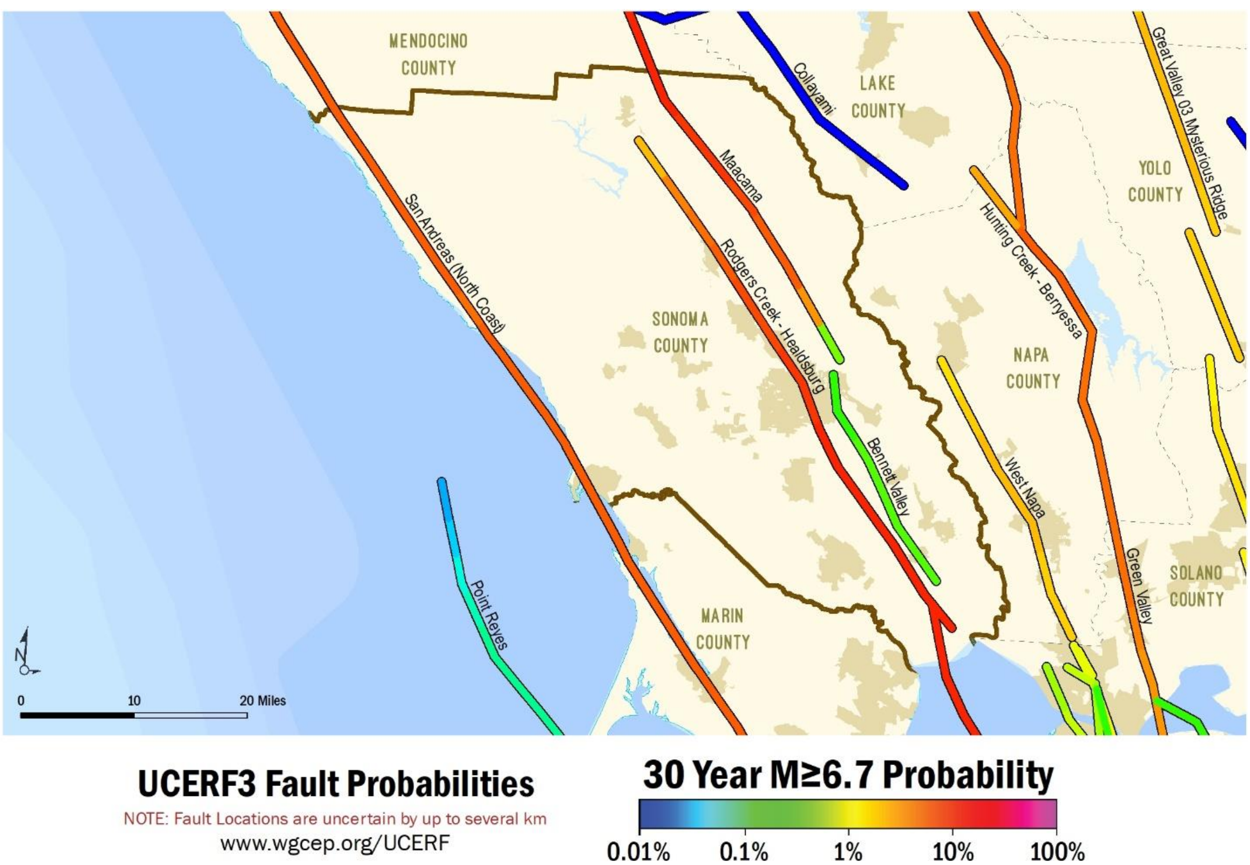
According to the California State Hazard Mitigation Plan, earthquakes large enough to cause moderate damage to structures—those of Magnitude 5.5 or larger—occur three to four times a year statewide. Strong earthquakes of Magnitude 6 to 6.9 strike on an average of once every two to three years. Major earthquakes (Magnitude 7 to 7.9) occur in California about once every 10 years.

30-Year Earthquake Probability (UCERF3)

Probability of earthquake events is based on the approximate location of earthquake faults within and outside the region. The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) is a comprehensive model of earthquake occurrence for California. UCERF3 was developed by the 2014 Working Group on California Earthquake Probabilities (WGCEP), a multi-disciplinary collaboration of leading experts in seismology, geology, geodesy, paleoseismology, earthquake physics, and earthquake engineering. The study was led by the U.S. Geological Survey, the Southern California Earthquake Center, and the California Geological Survey, with partial financial support from the California Earthquake Authority, which is the largest provider of homeowner earthquake insurance in California. It represents the best available science for authoritative estimates of the magnitude, location, and likelihood of potentially damaging earthquakes in California.

Figure 10-7 shows the faults within and near Sonoma County that UCERF3 evaluated. As it shows, the Maacama and Rodgers Creek-Healdsburg faults are the nearest to Cloverdale. According to UCERF3, the Maacama fault, which runs north-south due east of Cloverdale, has a 13.2 percent chance of an earthquake of 6.7 magnitude or greater in the next 30 years. The Rodgers Creek-Healdsburg fault, located just south of Cloverdale at its northernmost extent has a 2.3 percent chance.

FIGURE 10-7: UCERF3 FAULT PROBABILITIES



Earthquake Shaking Potential

The Earthquake Shaking Potential Map, Figure 10-8, shows potential seismic shaking from anticipated future earthquakes. It is probabilistic in the sense that the analysis takes into consideration the uncertainties in the size and location of earthquakes and the resulting ground motions that can affect a particular site. It is also useful in understanding the probability of severe shaking in the Cloverdale area, as discussed in Section 10.5.3. The map is expressed in terms of probability of exceeding a certain ground motion. Specifically, the shaking potential is calculated as the level of ground motion that has a two percent probability of being exceeded in 50 years, which is the same as the level of ground-shaking with about a 2,500-year average repeat time. The potential is based on relatively long-period earthquake (i.e., exceeding one second of ground motion). Based on the USGS National Seismic Hazard Model and in partnership with California Geological Survey, the earthquake shaking potential considers historic earthquakes, slip rates on major faults, deformation throughout the region, and the potential for amplification of seismic waves by near-surface geologic materials.

Figure 10-8 depicts a range of lower hazard to higher hazard probability, with Cloverdale falling into the moderate to high level of probability of experiencing more frequent, stronger earthquakes. Intense shaking can damage even strong, modern buildings.

Maacama Garberville Earthquake Scenario

The Maacama-Garberville earthquake scenario, which assumes a magnitude 7.4 event, was chosen from a range of regional, scenario-based shakemaps available from USGS for the vulnerability analysis. The shakemap data consist of peak ground velocity, peak ground acceleration, peak spectral accelerations in an earthquake scenario. As Figure 10-9, the Maacama-Garberville scenario would result in very strong to severe shaking in Cloverdale. Section 10.6.8 analyzes Cloverdale’s exposure to this scenario and details damage estimation to privately-owned property and critical facilities.

10.6.5 Severity and Extent

Even a moderate earthquake occurring can result in deaths, casualties, property destruction, environmental damage, and disruption of normal services and activities. The severity of the event could be aggravated by collateral emergencies such as fires, hazardous material spills, utility disruptions, landslides, and transportation emergencies. Neither the occurrence of an earthquake nor the severity can be predicted. Instead, scientists can only calculate the probability that a significant earthquake will occur in a specific area within a certain number of years. As explained in Section 10.6.4 , the probabilistic Earthquake Shake Potential Map, Figure 10-8, shows that Cloverdale falls into the moderate to high level of probability of experiencing more frequent, stronger earthquakes (i.e., an earthquake exceeding one second of ground motion in 50 years). In the Cloverdale area, the greatest probability of a severe earthquake focuses around the Maacama fault.

FIGURE 10-8: EARTHQUAKE SHAKING POTENTIAL

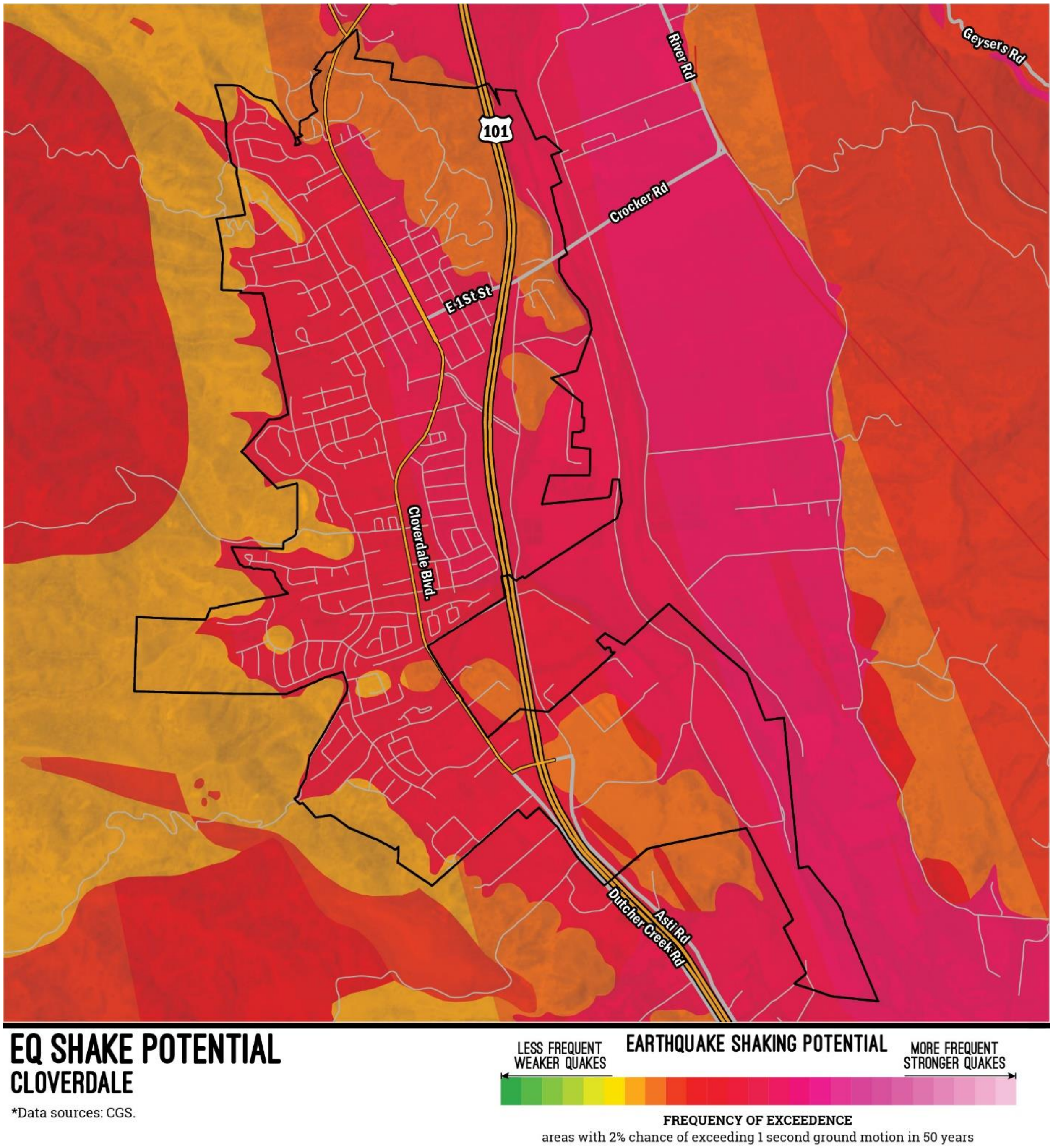
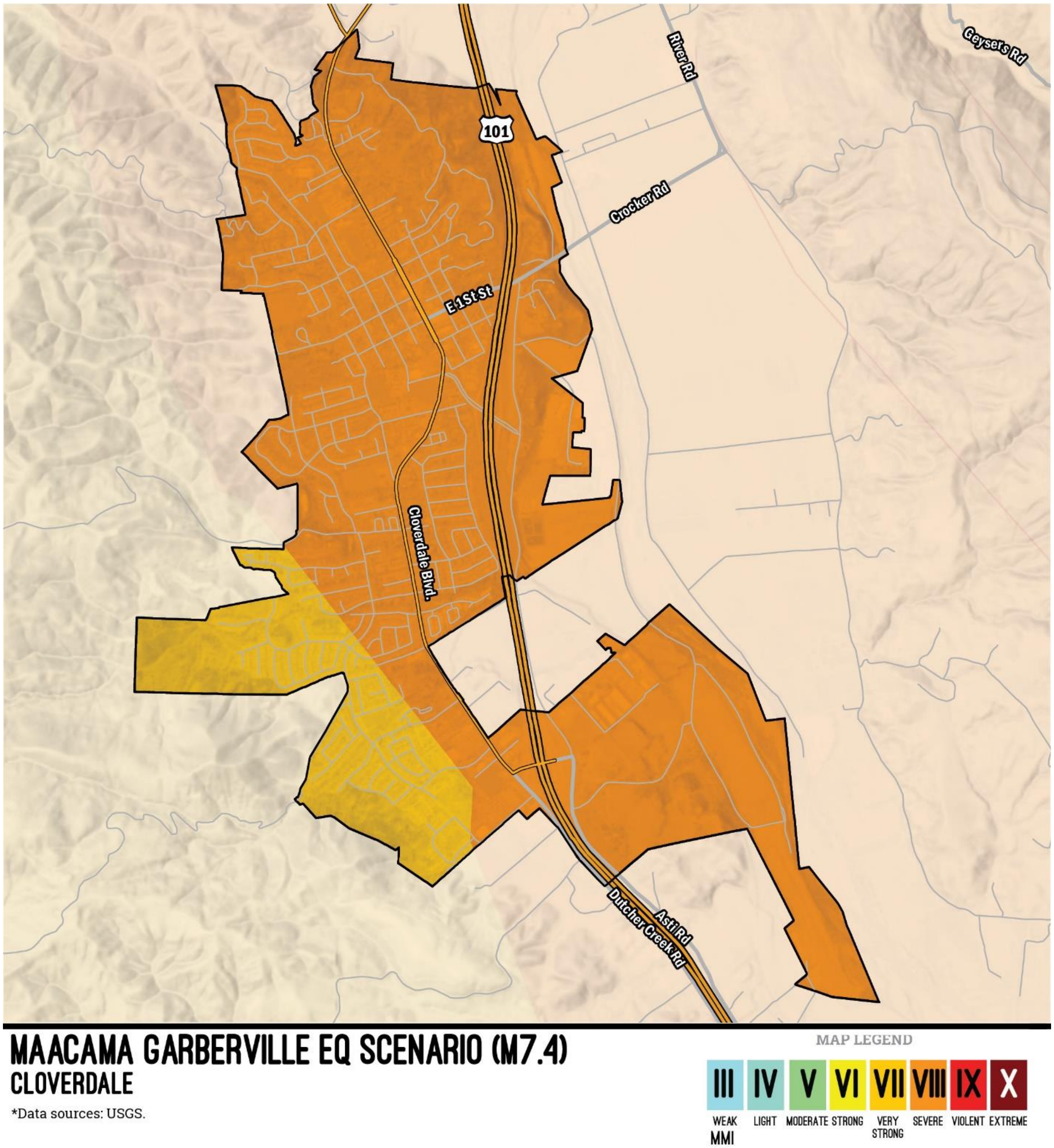


FIGURE 10-9: MAACAMA GARBERVILLE EARTHQUAKE SCENARIO (M7.4)



10.6.6 Warning Time

There is currently no reliable way to predict when an earthquake will occur at any given location. Seconds and minutes of advance warning can allow people and systems to take actions to protect life and property from destructive shaking. Even a few seconds of warning can enable protective actions specific to various sectors of the population, such as:

- **Public:** Citizens, including schoolchildren, drop, cover, and hold on; turn off stoves, safely stop vehicles.
- **Businesses:** Personnel move to safe locations, automated systems ensure elevator doors open, production lines are shut down, sensitive equipment is placed in a safe mode.
- **Medical Services:** Surgeons, dentists, and others stop delicate procedures.
- **Emergency Responders:** Open firehouse doors, personnel prepare and prioritize response decisions.
- **Power Infrastructure:** Protect power stations and grid facilities from strong shaking.

In October 2019, the State of California launched Earthquake Warning California, which is the country's first publicly available, statewide warning system. Managed by the Cal OES, the system uses ground motion sensors from across the state to detect earthquakes before humans can feel them and can notify Californians via mobile devices to "Drop, Cover, and Hold On" in advance of an earthquake.

10.6.7 Secondary Hazards

Earthquakes can cause secondary effects such as tsunamis and soil liquefaction. While tsunamis may affect other areas of Sonoma County, they would not reach Cloverdale. Soil liquefaction occurs when seismic waves pass through saturated granular soil, distorting its granular structure, and causing some of the pore spaces between granules to collapse. Pore-water pressure may also increase sufficiently to cause the soil to behave like a fluid for a brief period and cause deformations. As described in Section 10.8, within the city limits, susceptibility to liquefaction is principally concentrated along the Russian River in areas that are largely undeveloped.

10.6.8 Vulnerability Assessment

Earthquakes are a considerable threat to life and property in Sonoma County. A moderate to severe seismic incident on any fault zones in or near the county could result in the following effects:

- Extensive property damage
- Fatalities and injuries
- Damage to water and sewage systems
- Disruption of communications systems
- Broken gas mains and petroleum pipelines
- Disruption of transportation arteries
- Competing requests for regional aid resources

While Cloverdale has avoided major damage from past earthquakes, the city's proximity to major faults makes it vulnerable to future seismic events. In the wake of such an event, community needs would quickly exceed the City's response capabilities, necessitating calls for mutual assistance from other local agencies, volunteer and private agencies, Cal OES, and the Federal Emergency Support Functions.

In any earthquake, the primary consideration is saving lives, although attention must be paid to providing for people's mental health by reuniting families, providing shelter to the displaced persons, and restoring basic needs and services. In collaboration with response and recovery partners, the City would also have to attend to debris removal and roadway clearance, demolition of unsafe structures, reestablishment of public services and utilities, and provision of continuing care and temporary housing for affected citizens.

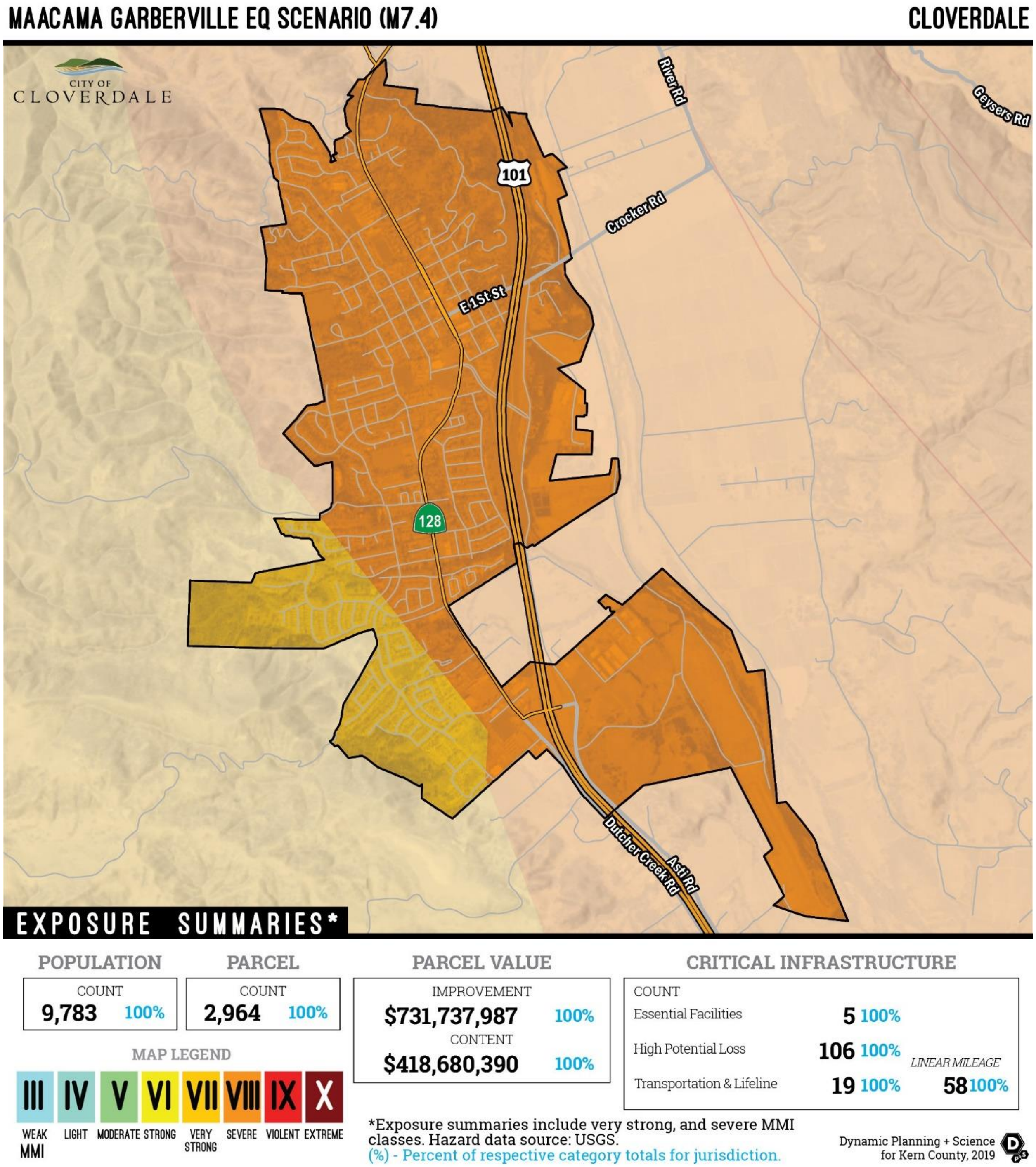
After any earthquake there will be a loss of income both in private and public sectors. Individuals can lose wages due to businesses inability to function because of damaged goods or facilities. Due to business losses, the City of Cloverdale will lose revenue. Economic recovery from even a minor earthquake is critical.

The assessment of vulnerability focuses on two concerns, the level of exposure and the potential for damage. To quantify exposure and damage potential, using GIS tools, the Planning Team focused on an earthquake scenario produced from the Maacama fault (the Maacama Garberville M7.4 scenario). As discussed in Section 10.6.4, this scenario represents the highest probability for a severe earthquake and severe shaking in Cloverdale. Figure 10-9 shows the potential effects of the Maacama Garberville scenario in Cloverdale, indicating that most of the city would be subject to severe shaking.

Exposure

To determine the level of exposure, the Planning Team compared inventories of population, property, and critical facilities with earthquake shaking intensity data from the USGS, as shown in Figure 10-10. For damage and loss estimation, the Planning Team deployed FEMA's Hazus software. Following are summaries of exposure for population, property, and critical facilities, and estimates of potential damage associated with the Maacama Garberville scenario.

FIGURE 10-10: EARTHQUAKE DAMAGE EXPOSURE, MAACAMA GARBERVILLE M7.4 SCENARIO



Population Exposure

Figure 10-11 and Table 10-10 summarize population exposure results for the Maacama Garberville earthquake scenario (M7.4). Under that scenario, the entire population of Cloverdale is potentially exposed to direct and indirect impacts from earthquakes, with 80 percent of the city subject to severe shaking and 20 percent subject to very strong shaking. The degree of exposure depends on many factors, including the age and construction type of dwellings, the soil types on which their homes are constructed, and proximity to fault location. Whether directly or indirectly impacted, 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 affect people who suffered no direct damage from an event itself.

FIGURE 10-11: POPULATION EXPOSURE, M7.4 MAACAMA GARBERVILLE EARTHQUAKE SCENARIO

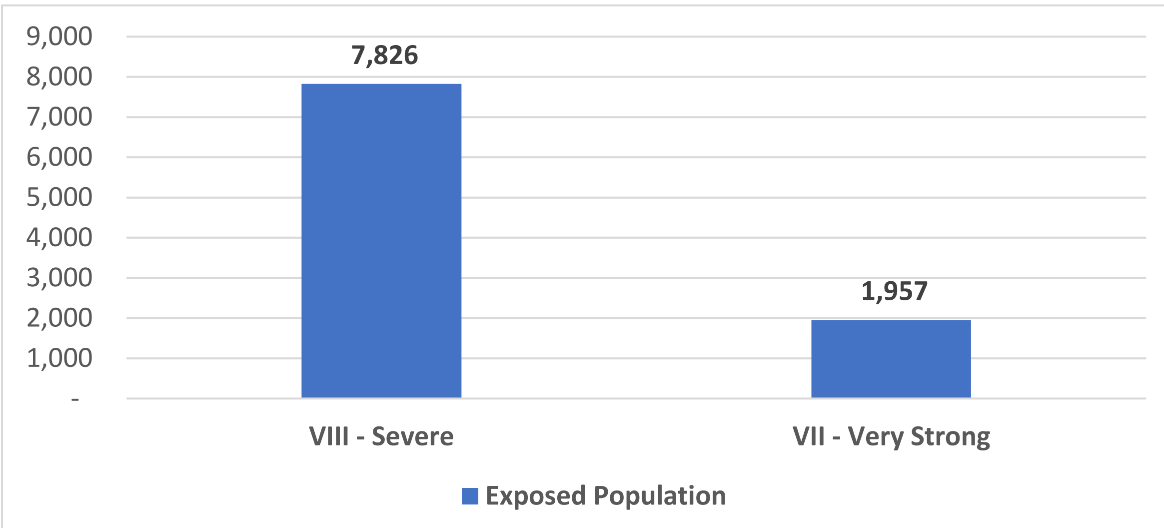


TABLE 10-10: POPULATION EXPOSURE, M7.4 MAACAMA GARBERVILLE EARTHQUAKE SCENARIO

Shake Severity Zone	Exposed Population	% of Total Population
VIII - Severe	7,826	80.0
VII - Very Strong	1,957	20.0
Total	**9,783**	**100.0**

Property Exposure

The level of exposure for privately-owned property in a community is a function of several qualitative and quantitative factors. This includes the type of construction, the age of construction, and the value of improvements on a parcel. In Cloverdale, this information is derived from the Sonoma County Assessor's Office, which maintains and periodically updates information on all private property in the county for tax assessment purposes. This information is keyed to parcels, rather than individual buildings, so the information summarized in the following tables represents the predominant use on each parcel. The number of parcels does not reflect the number of total housing units, as many multi-family units and attached housing units are reported on one parcel.

The type of construction for buildings in a community is key to understanding vulnerability to earthquakes, since different building types have different levels of tolerance for seismic shaking. Table

10-11 summarizes the number of parcels with the five predominant building types in Cloverdale. As it shows, 89.3 percent of the parcels in Cloverdale have single-family residential uses with wood frame construction and another 7.7 percent have commercial or industrial buildings with wood frame construction. Depending on their age, wood frame construction buildings are generally able to withstand shaking without sustaining considerable damage. Another 2.6 percent of the parcels in the city contain buildings with steel frame construction, which are generally resistant to damage from seismic shaking. The remaining parcels contain either reinforced masonry buildings or mobile homes. There are no unreinforced masonry (URM) buildings in Cloverdale.

TABLE 10-11: CONSTRUCTION TYPES

Construction Type	Description	Parcels	% of Total
W1	Wood Light Frame (Single-Family Residential), less than 5,000 square feet	2,647	89.3%
W2	Wood Frame (Commercial and Industrial), more than 5,000 square feet	228	7.7%
S3	Steel Light Frames	77	2.6%
RM1	Reinforced Masonry Walls with Flexible Diaphragms	4	0.1%
MH	Mobile Homes	8	0.3%
Total		**2,964**	**100.0%**
Source: Sonoma County Assessor, 2020			

The age of construction is also a key consideration in determining vulnerability, in part because older buildings were subject to less stringent building standards. Table 10-12 shows the number of parcels in Cloverdale with buildings constructed during six time periods, each of which is associated with the evolution of building standards, with the oldest being the least exacting. Table 10-13 shows the distribution of construction types by construction period.

TABLE 10-12: CONSTRUCTION IMPROVEMENT PERIODS

Time Period	Parcels Developed in Period	% of Total	Significance of Time Frame
Pre-1933	246	8.3%	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	31	1.0%	Before the first strong motion recording was made in 1940.
1941-1960	606	20.4%	Prior to when the Structural Engineers Association of California published guidelines on earthquake construction in 1960.
1961-1975	189	6.4%	Prior significant improvements to lateral force requirements in 1975.
1976-1994	620	20.9%	Prior to the Uniform Building Code being amended to include provisions for seismic safety in 1994.
1995 - present	1,272	42.9%	Seismic code is currently enforced.
Total	**2,964**	**100.0%**	
Source: Sonoma County Assessor, 2020			

TABLE 10-13: CONSTRUCTION TYPE BY PERIOD OF CONSTRUCTION

	W1	W2	S3	RM1	MH	Total
Pre-1933	5.9%	4.8%	-	25.0%	-	5.6%
1933-1940	1.1%	0.9%	1.3%	-	-	1.0%
1941-1960	21.7%	6.1%	20.8%	25.0%	-	20.4%
1961-1975	6.8%	2.6%	2.6%	25.0%	12.5%	6.4%
1976-1994	18.6%	52.6%	7.8%	-	25.0%	20.9%
1995 - present	45.2%	20.6%	36.4%	-	12.5%	42.9%
Unknown	0.8%	12.3%	31.2%	25.0%	50.0%	2.7%
Source: Sonoma County Assessor, 2020						

The City's Planning Team completed an inventory of current market values and content value for private property using County Assessor's parcel data. Using GIS, the Planning Team created centroids, or points, to represent the center of each parcel polygon, assumed to be the location of the structure for analysis purposes. The centroids were then superimposed with the USGS probabilistic shaking severity zones to determine the at-risk structures. Table 4-37 shows the count of at-risk parcels and their associated building and content exposure values to the magnitude 7.5 Maacama-Garberville earthquake scenario.

TABLE 10-14: PROPERTY VALUE EXPOSURE

Shake Severity Zone	Parcel Count	% of Total	Market Value Exposure ($)	Content Value Exposure ($)	Total Exposure ($)	% of Total
VIII - Severe	2,261	76.3%	$534,175,833	$316,216,094	$850,391,927	73.9%
VII - Very Strong	703	23.7%	$197,562,154	$102,464,296	$300,026,450	26.1%
Total	**2,964**	**100.0%**	**$731,737,987**	**$418,680,390**	**$1,150,418,377**	**100.0%**
Source: Sonoma County Assessor, 2020						

<u>**Critical Facility and Infrastructure Exposure**</u>

Earthquakes pose numerous risks to critical facilities and infrastructure. Seismic risks, or losses, that are likely to result from exposure to seismic hazards include:

- Utility outages
- Economic losses for repair and replacement of critical facilities, roads, and buildings
- Indirect economic losses such as income lost during downtime resulting from damaged public infrastructure
- Roads or railroads that are blocked or damaged can prevent access throughout the area and can isolate residents and emergency service providers needing to reach vulnerable populations or to make repairs

Linear utilities and transportation routes, often referred to as lifelines, are vulnerable to rupture and damage during and after a significant earthquake event. The cascading impact of a single failure can have affects across multiple systems and utility sectors, resulting in system outages that could last weeks for the most reliable systems and months for systems at greater risk because of age or disrepair.

All critical facilities in Cloverdale are exposed to earthquakes. Table 10-15 lists the number of each type of facility in the Severe and Very Strong MMI severity zones within the city, described in Table 10-7.

TABLE 10-15: CRITICAL INFRASTRUCTURE EXPOSURE, MAACAMA GARBERVILLE EARTHQUAKE SCENARIO

Infrastructure Type	VIII - Severe	VII - Very Strong	Total
Essential Facilities			
Fire	1		1
Police	2		2
EOC	1		1
Subtotal	**4**		**4**
High Potential Loss			
Child Care Center	6		6
School	9		9
Library	2		2
Residential Elder Care Facility		1	1
Historic Building	4		4
Home Care Organization	1		1
Family Child Care Home	4		4
Government Asset*	44	2	46
Airport	1		1
Vulnerable Housing	10		10
Park	3	1	4
Mobile Home Park	1		1
Wastewater Treatment	2		2
Corp Yard	1		1
Healthcare Center	5		5
Affordable Housing	1		1
Evacuation Center	1		1
Communications Tower	3		3
City Hall	2		2
Town Hall	1		1
Senior Center	2		2
Water Treatment	2		2
Subtotal	**105**	**4**	**109**
Transportation and Lifeline			
Bridge	7		7
Substation	1		1
Airport	1		1
Water Tank	1	2	3
Park	3	1	4
Pump House	3	1	4
Subtotal	**16**	**4**	**20**
Grand Total	**125**	**8**	**133**

*Government Assets are those referenced in City's insurance roll and includes accessory buildings as well as non-categorical assets and their values

Linear utilities and transportation infrastructure (lifelines) would likely suffer considerable damage in the event of a strong earthquake. Due to the amount of infrastructure and sensitivity of utility data, linear utilities are difficult to analyze without further investigating individual system components. Table 10-16 provides best available linear utility data; it should be assumed that these systems are exposed to breakage and failure.

TABLE 10-16: LIFELINE EXPOSURE (IN MILES), MAACAMA GARBERVILLE EARTHQUAKE SCENARIO

Infrastructure Type (Linear)	VIII - Severe	VII - Very Strong	Total
Levee	1.66	-	1.66
NG Pipeline	2.88	-	2.88
Railroad	2.89	-	2.89
Streets/Roadways			
Alley	0.14	-	0.14
Cul-de-sac	0.10	-	0.10
Driveway	0.16	0.27	0.43
Interstate	4.67	-	4.67
Local road	30.91	6.88	37.79
Primary Highway	3.20	-	3.20
Ramp	1.97	-	1.97
State/county highway	1.55	-	1.55
Subtotal	**42.70**	**7.15**	**49.85**
Transmission Line	0.43	-	0.43
Grand Total	**50.57**	**7.15**	**57.71**

Property Damage / Loss Estimation

The Planning Team generated earthquake damage estimates using a Level 2 Hazus 4.2 analysis. Hazus uses GIS to analyze multiple factors influencing earthquake damage estimates including peak ground velocity (PGV), peak ground acceleration (PGA) and soil of a given scenario and geographic area. Once the location and size of a hypothetical earthquake is identified, Hazus software 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.

The Planning Team imported Cloverdale-specific assessor's parcel data and City's insured asset data into Hazus as User Defined Facilities (UDF) serving as the basis for replacement and content cost as well as associated damage estimation and loss. County assessor data does not include detailed information for tax exempt structures, such as buildings on government property, so the Planning Team added this data based on the City's insurance schedule table of insured assets.

To understand building damage, damage outputs from Hazus are categorized into slight, moderate, and extensive damage. Ranges of damage are used to provide the user with an understanding of the building's physical condition. Table 10-17 provides a physical description of each damage state.

TABLE 10-17: HAZUS BUILDING DAMAGE DESCRIPTIONS

Damage State	Damage Description
Slight	Small plaster cracks at corners of door and window openings and wall/ceiling intersections; small cracks in masonry chimneys and masonry veneers. Small cracks are assumed to be visible with a maximum width of less than 1/8 inch (cracks wider than 1/8 inch are referred to as "large" cracks).
Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
Extensive	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations.
Complete	Structure may have large permanent lateral displacement or be in imminent danger of collapse due to cripple wall failure or failure of the lateral load resisting system; some structures may slip and fall off the foundation; large foundation cracks. Three percent of the total area of buildings with Complete damage is expected to be collapsed, on average.

While there are limitations to the FEMA Hazus earthquake model, it does allow for potential loss estimation for each building construction category. Citywide loss estimation results are summarized by building category type in Table 10-18 for the Maacama Garberville 7.4 magnitude earthquake scenario. It is important to understand that the Hazus loss estimation values for earthquake are categorized in exceedance values. From reviewing Table 10-18, one can infer the probability of structures exceeding extensive damage is relatively low. However, if damage were to occur, the economic loss is averaged and summarized for each building type defined in the software.

Property Damage

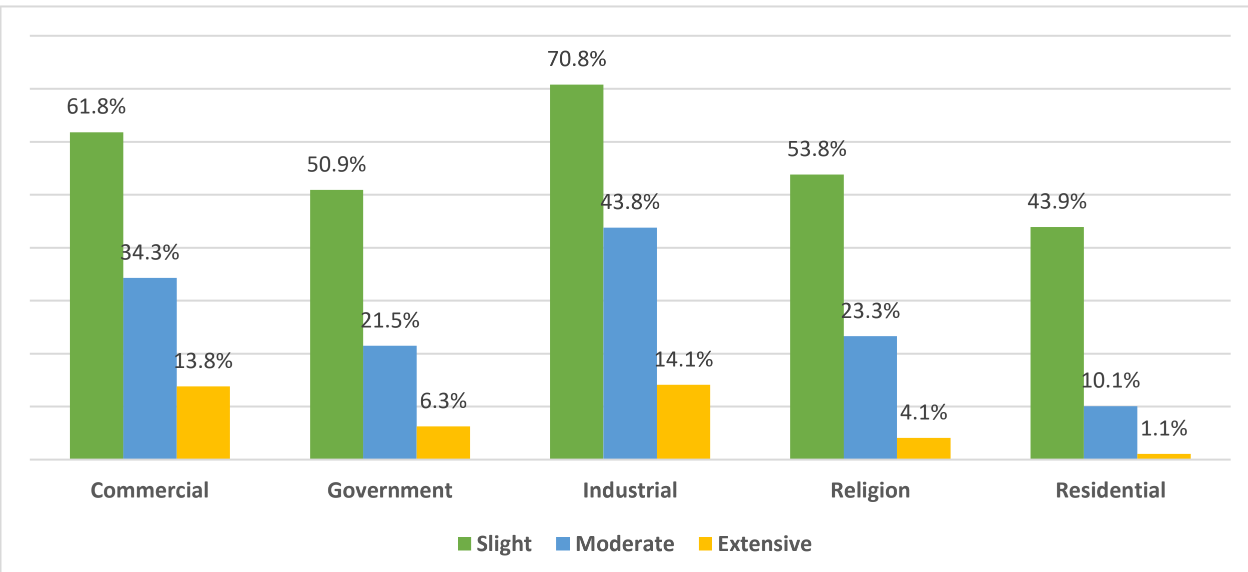
Hazus 4.2 was used to estimate the loss potential to residential properties and government service facilities exposed to the Maacama Garberville M7.4 earthquake scenario. Hazus reports the damage potential and loss potential from a given earthquake scenario in four categories: slight damage, moderate damage, extensive damage, and economic loss. Economic loss consists of estimations on the cost of repair and replacement to damaged or destroyed buildings and contents, relocation expenses, capital-related income, wage losses, and rental income losses. As Table 10-18 shows, because the vast preponderance of property in Cloverdale is residential, the greatest economic loss in Cloverdale would result from damage to residential properties, with 70.6 percent of the total losses in the city, although only 43.9 percent of the city's residential properties would sustain damage. Most of the damage to residential properties would fall into the "slight" damage probability category, with only 1.1 percent of city's residential properties falling into the "extensive" damage probability category. This reflects the city's high percentage of damage-resistant and relatively recent construction, as shown in Table 10-12. As Figure 10-12 shows, commercial and industrial buildings would suffer the most widespread damage, with 61.8 and 70.8 percent, respectively, sustaining at least "slight" damage.

TABLE 10-18: LOSS ESTIMATION, MAACAMA GARBERVILLE M7.4 EARTHQUAKE SCENARIO

Building Type	Average of Potential Damage to Exceed			Avg Econ Loss by Type	Total Econ Loss	% of Total Value
	Slight	Moderate	Extensive			
Commercial	61.8%	34.3%	13.8%	$84,400	$7,509,200	10.7%
Government	50.9%	21.5%	6.3%	$76,500	$5,353,000	7.6%
Industrial	70.8%	43.8%	14.1%	$147,900	$7,247,400	10.3%
Religion	53.8%	23.3%	4.1%	$53,400	$534,000	0.8%
Residential	43.9%	10.1%	1.1%	$17,600	$49,525,400	70.6%
Total					**$70,169,000**	**100.0%**

Note: Total Inventory Values
1 - Building Replacement Costs = $778,724,987
2 - Content Replacement Costs = $421,027,145
3 - Total Value = $1,199,752,132

FIGURE 10-12: PERCENTAGE OF DAMAGED STRUCTURES BY TYPE, MAACAMA GARBERVILLE M7.4 EARTHQUAKE SCENARIO



City-Owned Property

The Planning Team used Hazus 4.2 to estimate the loss potential to City-owned facilities exposed to shaking from the Maacama Garberville earthquake scenario. Information on City facilities was derived from insurance data and formatted for use in Hazus. This dataset included more detailed information than default Hazus database, including the number of floors, building value, content value, and construction type, thus allowing for enhanced results.

As Table 10-19 shows, there would be 50.3 percent probability that aggregated City facilities would sustain at least slight damage from the Maacama Garberville earthquake scenario, but only a 6.1 percent probability that all would sustain extensive damage. The City's radio tower on Vista View Drive would be the most vulnerable facility, with a 54.3 percent probability of extensive damage, but it is a low-value improvement, so the overall economic loss would be low. The Cloverdale Airport would also be highly susceptible to damage, with a 22.5 percent probability of sustaining extensive damage. In terms of economic loss, the City's water and wastewater treatment plants would be subject to the greatest damage value, mainly because they are the City's highest value assets.

TABLE 10-19: CITY ASSET LOSS ESTIMATION, MAACAMA GARBERVILLE M7.4 EARTHQUAKE SCENARIO

Building/Site Name	Total Value	Probability Damage Exceeds			Economic Loss	Loss Pct.
		Slight	Moderate	Extensive		
Cherry Creek Reservoir	$375,000	55.8%	23.2%	3.8%	$52,940	14.1%
City Hall	$1,226,980	54.1%	21.3%	3.4%	$104,870	8.5%
Clover Spring Reservoir	$1,649,000	40.7%	8.5%	0.9%	$83,820	5.1%
Cloverdale Airport	$1,396,320	72.8%	48.3%	22.5%	$508,300	36.4%
Cloverdale Library	$1,918,000	48.2%	19.6%	3.0%	$150,470	7.8%
Foothill Pump Station	$283,000	30.1%	9.4%	0.8%	$17,360	6.1%
Furber Park	$127,000	44.5%	12.5%	1.6%	$6,440	5.1%
Furber Reservoir	$1,374,000	47.1%	15.2%	2.1%	$121,950	8.9%
Police Station/Fire Station	$2,096,860	46.3%	15.0%	2.0%	$131,850	6.3%
Radio Tower	$13,170	89.6%	81.4%	54.3%	$2,930	22.3%
Ritter Reservoir	$618,000	60.2%	26.6%	4.8%	$98,600	16.0%
School Street Pump Station	$142,000	48.9%	16.6%	2.2%	$15,210	10.7%
Second Street Park	$769,610	45.2%	12.0%	1.5%	$53,020	6.9%
Senior Center	$1,032,450	57.6%	20.0%	3.4%	$72,130	7.0%
Shahan Sewer Lift Station	$155,000	48.9%	16.6%	2.2%	$16,620	10.7%
Vista View Reservoir I	$796,000	66.2%	31.9%	6.5%	$140,760	17.7%
Wastewater Treatment	$25,232,670	46.3%	16.9%	5.2%	$2,105,060	8.3%
Water Treatment Plant	$10,128,710	50.6%	25.0%	8.1%	$1,568,320	15.5%
Grand Total	**$49,333,770**	**50.3%**	**20.9%**	**6.1%**	**$5,250,650**	**10.6%**

10.7 FLOODING

Flooding is one of the most prevalent and consequential hazards in California, along with earthquake and wildfire. It represents the second most destructive source of hazard, vulnerability, and risk statewide according to Cal OES.

Flooding takes several forms and can be caused by a variety of circumstances. In Sonoma County generally and Cloverdale specifically, riverine flooding is the most common form, and its cause is primarily the result of severe weather and excessive rainfall, either in the flooded area or in an upstream reach. Riverine in Sonoma County flooding occurs when a river exceeds its 'bank-full' capacity, usually as a result of prolonged rainfall combined with saturated soils from previous rain events. It is characterized by high peak flows of moderate duration and by a large volume of runoff. Riverine flooding occurs in river systems whose tributaries drain large geographic areas and can include many watersheds and sub-watersheds. The duration of riverine floods varies from a few hours to many days. Factors that directly affect the amount of flood runoff include precipitation amount, intensity; and distribution; soil moisture content; channel capacity; seasonal variation in vegetation, and water-resistance of the surface due to urbanization.

10.7.1 Floodplains

A "floodplain" is the area adjacent to a watercourse or other body of water that is subject to recurring inundation from floods. Floods on small streams usually peak and recede quickly, while floods on rivers may not peak for two days or more after the start of a storm and may exceed flood stage for four days or more. FEMA classifies floodplains based on their probability of occurrence and describes their physical boundaries based on their relationship to the body of water that is being flooded. Table 10-20 defines several of the key terms used in discussing floodplains.

TABLE 10-20: FLOODPLAIN TERMINOLOGY

Term	Definition
100-Year Floodplain	The boundaries of the 100-year floodplain coincide with an annual risk of 1 percent and are a FEMA study product consisting of both floodway and flood fringe.
500-Year Floodplain	The boundaries of the floodplain coincide with an annual risk of 0.2 percent and are a FEMA study product. The 500-year floodplain includes the 100-year.
Floodway	This includes the channel of the tributary and the land adjacent to it. This zone needs to remain free from obstruction so the 100-year floodplain can be conveyed downstream.
Flood Fringe	This is the remaining portion of the 100-year floodplain, excluding the floodway. This zone can be obstructed or developed if criteria are met.
Special Flood Hazard Area (SFHA)	An area having special flood, mudflow, or flood-related erosion hazards and shown on a Flood Insurance Rate Map (FIRM). The SFHA is the area where the National Flood Insurance Program's (NFIP) floodplain management regulations must be enforced.

Dam Failure

Dam inundation is defined as flooding which occurs as a result of structural failure of a dam. The most common cause of dam failure is overtopping when the water behind the dam flows over the face of the dam and erodes the structure. Structural failure may be caused by seismic activity. Seismic activity may also cause inundation by the action of a seismically induced wave that overtops the dam without causing dam failure. This action is referred to as seiche. Landslides flowing into reservoirs are also a source of potential dam failure or overtopping.

The only upstream dam that might cause problems in the Cloverdale area is the Coyote Valley Dam, also known as Coyote Dam or Lake Mendocino Dam. It is located near Ukiah in Central Mendocino County, approximately 30 miles north of Cloverdale. Coyote Valley Dam was established in 1958 to control floods along the Russian River, as well as to provide water supply and recreational opportunities. According to analysis and mapping prepared by the Division of Safety of Dams within the California Department of Water Resources, if the Coyote Valley Dam were to fail, the inundation area along the Russian River would stop short of the county line. Thus, Cloverdale would not be directly affected.

Floodplain Ecosystems

Floodplains can support ecosystems that are rich in quantity and diversity of 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 left over from the last flood and resulting from the rapid decomposition of organic matter that had accumulated. 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; however, the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, trees in floodplains and riparian areas tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

Floodplains that are undisturbed or have been restored to a natural state provide many benefits to both human and natural systems. In their natural vegetative state, undisturbed floodplains provide the following benefits:

- Slow the rate at which incoming surface runoff reaches the main body of water, slowing down the impact of flood events.
- Maintain water quality by allowing surface runoff to drop sediment into the natural soil, preventing it from depositing in streams and rivers.
- Recharge groundwater. The slowing of runoff allows additional time for the runoff to recharge existing groundwater aquifers.
- Provide habitat for large and diverse populations of plants and animals.

Floodplains are often compromised by human development. Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains because water is readily available, land is fertile and suitable for farming, transportation by water is easily accessible, and land is flatter and easier to develop.

But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

10.7.2 Plans, Policies, and Regulatory Environment

National Flood Insurance Program (NFIP)

The NFIP makes federally-backed flood insurance available to homeowners, renters, and business owners in participating communities. Sonoma County, including Cloverdale, participates in the NFIP.

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 (the 100-year flood) and the 0.2-percent annual chance flood (the 500-year flood).

Base-flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principal tool for identifying the extent and location of the flood hazard. FIRMs also designate and display the floodway which is the channel of the river or stream and adjacent land that must remain free from obstruction so that the 100-year flood can be conveyed downstream. 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. The most recent FIRM for Cloverdale was completed in December 2008 and is a digital flood insurance rate map (DFIRM).

Flood Damage Prevention Ordinance / Floodplain Overlay District

In 1996, the City of Cloverdale adopted a Flood Damage Prevention Ordinance (#507-96) as part of its Municipal Code (Chapter 15.20). The ordinance, which responded to the Flood Insurance Study performed by the FEMA in July of 1996, is intended to protect human life and health; minimize public expenditures; minimize prolonged business interruptions; minimize damage to public facilities; maintain a stable tax base; ensure disclosure to potential purchasers of property; and ensure that those occupying structures within the special flood hazard areas assure responsibility for their actions.

At the same time the City adopted the Flood Prevention Ordinance, it added a "Primary Floodplain (FP) Overlay District" into its Zoning Ordinance (Chapter 18.07). The district establishes development standards within the 100-year floodplain areas delineated on the FEMA’s FIRM for the city. The intent of the FP Overlay District is to protect land situated in floodways and along creeks and streams by ensuring adequate open corridors to safeguard against the effects of bank erosion, channel shifts, increased runoff, and other threats to life and property.

Sonoma Water

The Sonoma County Water Agency (known as Sonoma Water) was created as a special district in 1949 by the California Legislature to provide flood protection and water supply services. The district’s charge was broadened in 1995 to add the treatment and disposal of wastewater. It advances flood protection in partnership with federal agencies to help build and manage a variety of projects, including Warm Springs Dam, Spring Lake, Coyote Valley Dam, Matanzas Creek Reservoir, Piner Creek Reservoir, Brush Creek Middle Fork Reservoir, and Spring Creek Reservoir. Sonoma Water also manages a proactive stream maintenance program that maintains more than 80 miles of creeks throughout its service area. The Sonoma County Board of Supervisors acts as Sonoma Water's Board of Directors.

10.7.3 Past Events

The Russian River has a long history of flooding, with the earliest major flood having been recorded in 1862. Significant historic floods have since occurred in 1955, 1964, 1986, 1995, 1997, 2006, 2017, and 2019. While most of the major damage from Russian River flooding has occurred south of Cloverdale, the Cloverdale area has experienced problems near the river and along the creeks that feed into the river (e.g., Porterfield Creek, Cloverdale Creek, Cherry Creek). These problems have generally coincided with heavy rainfall associated with major storms, which—in turn—have been reflected in the flows in the Russian River. Table 10-21 shows the peak stream flow and peak gage heights since 1952 for the USGS Cloverdale Gage, which is located approximately five miles north of Cloverdale in Mendocino County. Figure 10-13 shows the variations in the gage height measurements at the Cloverdale gage and Figure 10-14 shows the corresponding stream flow variations.

TABLE 10-21: PEAK STREAM FLOWS AND GAGE HEIGHTS AT CLOVERDALE GAGE (1952 TO 2019)

Year	Date	Stream Flow (CFS)	Gage Height (Feet)	Year	Date	Stream Flow (CFS)	Gage Height (Feet)
1952	12/28/51	21,500	20.4	**1986**	02/17/86	40,700	23.6
1953	12/07/52	23,200	21.2	**1987**	03/12/87	9,450	11.6
1954	01/17/54	33,300	25.6	**1988**	01/04/88	18,500	15.8
1955	12/06/54	6,740	12.8	**1989**	03/18/89	13,700	14.4
1956	12/22/55	53,000	30.9	**1990**	01/07/90	7,880	10.8
1957	02/24/57	20,600	20.0	**1991**	03/04/91	13,700	13.8
1958	02/24/58	38,100	26.2	**1992**	02/15/92	13,100	13.5
1959	02/16/59	18,100	18.8	**1993**	01/21/93	26,900	19.6
1960	02/08/60	24,900	21.7	**1994**	02/18/94	6,800	10.6
1961	12/01/60	15,400	17.7	**1995**	01/09/95	39,400	23.3
1962	02/13/62	19,400	19.5	**1996**	01/25/96	18,300	15.8
1963	01/31/63	25,200	21.8	**1997**	01/01/97	29,000	19.6
1964	01/20/64	16,600	18.2	**1998**	02/03/98	23,300	19.6
1965	12/22/64	55,200	31.6	**1999**	02/09/99	15,900	15.0
1966	01/05/66	32,600	24.4	**2000**	02/14/00	14,300	14.3
1967	01/21/67	20,400	19.9	**2001**	03/04/01	15,300	14.8
1968	01/14/68	11,800	15.9	**2002**	01/02/02	14,700	14.5
1969	01/13/69	24,800	21.3	**2003**	12/16/02	24,000	18.3
1970	01/23/70	36,000	25.5	**2004**	02/17/04	27,700	19.6
1971	12/04/70	25,000	18.9	**2005**	12/08/04	10,300	12.2
1972	01/23/72	6,140	10.3	**2006**	12/31/05	50,700	26.2
1973	01/16/73	18,900	16.7	**2007**	02/10/07	11,700	13.0
1974	01/16/74	51,900	26.5	**2008**	01/04/08	18,800	16.3
1975	02/12/75	21,200	17.5	**2009**	02/23/09	9,180	11.6
1976	02/29/76	4,340	8.6	**2010**	01/20/10	17,000	15.6
1977	03/16/77	370	3.4	**2011**	03/25/11	14,900	14.6
1978	01/16/78	27,700	19.8	**2012**	03/27/12	14,200	14.3
1979	01/11/79	15,100	14.9	**2013**	12/02/12	20,300	16.9
1980	01/13/80	28,800	20.1	**2014**	03/29/14	7,290	10.5
1981	01/27/81	12,400	13.7	**2015**	12/11/14	18,100	17.2
1982	12/20/81	24,800	18.8	**2016**	01/18/16	12,700	13.9
1983	01/26/83	33,200	13.7	**2017**	01/11/17	23,600	18.5
1984	12/09/83	17,200	15.9	**2018**	04/07/18	8,930	12.0
1985	02/08/85	13,300	14.1	**2019**	02/27/19	33,400	21.7

FIGURE 10-13: GAGE HEIGHT AT CLOVERDALE GAGE (1952 TO 2019)

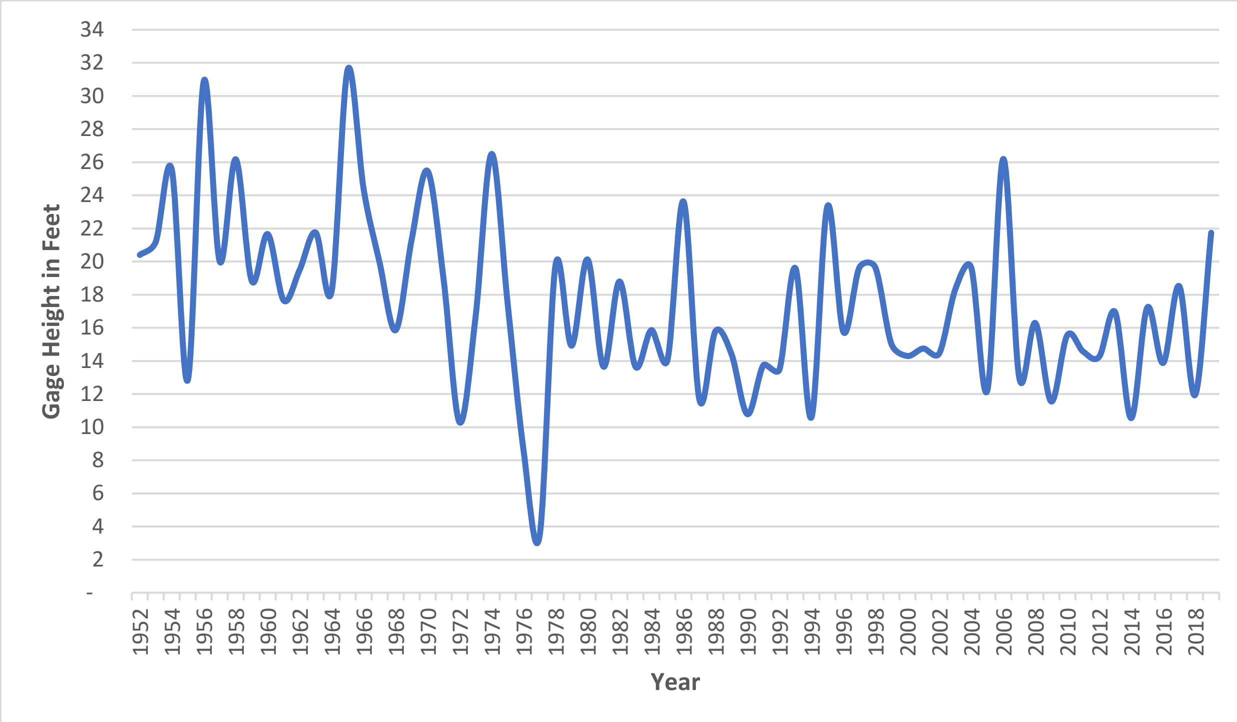
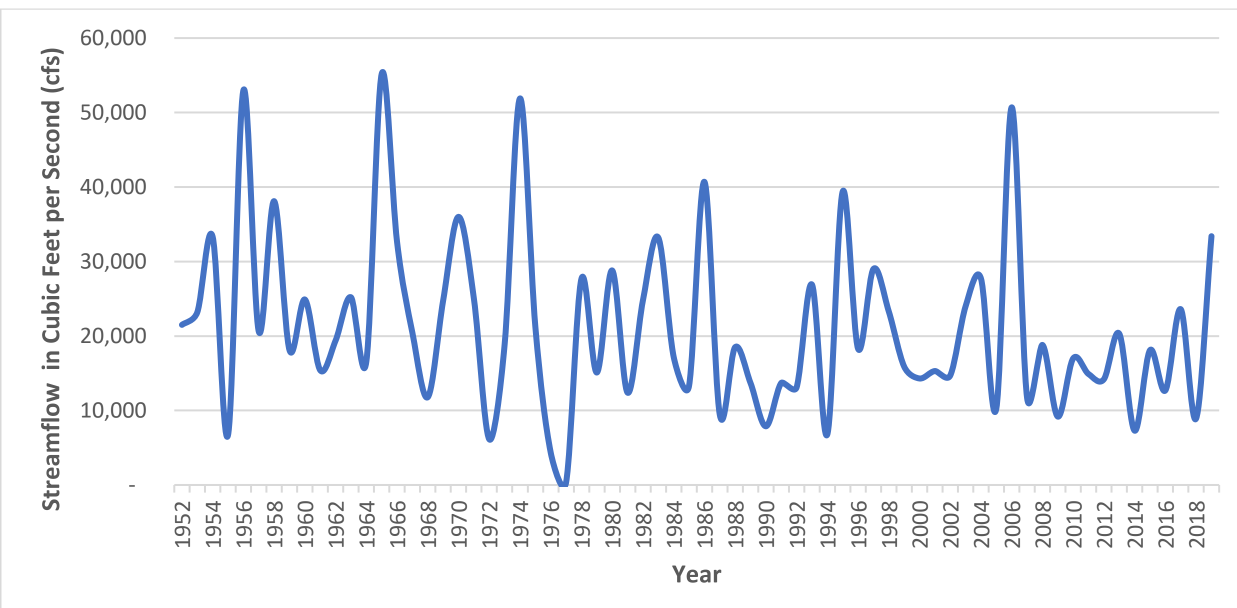


FIGURE 10-14: STREAM FLOW AT CLOVERDALE GAGE (1952 TO 2019)



10.7.4 Location

Flooding can be a problem in almost any part of Cloverdale, particularly when heavy rains combine with obstructions in waterways/drainage ways. Following are descriptions of flood sources and the areas in Cloverdale that are subject to flooding from those sources.

FEMA Floodplains

The areas in Cloverdale that are most prone to flooding, as identified on the FEMA Flood Insurance Rate map (FIRM) and shown in Figure 10-15, include the following:

- **Cloverdale Creek:** Those areas along Cloverdale Creek from the northwestern-most area of the city down toward Cloverdale Boulevard, then crossing University Street, Vista View Drive, Third Street, Second Street, Oakbrook Lane, and the area between First Street and the Frontage Road to the Russian River. During and following heavy rain events, localized flooding has been particularly problematic where Cloverdale Creek crosses Triplett Drive and Third Street.
- **Russian River:** The area on both sides of the Russian River, extending approximately 500 feet east of the former Northwestern Pacific Railroad track bed and to the eastern city limits. The low-lying areas between Highway 101 and the Russian River, near the City's water treatment plant.
- **Cherry Creek:** Along Cherry Creek from the western city limits running to the area between Clark Avenue and the railroad tracks east of Highway 101.
- **Porterfield Creek:** Along Porterfield creek from approximately 600-feet west of Cloverdale Boulevard to Highway 101.

Downtown Flooding

In addition to the areas identified by FEMA, Downtown Cloverdale is subject to localized flooding caused by a drainage system made up of open channels and aging, under-sized pipes that do not have sufficient capacity to carry runoff during heavy rainfall events. The system includes a partially-piped “captured creek” underneath both public and private properties in the Downtown area, including directly beneath residential structures. Storm events that exceed an inch per day of rainfall frequently overwhelm the “captured creek,” even when the Russian River is flowing well below flood stage. These events often result in overflows onto surface streets and into adjacent businesses and homes. The 2016-2017 rainy season also caused the first sink hole directly attributable to the “captured creek.” Because significant portions of the existing drainage system run underneath privately-owned property and are inaccessible for routine maintenance, there is risk of larger sinkholes forming.

Based on modeling prepared for the City (see Figure 10-16), a 100-year flood would cause Downtown streets and properties to accumulate an average of 0.5 feet to 2.0 feet of water, including City Hall, the Police Department, the Post Office, and much of the Citrus Fairgrounds, which provides essential evacuation and service functions during emergency events. In neighboring residential areas, the flooding would go up to between four and five feet. The Highway 101 underpass, which provides primary access to Downtown Cloverdale, would flood up to 9.5 feet, thereby disrupting normal access to the city. While Cloverdale High School, which provides emergency shelter, and the Fire Department, are located outside of the inundation area, access to these facilities would also be disrupted by floodwaters.

As part of the 2017 Downtown Flood Reduction Study, the City prepared conceptual/preliminary design plans that call for replacement and rerouting existing drainage facilities, including conversion of the channels and culverts that carry the "captured creek" into new underground drainage pipes. The redesigned system would hold a 10-year flood with 3,115 feet of new 24-, 60-, and 72-inch storm drain lines. It will also include 16 drain inlets, 8 SD manholes, and 1 outfall structure. Nearly all of these improvements would be constructed within existing streets, so land acquisition would be unnecessary. The new system would convey upstream runoff through the city safely, connecting existing upstream channels and the Caltrans channel at Highway 101, downstream of Downtown, and thereby reducing the risk of flooding in Downtown Cloverdale. Runoff would be conveyed to the Russian River at the same location it is currently conveyed.

10.7.5 Frequency/Probability of Future Events

Historically, flooding problems in Cloverdale have been associated with major storms, which result both in heavy flows and high levels in the Russian River and heavy runoff into the creeks and streams that flow into the city from the hills to the west. The flood zones depicted in FEMA's Flood Insurance Rate Maps (FIRMs) account for the probability of future occurrence. As illustrated in Figure 10-17 and described in Section 10.7.4, several isolated areas of Cloverdale are within the 100-year floodplain, suggesting a one percent probability of flooding annually. Although the recurrence interval represents the long-term average period between floods of specific magnitude, significant floods could occur at shorter intervals or even within the same year.

10.7.6 Severity and Extent

In general, Cloverdale is well-protected from flood risk by well-confined stream and creek channels and levees along the Russian River. As explained above, there are, however, some areas that are at increased risk because of outdated storm drainage facilities. Through the Downtown Flood Study, the City has identified solutions that would limit the severity and extent of flooding problems in the area covered by the study.

FIGURE 10-15: FEMA FLOOD RISK AREAS

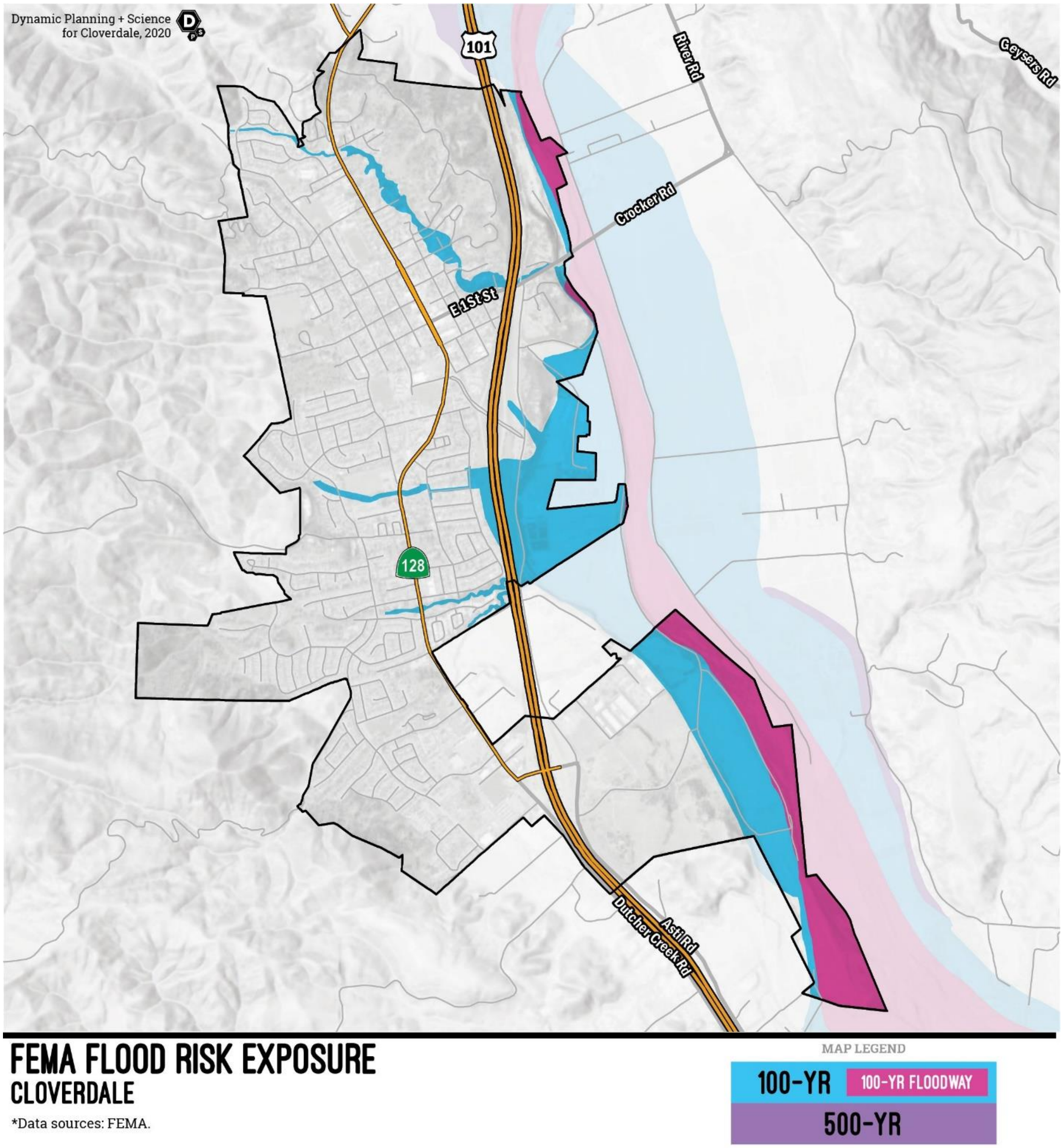
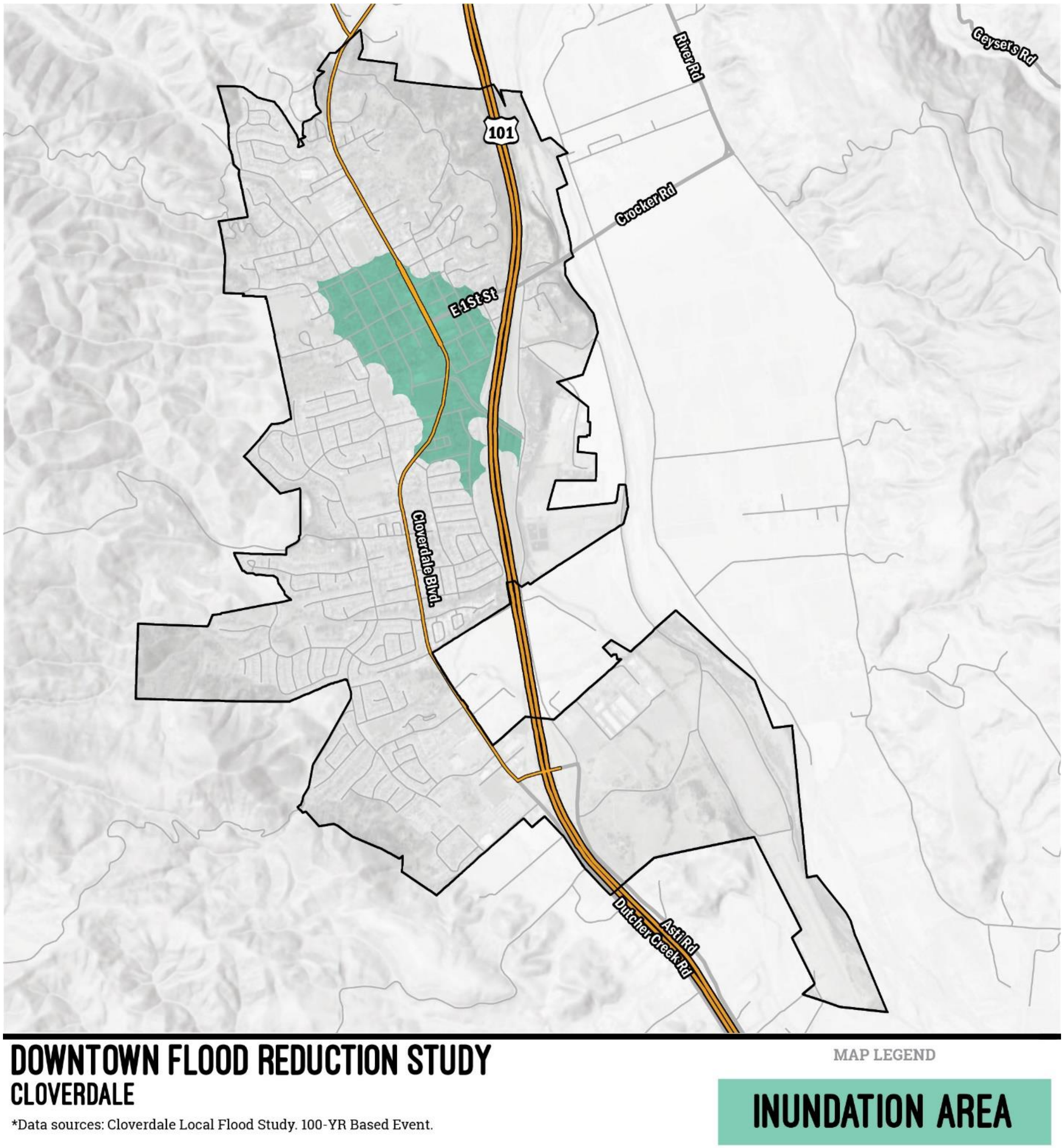


FIGURE 10-16: DOWNTOWN FLOOD REDUCTION STUDY INUNDATION AREA



10.7.7 Warning Time

The type and rate of flooding experienced in Cloverdale will vary depending on a variety of circumstances. In general, warning times for floods can be between 24 and 48 hours to prepare to reduce flood damage. Seasonal notification for flooding can enhance awareness for citizens at risk, and, when communicated effectively, advance notification can effectively reach at-risk populations.

10.7.8 Secondary Hazards

Slope failure (including landslides and mudslides) and levee failures are secondary hazards of flooding. With slope failure, soil rapidly collects and absorbs water during flooding, making slopes susceptible to slope failure involving a rock, earth, or debris flow. Slope failures that result from flooding either involve a flow of mud, rock, or earth that results from water accumulating in the ground or a slide of rock and debris down a steep slope that results from water moving down a slope and detaching material from that slope. Levee failures, also known as breaches or breaks, can occur when the forces of floodwater exceed the structural capacity of the levee.

10.7.9 Vulnerability Assessment

Cloverdale’s vulnerabilities from flooding vary depending on the origin of the flooding (i.e., Russian River, creeks and streams). Following are summaries of the nature and extent of exposure for flooding associated with the FEMA floodplains (Figure 10-17) and with the Downtown Flood Study scenario (Figure 10-18). The City’s Planning Team prepared both an exposure analysis and Hazus loss estimation analysis to evaluate Cloverdale’s flood vulnerability. The Planning Team overlaid private property value data and insured asset data with FEMA delineated floodplains and the Downtown Flood Study area to determine exposure.

Hazus flood vulnerability data was generated using a Level 2 Hazus-MH 4.2 analysis. Hazus analyzes 100-year depth grids derived from FEMA 100-year “A” zones with Base Flood Elevations (BFE) to estimate loss. The parcel-based GIS data was imported into Hazus as User Defined Facilities (UDF) and serves as the basis for replacement and content cost estimations as well as associated loss.

Exposure

The tables and figures in this section detail population, property, and infrastructure that are exposed to flooding in Cloverdale. Flood exposure is summarized for the FEMA 100-year floodplain and the area covered by the City’ s Downtown Flood Study. For the FEMA-mapped areas and the City’s Downtown Flood Study area, respectively, Figure 10-17 and Figure 10-18 depict the areas affected within the city limits and summarize the types of exposure. This information is further detailed below.

Population

The City’s Planning Team generated population counts of those living in the floodplain by analyzing County Assessor and parcel data that intersect with the 100-year floodplain and the Downtown Flood Study area. With GIS, the Planning Team used U.S. Census Bureau information to intersect the flood areas to estimated exposed population. This was calculated by weighting the population within each census block and tract with the percentage of flood risk area. Table 10-22 shows how much of the Cloverdale’s population would be exposed to flood hazard zones based on this methodology.

TABLE 10-22: POPULATION EXPOSURE TO FLOODING

Flood Hazard Zone	Exposed Population	% of Total Population
100-Year Floodplain	590	6.0%
Downtown Flood Area	910	9.3%
Sources: Sonoma County Assessor, 2020. US Census Bureau. FEMA DFIRM for Sonoma County. Dynamic Planning + Science.		

Private Property

Table 10-23 summarizes private property exposure to flooding in Cloverdale for both FEMA-mapped 100-year floodplain areas and the area identified in the City's Downtown Flood Study. All of the property within the 100-year floodplain is residential, while approximately 75 percent of the property in the Downtown Flood Area is residential and the rest is commercial. Note that the tabulations in Table 10-23 are based on parcels only (i.e., excluding public rights-of-way) and account only for privately-owned property as recorded by the County Assessor's records for non-exempt parcels. The tabulations exclude property tax-exempt land, so government-owned properties are not covered; exposure for these properties is covered under the discussion of critical facilities and infrastructure below.

TABLE 10-23: PRIVATE PROPERTY EXPOSURE TO FLOODING

Type of Exposure	Total City	100-Year Floodplain	Downtown Flood Area
Parcel Count*	2,964	53	387
Percentage of Citywide Total	--	1.8%	13.1%
Parcel Area (acres)*	760.2	16.7	79.8
Percentage of Citywide Total		2.2%	10.5%
Property Assessed Value Exposure	$731,738,000	$10,536,900	$78,111,600
Content Value Exposure	$418,680,400	$5,268,500	$49,066,000
Total Exposure	**$1,150,418,400**	**$15,805,400**	**$127,177,600**
Percentage of Citywide Total	**--**	**1.4%**	**11.1%**
*Privately-owned property derived from County Assessor's records for non-exempt parcels.			

FIGURE 10-17: FEMA FLOOD RISK EXPOSURE

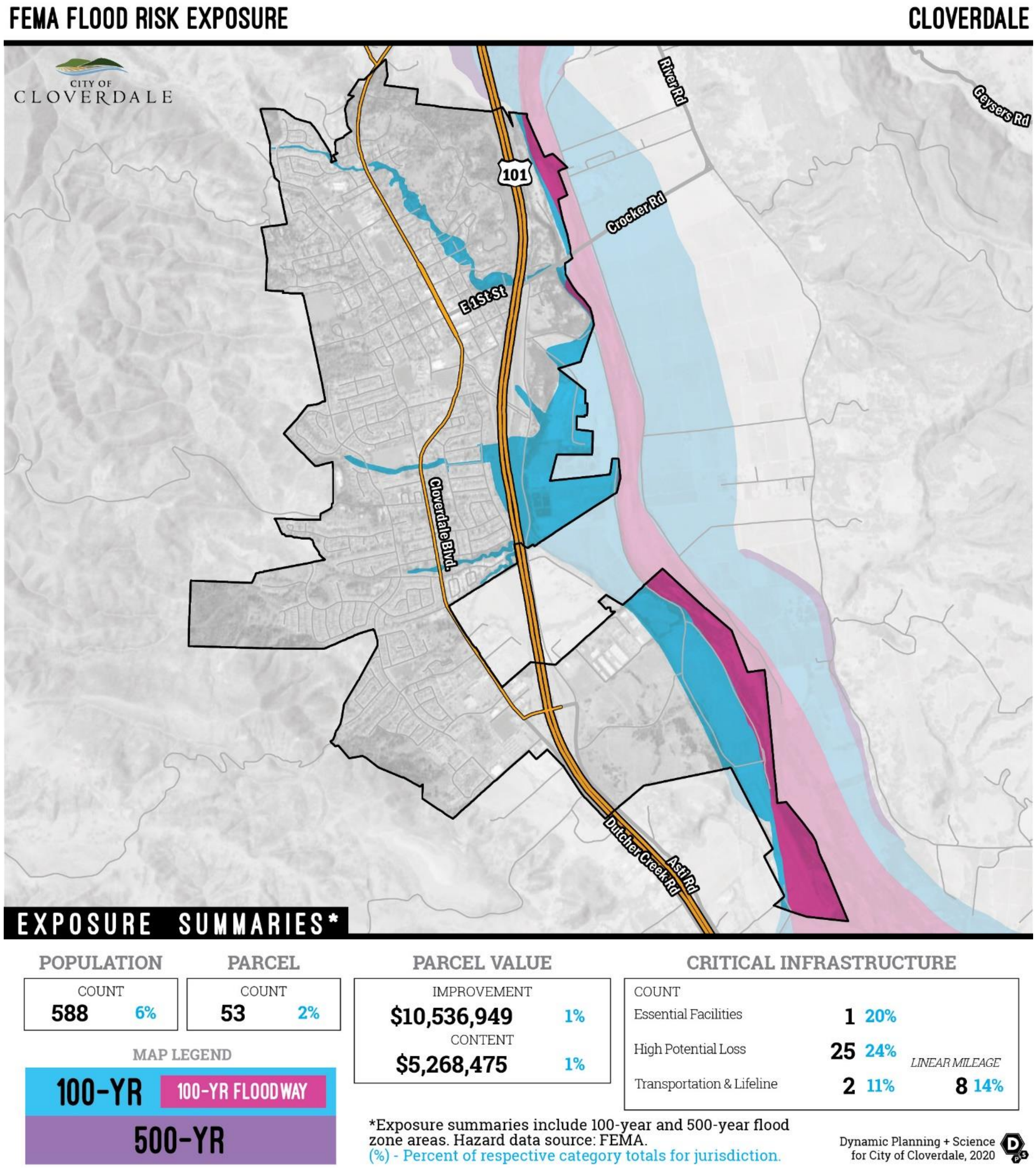
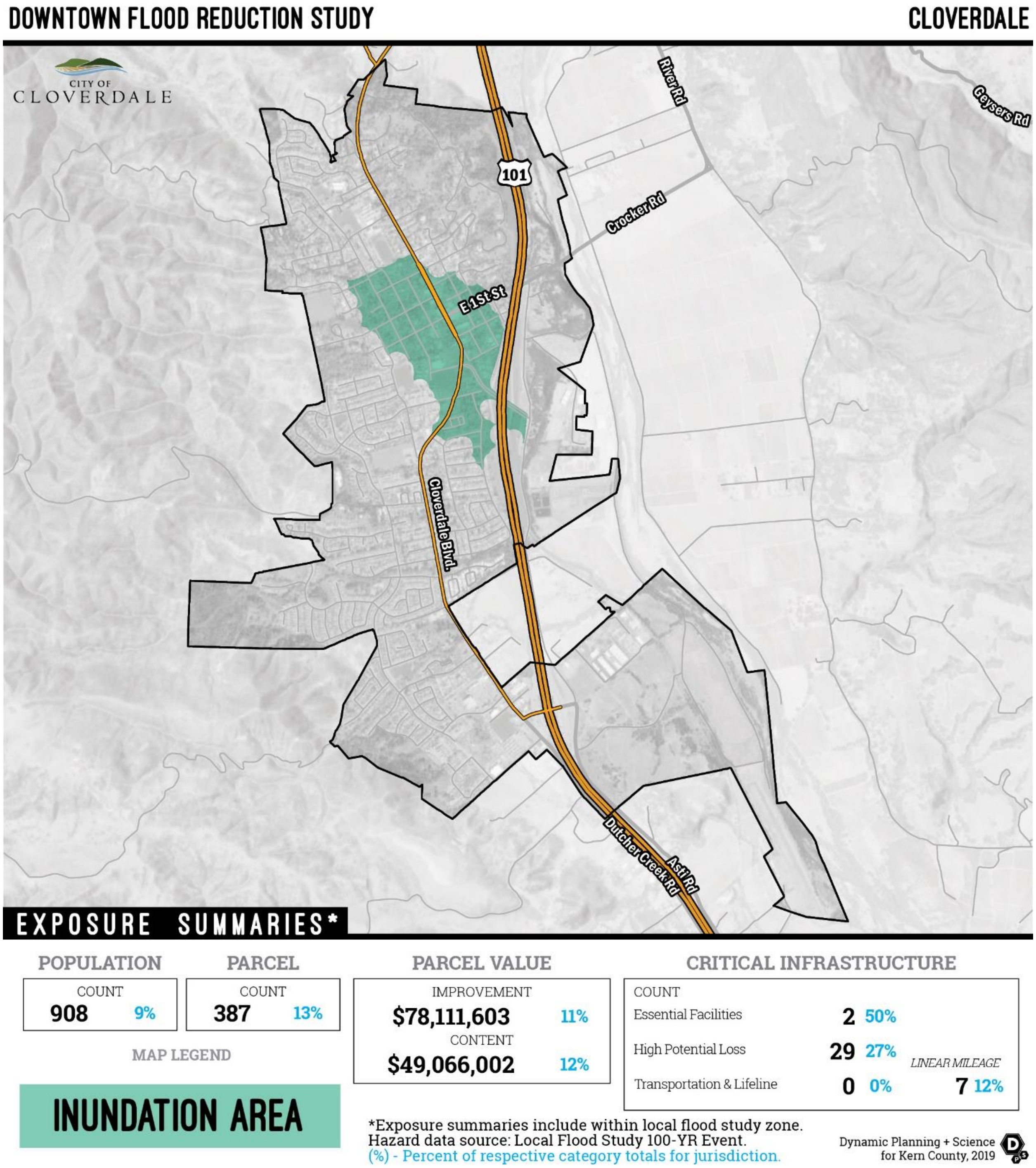


FIGURE 10-18: DOWNTOWN FLOOD RISK EXPOSURE



Critical Facilities and Infrastructure

Table 10-24 summarizes the critical facilities and infrastructure located in the FEMA-mapped flood areas and the area identified in the City's Downtown Flood Study. For the area within the 100-year floodplain, the greatest exposure is concentrated at the City's wastewater treatment plant/corporation yard property, which includes the vast majority of the high potential loss facilities (e.g., effluent ponds, aeration basin, settling basins, pump station, miscellaneous buildings). The other key City property in the 100-year floodplain is the airport. Within the Downtown Flood Study area, there are no City insured assets and half of the high potential loss buildings host childcare services and three are school facilities.

TABLE 10-24: CRITICAL FACILITIES / INFRASTRUCTURE EXPOSURE TO FLOODING

Infrastructure Type	Total City	100-Year Floodplain		Downtown Flood Study	
		Number	% of Total	Number	% of Total
Essential Facilities					
Police	2	-	-	2	100.0%
Subtotal	**2**	**0**	**0.0%**	**2**	**100.0%**
High Potential Loss Facilities					
Airport	1	1	100.0%	-	-
Child Care Center	6	-	-	4	66.7%
City Hall	2	-	-	2	100.0%
Communications Tower	3	-	-	1	33.3%
Corp Yard	1	1	100.0%	-	-
Evacuation Center	1	-	-	1	100.0%
Family Child Care Home	4	-	-	4	100.0%
Government Asset	46	21	45.7%	3	6.5%
Healthcare Center	5	-	-	3	60.0%
Historic Building	4	-	-	2	50.0%
Park	4	1	25.0%	1	25.0%
School	9	-	-	4	44.4%
Town Hall (Cloverdale Arts Ctr)	1	-	-	1	100.0%
Vulnerable Housing	10	-	-	3	30.0%
Wastewater Treatment	2	2	100.0%	-	-
Subtotal	**99**	**26**	**26.3%**	**29**	**29.3%**
Transportation and Lifelines					
Airport	1	1	100.0%	-	-
Park	2	1	50.0%	1	50.0%
Substation	1	1	100.0%	-	-
Subtotal	**4**	**3**	**75.0%**	**1**	**25.0%**
Grand Total	**105**	**29**	**27.6%**	**32**	**30.5%**

Linear utilities and transportation routes, often referred to as lifelines, may be at risk if they are damaged or their use is disrupted by flooding. Roads or railroads that are blocked or damaged can isolate residents and can prevent access throughout the city, including for emergency service providers needing to get to vulnerable populations or to make repairs. Water and sewer systems can be flooded or backed up, causing health problems. Underground utilities can be damaged. Levees can fail or be overtopped, inundating the land that they protect. Table 10-25 shows lifeline facilities in the flood areas including over a mile of Cloverdale Boulevard (as a "Primary Highway") that would be inundated under the flooding scenario evaluated in the Downtown Flood Reduction Study.

TABLE 10-25: LIFELINE EXPOSURE TO FLOODING

Infrastructure Type	City Total Miles	100-Year Floodplain		Downtown Flood Study	
		Miles	% Total	Miles	% Total
Levee	1.66	1.66	99.9%	-	-
NG Pipeline	2.88	0.04	1.2%	0.34	11.7%
Railroad	2.89	1.36	46.9%	0.08	2.9%
Transmission Line	0.43	0.43	99.8%	-	-
Streets/Roads					
Alley	0.14	0.01	7.9%	0.04	25.1%
Interstate	4.67	0.76	16.3%	0.06	1.4%
Local road	37.79	3.58	9.5%	5.17	13.7%
Primary Highway	3.20	0.04	1.2%	1.06	33.2%
Ramp	1.97	0.23	11.6%	0.15	7.7%
State/County Highway	1.55	0.07	4.6%	0.18	11.3%
Subtotal	**49.32**	**4.69**	**9.5%**	**6.66**	**13.5%**
Grand Total	**57.18**	**8.17**	**14.3%**	**7.08**	**12.4%**

Property Damage / Loss Estimation

This section provides estimate of damage to City of Cloverdale insured assets and buildings and structures on private property within the FEMA-defined 100-year floodplain and the area covered by the City's Downtown Flood Study. Damage estimates, as calculated by Hazus, estimate losses to structures from flooding by analyzing the depth of flooding and type of structure. 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, all non-vacant parcels with assessed taxable value were used instead of the default inventory data provided with Hazus.

All of the 53 privately-owned parcels within the FEMA floodplain area are residential. Under the 100-year flood scenario, according to the Hazus model, total damage to these properties would amount to approximately $2.58 million ($2.04 million in property value and $543,000 in content value). Most of the flood-related damage to critical facilities would be at the City's wastewater treatment plant property, with $437,000 in property loss, all of which would be associated damage to effluent ponds. The balance of the loss would be at the airport, which would suffer only very minor damage (i.e., less than one percent of the building value). These modeled estimates of potential damage need to be considered in light of the Cloverdale's direct experience. For instance, during the February 2019 storm events, the Russian River levee protecting the Cloverdale Airport, the City's water treatment plant, and River Park was breached, causing extensive flooding and property damage. This flooding affected the runway, tarmac and the hangars and other buildings at the airport; damaged the River Park trail, picnic area, fencing, park furniture, and the boat launch ramp; and submerged two wells at the water treatment plan, causing them to become non-operational. The City estimated damage costs exceeding $1,000,000.

FIGURE 10-19: CLOVERDALE AIRPORT RUNWAY FLOODING, FEBRUARY 2019

Of the 387 privately-owned parcels within the Downtown Flood Reduction Study inundation area, 324 are developed with residential uses (predominantly single-family homes), 55 are commercial, and 5 are industrial. According to the Hazus model, as shown in Table 10-26, the structures on 119 of these parcels would sustain damage based on the depth of flooding assumed by the model (ranging from 0.1 to 5.0 feet). The total damage to residential properties would amount to approximately $3.75 million ($2.8 million in structure value and $950,000 in content value). For commercial properties, the losses would be minor, with a total of $53,900. City Hall and the Police/Fire Station properties would also sustain relatively minor damage, with $66,300 and $102,600 in total damage, respectively.

TABLE 10-26: PROPERTY DAMAGE, DOWNTOWN FLOOD REDUCTION STUDY AREA

	Parcels with Damage		Building Damage		Content Damage		Total	
Building Type	**Number**	**% of Total**	**Value**	**% of Total**	**Value**	**% of Total**	**Value**	**% of Total**
Residential	91	76.5%	$2,805,200	96.0%	$947,600	89.9%	$3,752,800	94.4%
Commercial	23	19.3%	$9,900	0.3%	$44,000	4.2%	$53,900	1.4%
City Hall	2	1.7%	$26,700	0.9%	$39,600	3.8%	$66,300	1.7%
Police/Fire	3	2.5%	$79,700	2.7%	$22,900	2.2%	$102,600	2.6%
Total	**119**	**100.0%**	**$2,921,500**	**100.0%**	**$1,054,000**	**100.0%**	**$3,975,600**	**100.0%**

Note that the Downtown Flood Reduction Study area is predicated on the failure of the outdated drainage system that currently serves the area, including the “captured creek.” Hazus does not account for the costs associated with replacement of that infrastructure. It also does not account for property damage associated with failure, including sinkholes that would cause direct damage to structures. The Downtown Flood Reduction Study estimated that the overall benefit of drainage system improvements that would pre-empt such failure is approximately $7.6 million, however, is to identify old or outdated drainage infrastructure that could fail during heavy rainfall events. Hazus does not account for losses associated with such failure..

10.8 GEOLOGICAL HAZARDS

For purposes of this LHMP, geological hazards include slope failure and soil instability. Broadly defined, slope failure includes landslides, mudflow, debris flow, and rockfall, while soil instability includes phenomena such as liquefaction and subsidence.

10.8.1 Landslide

The many types of landslides are categorized based on form and type of movement. They range from slow moving rotational slumps and earth flows, which can slowly distress structures but are less threatening to personal safety, to fast-moving rock avalanches and debris flows that are a serious threat to structures and have been responsible for most fatalities during landslide events. Many large landslides are complex and a combination of more than one landslide type.

Generalized landslide susceptibility in Cloverdale is considered low to moderate. A combination of the generalized slope categories and the generalized landslide susceptibility areas results in following potentially hazardous zones:

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

Mudflow/Debris Flow

When slope material becomes saturated with water, a debris flow may develop. From a geologic perspective, there are generally two types of debris flows: debris flows related to shallow landslides and post-wildfire debris flows.

Debris flows related to shallow landslides occur on hillslope due to soil failure in which soil liquefies and runs downhill. This type of debris flow generally results from a shallow landslide (less than 10 to 15 feet deep) and has a discrete initiation zone depositional area. Shallow landslides tend to occur in winter but are most likely after prolonged periods of heavy rainfall when soil materials are saturated. Debris flows are typically more dangerous because they are fast moving, causing both property damage and loss of life.

Post-wildfire debris flows are a result of post-fire conditions, where burned soil surfaces enhance rainfall runoff that concentrates in a channel and picks up debris as it moves. The post-fire debris flow has a less discrete initiation zone but is similar to a debris flow derived from hillslopes in that it may result in inundation and a detrimental impact on lives and property within its zone of runout and deposition. It can result in downstream flooding.

Liquefaction Susceptibility

Soil liquefaction occurs when material that is ordinarily a solid behaves like a liquid. Saturated or partially-saturated soil substantially loses strength and stiffness in response to an applied stress such as shaking during an earthquake or other sudden change in stress condition. The phenomenon is most often observed in saturated, loose, low-density, or uncompacted, sandy soils. Dense sands, by contrast, tend to expand in volume or "dilate." If the soil is saturated by water, which often occurs when soil is below the water table or sea level, then water fills the pore spaces between soil grains. When shaken, the soil grains consolidate, pushing water towards the surface and causing a loss of strength in the soil.

The soil surface may sink or spread laterally. Structures located on liquefiable soils can sink, tip unevenly, or even collapse during an earthquake. Pipelines and paving can tear apart.

10.8.2 Plans, Policies, and Regulatory Environment

Cloverdale Zoning Ordinance: Hillside Protection

Section 18.09.040 of the City's Zoning Ordinance outlines policies and standards for any property with slopes exceeding 20 percent (i.e., a "hillside site"). It calls for all development applications for hillside sites to submit grading and erosion control plans that address revegetation of disturbed areas, avoidance of grading activities during wet weather, avoidance of drainage corridors and riverbanks, and other erosion control measures. It also requires all development applications for hillside sites to submit a geotechnical investigation concerning areas with identified significant geologic hazards, including potential liquefaction-related failures, slope stability and erosion hazards, existing or potential soil instability, or expansive soils. Finally, the ordinance permits hillside conservation areas to be annexed if the annexation provides permanent hillside open space or recreation opportunities for the city.

10.8.3 Past Events

Cloverdale has experienced a variety of non-catastrophic geological problems over the years, most of which have followed major weather events. This includes recent events, such as the Vista View Slide in 2017 and geological disruption following February 2019 storms. The former has been the subject of major repair work, including to damaged waterlines, while the latter included landslides and mudslides on private property near the City's Ritter water tank. Also, as documented in the March 2018 mitigated negative declaration for the Vista Oaks project, the project site is located within an area where 15 landslides have occurred. A review of Cloverdale Reveille archives results in several references to disruptions associated with landslides and mudslides, including closures of the old Highway 101 in 1937, 1940-41, and 1970, as well as reports of road closures following major storms in January 1995, including the access road to the Ritter water tank.

10.8.4 Location

In the Cloverdale area, geological hazards are evident either in hilly areas (landslides, mudflows) or along the Russian River (liquefaction). As Figure 10-20 shows, landslide risk within the city limits is concentrated mostly to the Vista View Drive area. There are also smaller areas in the Clover Springs and Furber Ranch neighborhoods at the western edge of the city and in the Alexander Valley Specific Plan area. The hillsides in the unincorporated areas to the northwest, west, and southwest of the city limits are all highly susceptible to landslides, as are the hillsides east of River Road.

Figure 10-21 shows the areas within the Cloverdale area that are susceptible to liquefaction. As it shows, within the city limits, susceptibility is principally concentrated along the Russian River. Outside of the city limits, in addition to the river corridor, the areas immediately north of Highway 128 are also susceptible.

FIGURE 10-20: HIGH LANDSLIDE RISK

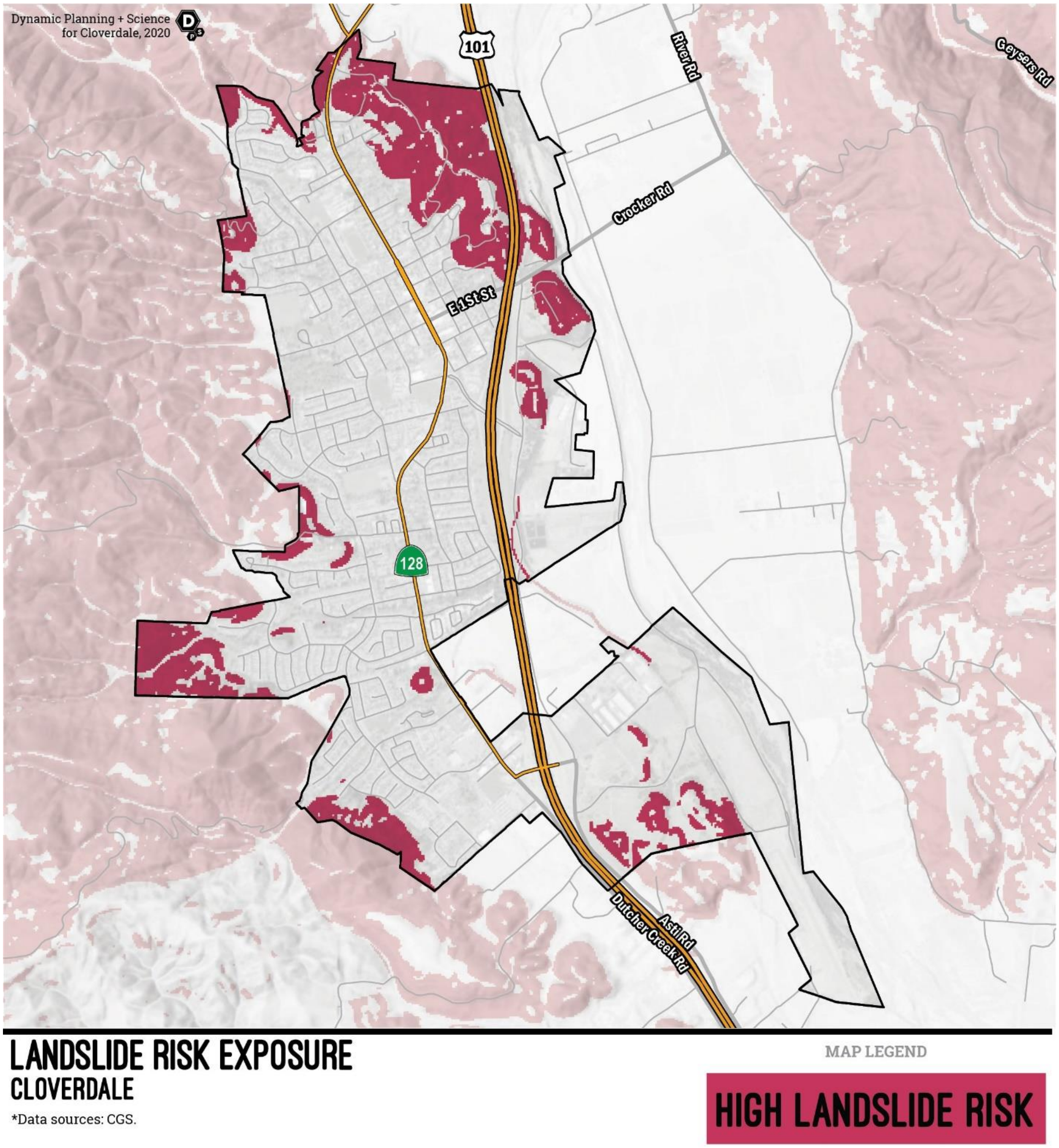
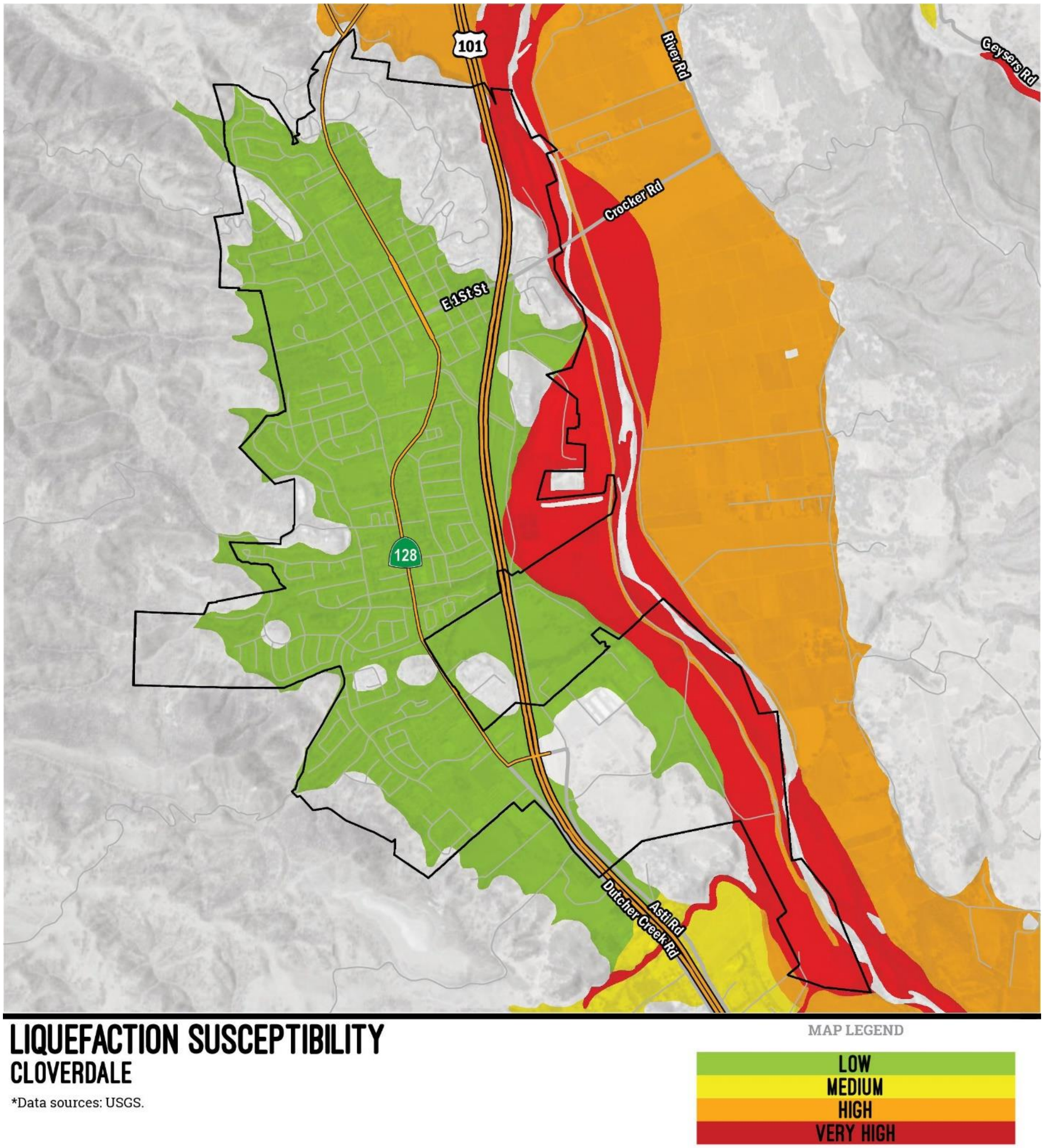


FIGURE 10-21: LIQUEFACTION SUSCEPTIBILITY



10.8.5 Frequency/Probability of Future Occurrences

Slope failures, including landslides and mudslides, are most frequently triggered in periods of high rainfall, but can also be triggered by earthquakes. The hazard is greatest in steeply-sloped areas, although slides may occur on slopes of 15 percent or less if the conditions are right. Slope steepness and underlying soils are the most important factors affecting the landslide hazard. Surface and subsurface drainage patterns also affect landslide/mudslide hazard, and vegetation removal can increase the likelihood. In addition, vulnerability is increased when vegetation is damaged by drought and wildfire, and the probability of both is exacerbated by climate change. Thus, as a matter of natural circumstances, Cloverdale is likely to be subject to greater frequency and probability of slope failure.

10.8.6 Severity and Extent

The severity of landslide problems depends upon the local bedrock and soil conditions, including moisture content, slope, and vegetation. Small landslides and mudslides have occurred in sloping areas around Vista View Drive as loose material has moved naturally down slope, typically after heavy rains. In addition, many human activities tend to make the earth materials less stable and, thus, increase the chance of ground failure. Some of the natural non-seismic causes of ground instability are stream erosion, heavy rainfall, and poor-quality natural materials. Human activities contribute to soil instability through grading of steep slopes or overloading them with artificial fill, by extensive irrigation, construction of impermeable surfaces, excessive groundwater withdrawal, and removal of stabilizing vegetation. As shown in Figure 10-20 and discussed in Section 10.8.9, very few parcels in Cloverdale are subject high landslide risk, so the geographic extent of landslides is limited, as is the potential severity of landslides, particularly given the hillside protection provisions in the City's Zoning Ordinance (Section 18.09.040).

10.8.7 Warning Time

Some geologic hazards occur slowly but can have significant property or health consequences, like erosion and some forms of slope movement or landsliding. The identification of those hazards generally takes site-specific analysis to determine if the site soils and geology are susceptible to these hazards and what mitigation is most relevant and prudent for a site. For these types of hazards, warning time is long.

For other hazards, such as debris flows, rockfall, and landslides, warning time is often very short and may not occur at all. Identifying areas where these events are known have occurred, or which have ideal characteristics for these hazards to occur, could help with hazard preparedness when triggering-type events like intense rainfall occur. This identification will not reduce the warning time, but it will make proactive response to potential triggering events more effective.

10.8.8 Secondary Hazards

While landslides and mudflow rarely present a threat to human life, they can damage buildings and infrastructure, resulting in disruption of everyday services, including emergency response capabilities. Both landslides and mudflow can block transportation routes, obstruct creeks and drainages, and contaminate water supplies. When these hazards affect transportation routes, they are frequently expensive to clean-up.

10.8.9 Vulnerability Assessment

Figure 10-22 displays and summarizes landslide susceptibility for population, property, and infrastructure in Cloverdale. These vulnerabilities, which are characterized in terms of exposure, are further described below. Because FEMA's Hazus model does not address geological hazards, property damage/loss was not estimated.

Population

Figure 10-22 indicates that 1,557 Cloverdale residents are estimated to be exposed to high landslide risk. This estimate was generated by analyzing County assessor and parcel data that intersect with landslide hazard areas identified by California Geological Survey. Using GIS, U.S. Census Bureau information was used to intersect slope failure hazards to develop an estimate of exposed population by weighting the population within each census block with the percentage of slope hazard areas. As a practical matter, far fewer residents are likely to be directly exposed to landslide risk. The more indicative level of population at risk is the number of parcels directly affected, which is only 104, and many of these parcels are undeveloped, in part because they are located difficult-to-develop, sloped areas.

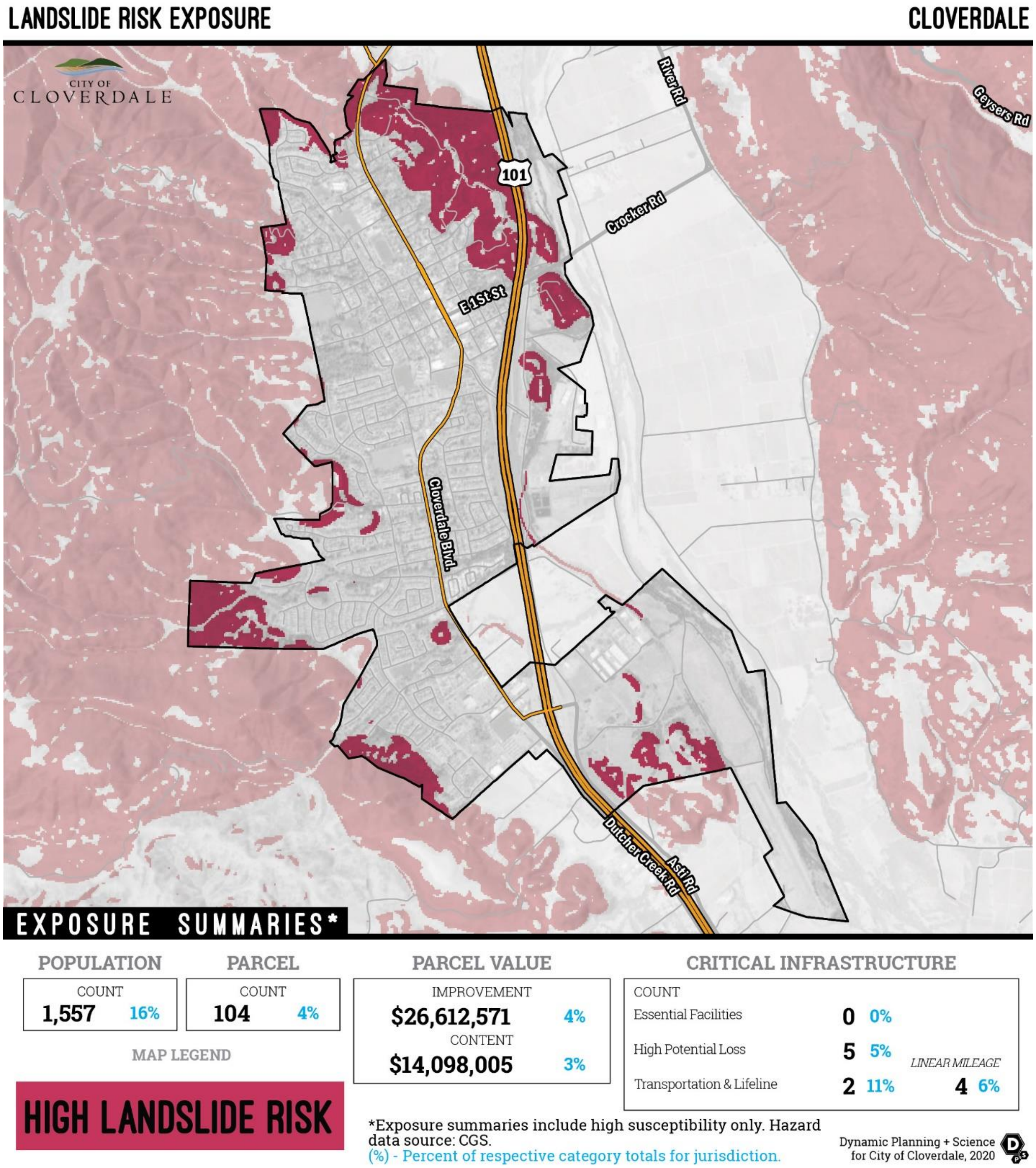
Private Property

As Figure 10-22 indicates, 104 privately-owned properties in Cloverdale are subject to high landslide risk. This represents approximately 3.5 percent of the private parcels in the city. These at-risk properties represent a land value of approximately $26.6 million, with an associated content value estimated at $14.1 million, for a total of $40.7 million in property exposure (approximately 3.5 percent of the citywide value).

Critical Facilities and Infrastructure

As Figure 10-22 indicates, no essential facilities are directly at risk from high landslide hazards, and only seven high potential loss facilities are at risk, including three water tanks, two communications towers, and one vulnerable housing facility. As Figure 10-22 also shows, approximately four miles of linear lifelines are located in high landslide risk areas, most of which are roadways serving those areas.

FIGURE 10-22: LANDSLIDE RISK EXPOSURE SUMMARY



10.9 EPIDEMIC/PANDEMIC/VECTOR-BORNE DISEASE

An epidemic is a localized outbreak that spreads rapidly and affects many people or animals in a community. A pandemic is an epidemic that occurs worldwide or over a very large area and affects a large number of people. While the most familiar epidemic/pandemic to occur within the past 100 years is the COVID-19 outbreak that emerged in early 2020, several others have occurred involving various diseases, including various forms of influenza (e.g., H1N1), the West Nile Virus, rabies, Hepatitis C, Lyme Disease, and measles. The following summaries are derived from the 2018 California State Hazard Mitigation Plan

10.9.1 Infectious Disease

The California Department of Public Health (CDPH) has infectious disease as a hazard that would have a significant impact throughout the state.

Seasonal Influenza

Seasonal influenza, also known as the flu, is a disease that attacks the respiratory system (nose, throat, and lungs) in humans. Seasonal influenza occurs every year. In the U.S. the influenza season typically extends from October through May, peaking in January or February with yearly epidemics of varying severity. Although mild cases may be similar to a viral "cold," influenza is typically much more severe. Influenza usually comes on suddenly; may include fever, headache, tiredness (which may be extreme), dry cough, sore throat, nasal congestion, and body aches; and can result in complications such as pneumonia. Persons aged 65 and older, those with chronic health conditions, pregnant women, and young children are at the highest risk for serious complications, including death.

Pandemic Influenza

A pandemic influenza occurs when a new influenza virus, for which there is little or no human immunity, emerges and spreads on a worldwide scale, infecting a large proportion of the human population. The 20^{th} century saw three such pandemics, and a fourth one occurred in the 21^{st} century. Until 2020, the most notable infectious disease pandemic was the 1918 Spanish influenza pandemic that was responsible for 20 million to 40 million deaths throughout the world.

COVID-19

COVID-19 is a new infectious disease, caused by a novel (or new) coronavirus that had not been seen in humans before late 2019. The virus spread quickly in early 2020, becoming a global pandemic. As of February 2021, there were 107 million COVID-19 cases worldwide and 2.3 million people had died, with 27.2 million cases in the United States and 470,000 deaths. Although most people who have COVID-19 experienced mild symptoms, the virus causes severe illness and death. Some groups, including older adults and people with certain underlying medical conditions, are at increased risk of severe illness. COVID-19 is spread mainly through close contact from person to person, including between people who are physically near each other (within about 6 feet). People who are infected, but do not show symptoms, can also spread the virus to others. The COVID-19 virus appears to spread more efficiently than influenza, but not as efficiently as measles, which is among the most contagious viruses known to affect people. Cases of reinfection with COVID-19 have been reported but are rare. COVID-19 vaccines were developed in late 2020, with distribution underway in early 2021.

10.9.2 Vector-Borne Diseases

The Vector-Borne Disease Section (VBDS) of CDPH protects the health and well-being of Californians from diseases transmitted to people from insects and other animals. VBDS conducts prevention, surveillance, and control of vector-borne diseases, including Hantavirus pulmonary syndrome, bubonic plague, Lyme disease, West Nile virus (WNV), and other tick-borne and mosquito-borne diseases. VBDS also performs surveillance and advises on control for introduction of exotic vector species that may harbor human pathogens.

Vector-borne diseases and exotic vectors that cause a significant risk to people are discussed further in this section. These include WNV and invasive Aedes mosquitoes. Natural disasters such as flooding, fires, and earthquakes may create mosquito-breeding habitat that must be assessed and surveyed. The devastating 2015 wildfires in Lake County resulted in exposed structures, particularly septic systems that became important mosquito-breeding sources, particularly for Culex spp. mosquitoes (vector of WNV). Damaged structures from earthquakes may also have new potential to hold water that can serve as mosquito-breeding sources.

10.9.3 Plans, Policies, and Regulations

An international network of health organizations conducts research and provides direction on addressing epidemics and pandemics resulting from all causes. In the United States, a variety of government agencies coordinate their services. Following are summaries of federal, state, and local agencies and their roles in addressing epidemics and pandemics.

Federal

Many federal agencies are responsible for various aspects of emergency preparedness and response. The HHS Pandemic Influenza Plan (November 2005) prepared by the Department of Health and Human Services (HHS) provides a summary of major pandemic preparedness roles of HHS officials, agencies and divisions. The section on HHS Actions for Pandemic Influenza Preparedness and Response summarizes key actions and responsible agencies by pandemic phase. Roles played by other federal departments are not detailed in the plan, nor are the coordination and communication amongst departments and agencies. A brief description of the roles played by HHS officials, agencies and divisions is as follows.

Department of Health and Human Services (HHS)

The US Secretary of Health and Human Services directs all HHS pandemic response activities. The Centers for Disease Control and Prevention (CDC) works with partners throughout the nation and the world to monitor health; detect and investigate health problems; develop, evaluate, and modify disease control and prevention strategies; stockpile antiviral drugs and other essential materials; and promote and support influenza vaccination programs. The Influenza Pandemic Operation Plan (OPLAN) is published by the CDC. The Food and Drug Administration (FDA), which is also part of HHS, regulates and licenses vaccines and antiviral agents through the Center for Biologics Evaluation and Research and the Center for Drug Evaluation and Research. The FDA also develops influenza viral reference strains and reagents and makes them available to manufacturers for vaccine development and evaluation.

Department of Homeland Security (DHS)

DHS has the overall authority for emergency response activities and will coordinate interventions to maintain community services during a pandemic.

State of California

The California Department of Public Health (CPDH) is the State’s lead agency in terms of epidemic and pandemic mitigation, preparation, and response. CDPH's fundamental responsibilities are comprehensive in scope and include infectious disease control and prevention, food safety, environmental health, laboratory services, patient safety, emergency preparedness, chronic disease prevention and health promotion, family health, health equity and vital records and statistics. CDPH's key activities and services include protecting people in California from the threat of preventable infectious diseases like Zika virus, HIV/AIDS, tuberculosis and viral hepatitis, and providing reliable and accurate public health laboratory services and information about health threats.

Among CDPH's programs is the California Influenza Surveillance Project (CISP), which obtains and analyzes hospital, pharmacy, and laboratory data year-round in an effort to determine the timing and impact of influenza activity and to determine how well circulating strains of the virus match those used in the current influenza vaccines. It is particularly important for California to have a strong influenza surveillance program as it has several ports of entry for international travel and shipping.

Local

The Sonoma County Department of Health Services (DHS) is responsible for protecting the health and well-being of individuals and communities in Sonoma County. The Department provides a broad range of programs and services designed to promote, develop, and sustain the health of individuals, families, and communities.

In response to the COVID-19 outbreak, the County Health Officer established a strategy to reduce the virus infection rate through widespread testing, contact tracing to isolate infected individuals, quarantine those infected, and implement mitigation measures such as social distancing, hygiene, face coverings, and implementation of sector specific business guidance and management plans.

In September 2020, the County Board of Supervisors authorized the establishment of a temporary Novel Coronavirus/COVID-19 Section within the Public Health Division of the County DHS. The COVID-19 Section provides targeted support to create an inclusive, comprehensive, and consolidated approach across all of the County's response operations that is also responsive to changing conditions. The functions of the COVID-19 Section include the recruitment, training and onboarding of staff and volunteers; equity and inclusion support; human resources and logistics support; operation of a public information hotline; facilitation of Alternate Care Sites and Non-Congregate Shelters for surge capacity; public information and outreach; and comprehensive testing, case investigations, and contact tracing.

Starting in early 2021, Sonoma County DHS began coordinating with primary care providers to administer COVID-19 vaccines according to State and Federal guidelines for distribution. Priority was determined by a number of factors including risk of exposure from work or living environments, as well as vulnerabilities due to age and medical conditions.

10.9.4 Past Events

1918 Pandemic (Spanish Flu)

The 1918 influenza pandemic was the most severe pandemic in recent history. It was caused by an H1N1 virus with genes of avian origin. Although there is not universal consensus regarding where the virus originated, it spread worldwide during 1918-1919. In the United States, it was first identified in military personnel in spring 1918. It is estimated that about 500 million people or one-third of the world's population became infected with this virus. The number of deaths was estimated to be at least 50 million worldwide with about 675,000 occurring in the United States.

1957-1958 Pandemic (Asian Flu)

In February 1957, a new influenza A (H2N2) virus emerged in East Asia, triggering a pandemic ("Asian Flu"). This H2N2 virus was comprised of three different genes from an H2N2 virus that originated from an avian influenza A virus, including the H2 hemagglutinin and the N2 neuraminidase genes. It was first reported in Singapore in February 1957, Hong Kong in April 1957, and in coastal cities in the United

States in summer 1957. The estimated number of deaths was 1.1 million worldwide and 116,000 in the United States.

1968 Pandemic (H3N2 virus)

The 1968 pandemic was caused by an influenza A (H3N2) virus composed of two genes from an avian influenza A virus. It was first noted in the United States in September 1968. The estimated number of deaths was 1 million worldwide and about 100,000 in the United States. Most deaths were in people 65 years and older. The H3N2 virus continues to circulate worldwide as a seasonal influenza A virus. Seasonal H3N2 viruses, which are associated with severe illness in older people, undergo regular antigenic drift.

2009 H1N1 Pandemic

In the spring of 2009, a novel influenza A (H1N1) virus emerged. It was detected first in the United States and spread quickly across the United States and the world. This new H1N1 virus contained a unique combination of influenza genes not previously identified in animals or people. This virus was designated as influenza A (H1N1)pdm09 virus or H1N1. The H1N1 virus was very different from H1N1 viruses that were circulating at the time of the pandemic. Few young people had any existing immunity, but nearly one-third of people over 60 years old had antibodies against this virus, likely from exposure to an older H1N1 virus earlier in their lives. Since the H1N1 virus was very different from previously circulating H1N1 viruses, vaccination with seasonal flu vaccines offered little cross-protection against H1N1 virus infection. During 2009 and 2010, CDC estimated there were 60.8 million cases, 274,304 hospitalizations, and 12,469 deaths in the United States due to the H1N1 virus.

Additionally, CDC estimated that as many as 575,000 people worldwide died from H1N1 virus infection during the first year the virus circulated. Globally, 80 percent of H1N1 virus-related deaths were estimated to have occurred in people younger than 65 years of age. This differed greatly from typical seasonal influenza epidemics, during which about 70 percent to 90 percent of deaths are estimated to occur in people 65 years and older.

Though the 2009 flu pandemic primarily affected children and young and middle-aged adults, the impact of the H1N1 virus on the global population during the first year was less severe than that of 1918 and 1968 pandemics.

COVID-19

On February 11, 2020, the World Health Organization announced an official name for the disease that caused the 2019 novel coronavirus outbreak, first identified in Wuhan China. It was called coronavirus disease 2019, abbreviated as COVID-19. In COVID-19, “CO” stands for corona, “VI” for virus, and ”D” for disease. Formerly, this disease was referred to as “2019 novel coronavirus” or “2019-nCoV.”

Table 10-27 summarizes the number of COVID-19 cases and deaths, ranging from worldwide totals to the number of cases in the Cloverdale zip code as of February 2021. The impacts of the COVID-19 pandemic remain ongoing.

TABLE 10-27: CUMULATIVE COVID-19 CASES AND DEATHS, FEBRUARY 2021

Geography	Cases	Deaths
Worldwide	106,880,652	2,339,991
United States	27,189,188	468,103
California	3,412,374	44,459
Sonoma County	26,909	277
Cloverdale (Zip Code 95425)	663	

Vector-Borne Disease

Mosquito-Borne Viruses

Mosquito-borne viruses belong to a group of viruses commonly referred to as arboviruses (for arthropod-borne). Although 12 mosquito-borne viruses are known to occur in California, only West Nile virus (WNV), western equine encephalomyelitis virus (WEE), and St. Louis encephalitis virus (SLE) are significant causes of human disease. WNV continues to seriously affect the health of humans, horses, and wild birds throughout the state. Since 2003, there have been over 6,000 WNV human cases with 248 deaths, and over 1,200 equine cases. Consequently, the California Arbovirus Surveillance Program emphasizes forecasting and monitoring the temporal and spatial activity of WNV, WEE, and SLE. These viruses are maintained in wild bird-mosquito cycles that do not depend upon infections of humans or domestic animals to persist.

WNV first appeared in the United States in 1999 in New York and rapidly spread across the country to California in subsequent years. California has historically maintained a comprehensive mosquito-borne disease surveillance and control program including the Mosquito-borne Virus Surveillance and Response Plan, which is updated annually in consultation with local vector control agencies.

In 2020, the WNV continued to be evident in California, although there were no reported cases in Sonoma County. Adjacent counties did, however, report cases in humans and birds, including Lake County, with two human cases, and Napa County, with no human cases.

Lyme Disease

Lyme disease is caused by a spirochete (a corkscrew-shaped bacteria) called Borrelia burgdorferi and is transmitted by the Western black-legged tick. Lyme disease was first described in North America in the 1970s in Lyme, Connecticut, the town for which it was then named. Though the tick has been reported from 56 of the 58 counties in California, the highest incidence of disease occurs in the northwest coastal counties and northern Sierra Nevada counties with western-facing slopes. This includes Sonoma County, which had 86 confirmed cases between 2010 and 2019. Ticks prefer cool, moist areas and can be found in wild grasses and low vegetation in both urban and rural areas.

10.9.5 Location

By its nature, the effects of epidemics and pandemics are geographically pervasive and difficult—if not impossible—to isolate at a jurisdictional level. This particularly the case with a community as small as Cloverdale. There are, however, segments of the population that may be more vulnerable to certain types of disease. For instance, COVID-19 affects older adults and people with certain underlying medical conditions more severely, so places where such residents live are at greater risk.

10.9.6 Frequency/Probability

According to the CDC, "Pandemic influenza is not a theoretical threat; rather, it is a recurring threat." Because of their propensity to change, their ability to spread easily among people, and their routes of transmission, the frequency of severe influenza outbreaks is impossible to predict. While, historically, major health pandemics have occurred infrequently, they remain probable.

10.9.7 Severity / Extent

While inevitable, the severity and extent of an epidemic, pandemic, or vector-borne disease outbreak cannot be predicted precisely. Their potential effects will depend on their virulence, the speed at which they spread, the availability and efficacy of vaccines, antivirals, and other treatments, and the effectiveness of medical and non-medical containment measures.

10.9.8 Warning Time

As with the severity and extent of their effects, the warning time associated with any particular epidemic, pandemic, or vector-borne disease outbreak will depend on their virulence, the speed at which they spread, the availability and efficacy of vaccines, antivirals, and other treatments, and the effectiveness of medical and non-medical containment measures. By definition, fast-spreading disease will provide less warning and the effectiveness of interventions will, in turn, affect speed of spread.

10.9.9 Secondary Hazards

As demonstrated historically, in addition to causing serious illness and death among people of all age groups, health pandemics have the potential to have major impacts on society. These societal impacts include significant economic disruption that can occur due to death, loss of employee work time, closure of public facilities like schools and government offices, and costs of treating or preventing the spread of disease.

10.9.10 Vulnerability Assessment

The specific vulnerability of Cloverdale to epidemics, pandemics, or vector-borne disease outbreaks is difficult to assess. Vulnerability of the city's residents will depend on the virulence of the virus or disease, the speed at which it spreads, the availability of vaccines, antivirals, or other medicine, and the effectiveness of medical and non-medical containment measures. Depending on the nature of the virus or disease, some residents of Cloverdale will be more vulnerable than others. For instance, COVID-19 affects older adults and people with certain underlying medical conditions more severely. Cloverdale's vulnerability will also depend on its general preparedness and the preparedness of its residents, both of which have been enhanced by the City's collaboration with Sonoma County and key stakeholders (e.g., through the Resilient Cloverdale program).

Epidemics, pandemics, or vector-borne disease outbreaks are not expected to have direct effects on property or critical infrastructure and facilities.

10.10 WILDFIRE

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 2018 California State Hazard Mitigation Plan provides the following definition of wildfires:

> *any free-burning vegetative fire that initiates from an unplanned ignition, whether natural (e.g., lightning) or human-caused (e.g., powerlines, mechanical equipment, escaped prescribed fires), where the management objective is full suppression.* (Cal OES, 2018, p. 507)

Wildfires are costly, putting lives and property at risk and compromising rivers and watersheds, open space, timber, range, recreational opportunities, wildlife habitats, endangered species, historic and cultural assets, scenic assets, and local economies. They can also increase vulnerability to flooding due to the destruction of forest and ground cover within watersheds. The potential for significant damage to life and property increases in areas where development is adjacent to densely vegetated areas, known as wildland urban interface (WUI) areas.

While some fires are allowed to burn naturally in order to maintain or restore the health of forest lands, out of control wildfires need to be prevented through cooperative, community, and land management planning.

10.10.1 Plans, Policies, and Regulatory Environment

Wildfire Protection Responsibility in California

Local, state, tribal, and federal organizations all have legal and financial responsibility for wildfire protection. 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 fire protection. To address wildfire jurisdiction responsibilities, in 1981 the California State Legislature outlined various wildfire responsibilities, described below, in Cal. Pub. Res. Code § 4291.5 and Cal. Health & Safety Code § 13108.5:

- **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 jurisdiction 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 the responsibility of the relevant local government agency, not the federal land management agency.
- **State Responsibility Areas (SRAs):** SRAs are lands in California where the California Department of Forestry and Fire Protection (CAL FIRE) has legal and financial responsibility for wildfire protection. CAL FIRE administers fire hazard classifications and establishes development and building standard regulations in these areas. SRAs are defined as lands that:
  - are in the unincorporated county areas,
  - are not federally-owned,
  - have wildland vegetation cover rather than agricultural or ornamental plants,
  - have row crops or seasonal crops, or
  - have watershed, range, or forage values.

  - CAL FIRE adopts SRA boundaries and updates them every 5 years. Where SRAs contain structures or development, the relevant local government agencies have fire protection responsibility for those improvements.

- **Local Responsibility Areas (LRAs):** LRAs include land in cities, cultivated agriculture lands, unincorporated non-flammable areas, and lands that do not meet the criteria for SRA or FRA. LRA fire protection is typically provided by city or county fire departments, fire protection districts, or by CAL FIRE under contract to local governments. LRAs may include areas of flammable vegetation and WUI.

The area within the Cloverdale city limits is classified as an LRA, as are the areas along the Russian River east of the city limits. All of the area immediately to the west and southwest of the city limits falls into the CAL FIRE SRA.

Fire Protection Services

The City of Cloverdale relies on the Cloverdale Fire Protection District (CFPD) to provide fire protection services within the LRA. CFPD has responsibility for a 76-square mile area that includes incorporated Cloverdale and the immediate surrounding unincorporated areas, as well as a much larger area that extends to Sonoma County's northern border with Mendocino County. The District employs 4 full-time fire personnel and 28 volunteer firefighters who provide first responder, fire, and medical services to a service area population of approximately 11,500. It is directed by a five-member Board of Directors that is autonomous of the City of Cloverdale and Sonoma County. In August 2021, the District initiated the preparation of a Community Wildfire Protection Plan (CWPP) that will include a strategy to reduce fire hazard and risk within Cloverdale's WUI areas. The goal of the project is to "help ensure the protection of economic and ecological values and resources (assets) within CFPD's jurisdiction" while fostering "collaboration to develop a more fire resilient community." The project will include a parcel-specific hazard assessment.

CAL FIRE's Sonoma-Lake-Napa Unit (LNU) covers the unincorporated SRA in the larger Cloverdale area from a station located at 1001 South Cloverdale Boulevard in Cloverdale. In July 2020, the CAL FIRE adopted the LNU Strategic Fire Plan (Fire Plan), which outlines its strategy for fire protection and wildfire risk reduction within Sonoma, Lake, Napa, Colusa, Solano, and Yolo counties. The Fire Plan's goals strive to increase firefighter and citizen safety, reduce property losses and firefighting costs, and enhance ecosystem health. An overarching objective of build resilience and resistance to damaging wildfire, while also recognizing fire's beneficial aspects to forestry and environment practices. The Fire Plan also references CAL FIRE's automatic aid and Mutual Threat Zone (MTZ) agreement with CFPD, as well as a dispatching agreement with CFPD.

Water Supply for Fire Protection

The City's Urban Water Management Plan (2021) includes an evaluation of water supply to meet fire flow requirements. It concludes that there is sufficient capacity to address such requirements, but refers to the City's most recent Water Master Plan, which includes a project to increase storage capacity to meet fire flow capacity and additional demands when the area to the south of the current City limits is developed.

Fire Hazard Severity Zones

CAL FIRE maintains fire hazard severity zone (FHSZ) data and maps for all of California. There are three classes of fire hazard severity ratings within FHSZs: Moderate, High, and Very High. Fire hazard severity considers vegetation, topography, and weather (temperature, humidity, and wind), and represents the likelihood of an area burning over a 30- to 50-year time period.

The California Government Code (§51177 and §51178) defines "Very High Fire Hazard Severity Zones" (VHFHSZs) within LRAs to mean areas outside of SRAs designated by the CAL FIRE Director based on consistent statewide criteria and the severity of fire hazard in those areas. VHFHSZs are based on fuel loading, slope, fire weather, and other relevant factors including areas where winds have been identified by CAL FIRE as a major cause of wildfire spread.

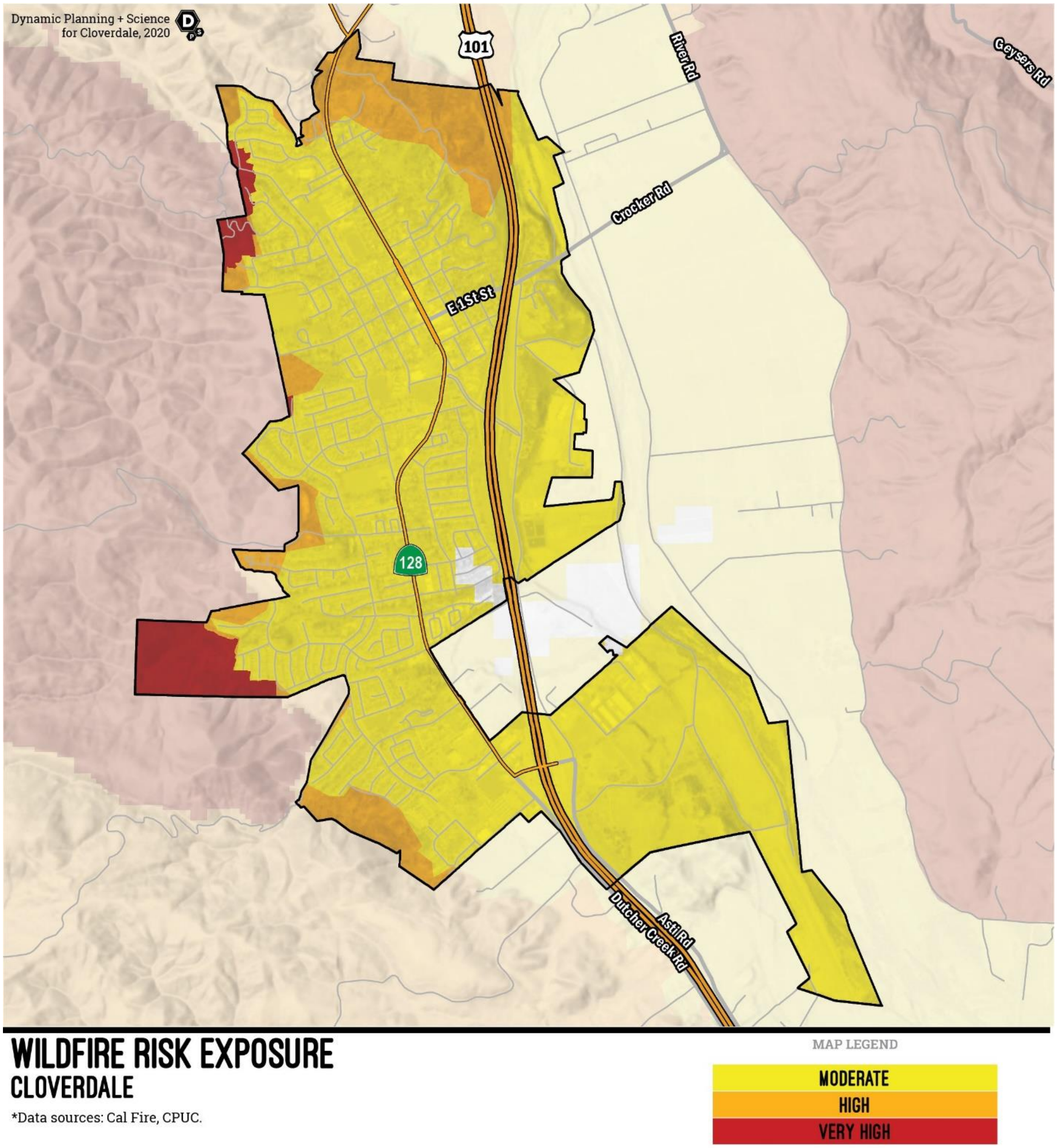
CAL FIRE has a list of incorporated cities or areas within the LRA for which it has made recommendations on VHFHSZs, including Cloverdale. Local agencies must designate VHFHSZs within their jurisdictions within 120 days of receiving recommendations from the Director (GC § 51179(a)). A local agency may, at its discretion, include areas within the jurisdiction of the local agency, not identified as VHFHSZs by the Director, as VHFHSZs following a finding supported by substantial evidence in the record that the requirements of Section 51182 are necessary for effective fire protection within the area (GC § 51179(b)).

Figure 10-23 shows the wildfire risk exposure ratings within the Cloverdale city limits. As it shows, the only VHFHSZ areas in the Cloverdale city limits are on the largely undeveloped western edge of the city; they are on the eastern margins of a much larger VHFHSZ area that extends well into the unincorporated hills west of Cloverdale. This margin is Cloverdale's most defined WUI. Most of the rest of the city is classified as "Moderate," except for a few spots on the western edge of the city and in the Vista View area classified as "High." Notwithstanding the fact that very little land in the city is classified as within a VHFHSZ, almost any area of the city is subject to wildfire encroachment. As the 2017 Tubbs Fire demonstrated in Santa Rosa, a combination of climatic conditions and vegetative fuel can cause fire to spread rapidly from wildland to urban areas. Thus, while the developed areas of Cloverdale that are adjacent to undeveloped wildland areas (i.e., the WUI) may be the most vulnerable to fires, they are not the only vulnerable areas. The hilly areas to the west of Cloverdale, outside of the city limits, are generally characterized by steep slopes, difficult fire suppression access, spotty water supply, and high fuel loads. These unincorporated areas contain the major wildland fire hazard risks for residential structures and other development.

The Cloverdale General Plan designates the area's highest fire hazard areas as "Conservation (CF)," including adjacent unincorporated areas to the west of the city limits. The CF designation is "intended to manage and preserve biological, visual, and agricultural resources," with very limited housing permitted (one unit per 160 acres). The General Plan, thus, discourages extension of the city's WUI into the heavily vegetated hillsides to the west of town. Furthermore, through previous development agreements, the City of Cloverdale has acquired and controls a substantial amount of land on the western edge of the city. The City has managed this land in accordance with best practices for wildland fire management practices. Given Cloverdale's relatively small size, its modest capacity for growth, and the commitments made through its General Plan to limit development in high-risk areas, future development within the city limits is not expected to add to the city's exposure to wildfire. Furthermore, the City will continue to collaborate with Sonoma County to ensure that future development in the unincorporated areas surrounding Cloverdale does not exacerbate vulnerability to wildfire, either for the unincorporated areas or areas within the city limits.

A comparison of Figure 10-2, Critical Facilities, with Figure 10-23 shows that there are no critical facilities or lifelines within VHFHZs in the city limits. The vulnerability analysis in Section 10.10.7 of this chapter includes further details about exposure of critical and essential facilities to wildfire risk.

FIGURE 10-23: WILDFIRE RISK



10.10.2 Past Events

Sonoma County has a long history of wildfires, particularly in areas that CAL FIRE has defined as “historic wildland fire corridors.” This includes the Guerneville/Cazadero area, which experienced fires in 1923, 1951, and 1978; the Geysers area, which has experienced multiple fires over the years; and the 1964 Hanley fire area, northeast of Santa Rosa. Another area with a repetitive fire loss history is Sonoma Valley where the Cavedale fires of 1925 and 1996 caused significant property damage. While many of these fires were large and caused considerable damage, the frequency and severity of fires in the county escalated in 2017. Between 2017 and 2020, several of the most consequential fires in Sonoma County history occurred (see following descriptions).

- **Pocket Fire (October 2017):** The Pocket fire, which began in the early morning on October 9, 2017, and burned approximately 17,500 acres. The fire broke out in a sparsely populated area near Geyserville, so structural damage was limited, and there were no fatalities. According to data released by Cal Fire, out of the close to 100 structures within the perimeter, 6 were destroyed and 2 were left damaged.
- **Tubbs Fire (October 2017):** The Tubbs Fire started near Tubbs Lane in Calistoga (Napa County) on the evening of October 8, 2017. It spread to the southwest into Sonoma County, eventually reaching the northeast neighborhoods of Santa Rosa. The fire burned approximately 37,000 acres, destroying over 5,600 structures and causing over 20 deaths. Half of the destroyed structures were homes in Santa Rosa. By the time it was contained, the Tubbs Fire had become the most destructive wildfire in California history.
- **Nuns Fire (October 2017):** The Nuns Fire, which started on October 11, 2017, in Glen Ellen, merged with the Partrick, Presley, and Oakmont fires to cover over 56,500 acres. It affected both Napa and Sonoma counties, with damage in the latter concentrated in areas to the east and north of the city of Sonoma. It destroyed over 1,500 structures and resulted in two deaths.
- **Kincade Fire (October 2019):** The Kincade Fire started when a 230,000 volt transmission line failed during an extreme wind event in the Geysers area, northeast of Geyserville, on October 23, 2019. The fire burned 77,750 acres before being fully contained on November 6, 2019. It threatened over 90,000 structures, prompting evacuations throughout Sonoma County and parts of Lake County. The fire was the largest of the 2019 California wildfire season, and also the largest wildfire recorded in Sonoma County at the time before being surpassed by the LNU Lightning Complex fires in 2020.
- **LNU Lightning Complex (August 2020):** The LNU Lightning Complex covered several, lightning-sparked wildfires that burned across Lake, Napa, Sonoma, Solano, and Yolo counties from August 17, 3030 to October 2, 2020. The total burn area reached 363,200 acres, making it the fourth largest wildfire in California history, although the acreage was not all contiguous. The largest single component was the Hennessey Fire in Napa, Lake, Solano, Yolo, and Colusa counties, which covered 192,000 acres. The largest part of the complex in Sonoma County was the Walbridge fire, which burned over 55,000 acres in the hills southwest of Cloverdale, beyond Lake Sonoma. Overall, the LNU complex destroyed 1,491 structures and damaged another 232, few of which were in Sonoma County. In all, six people were killed and another five injured, none in Sonoma County.
- **Glass Fire (September 2020):** The Glass Fire was a wildfire in Northern California, that started on September 27, 2020, near Glass Mountain Road in Deer Park, Napa County, before spreading into Sonoma County east of Santa Rosa. from an undetermined cause and was active for 23 days. Initially a single 20-acre brush fire, it rapidly grew and merged with other fires, expanding to approximately 67,500 acres. The fire destroyed over 1,500 structures, including almost 500 homes, about evenly

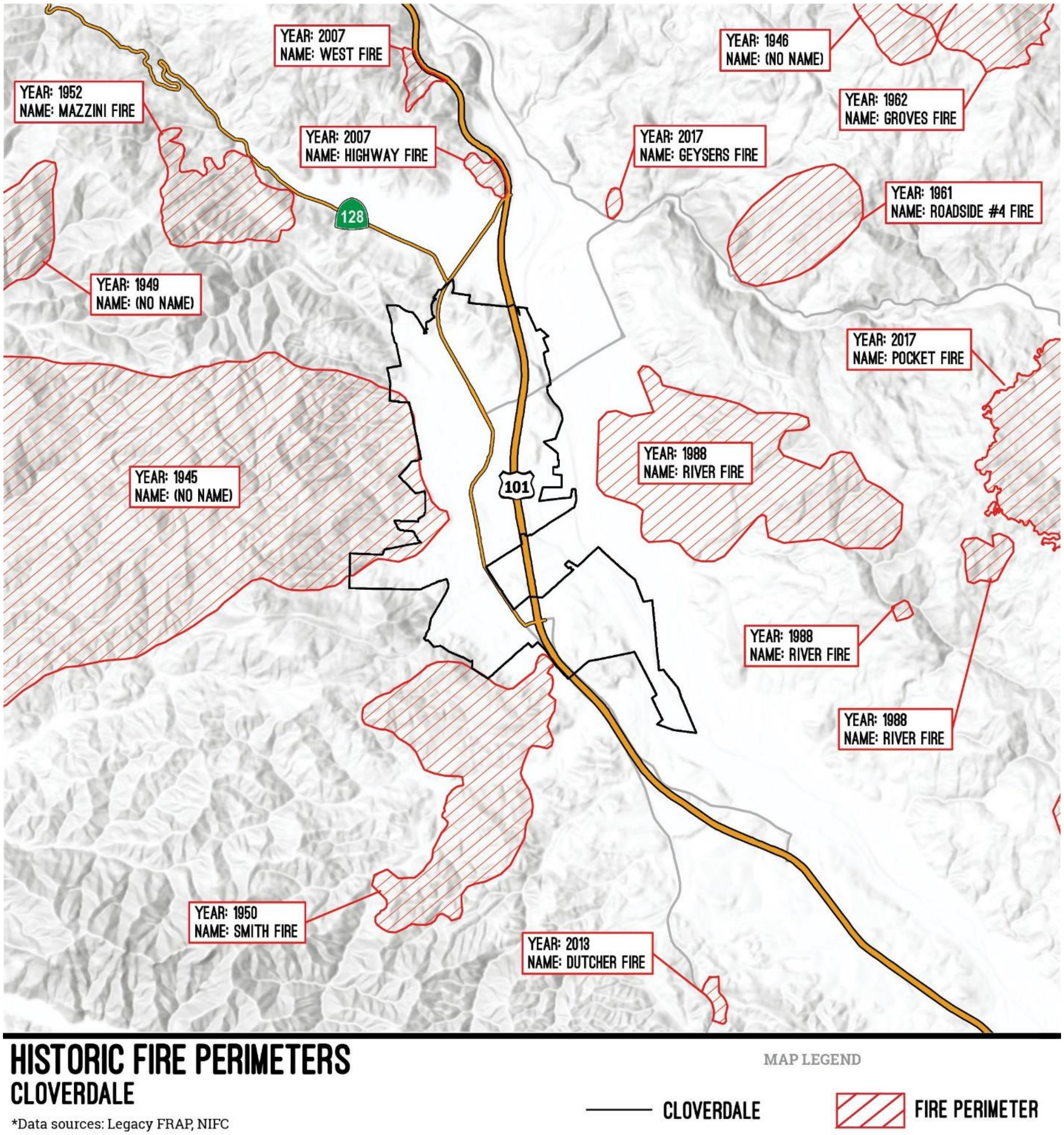
distributed between Napa and Sonoma counties. In addition, almost 300 structures were damaged, including 73 homes in Sonoma County and 64 homes in Napa County. More than 36,000 people were evacuated from their homes, but there were no fatalities.

While none these fires directly affected Cloverdale, the perimeters of the Nuns Fire and the Kincade Fire both came within five miles of the city to the east, across the Russian River. Table 10-28 lists the wildfires that have encroached into the immediate Cloverdale area between 1945 and 2017 and Figure 10-24 shows the perimeters of these fires. As Figure 10-24 shows, only one of these fires, an unnamed fire in 1945, entered Cloverdale's 2020 city limits, while the 1950 Smith Fire and 1988 River Fire, came close. There is no known record of the 1945 fire, which reportedly covered over 4,500 acres. According to an August 3, 1950, account in the Cloverdale Reveille, the Smith Fire was started "by sparks from the waste burner at Ray Smith's lumber mill" and "a stiff breeze spread the blaze rapidly up the canyon and along the crest of the mountain." The account further indicates that "1100 acres were burned over, several orchards destroyed and 102 sheep burned or shot to death." In addition to the loss of sheep, several structures on the Vern Richards ranch were destroyed, although "fire fighters saved the main building." The 1988 River Fire started on August 24, 1988, when a spark from welding equipment ignited a barn wall in the 28000 block of River Road, less than a mile from the Cloverdale city limits east of the Russian River. The flames from the structure expanded up a dry hillside at the rear of the property, covering over 1,800 by the time it was contained three days later. According to an account in the Reveille, "a total of 800 firefighters, 51 fire engines, 32 fire hand crews, 3 helicopters, and 7 airtankers fought the 1,833-acre fire." The Citrus Fairgrounds served as a staging area for the firefighters, who came from as far away as Santa Cruz, while the Citrus Fair Board Room was turned into a command center. The River Fire threatened homes in the Palomino Lakes subdivision southeast of Cloverdale and other nearby properties, but the only reported structure damage was to the barn where the fire originated. Note that CAL FIRE's records show the fire covering just over 1,200 acres, as opposed to the over 1,800 acres reported at the time of the fire.

TABLE 10-28: WILDFIRES IN THE CLOVERDALE AREA

Year	Fire Name	Acres Burned	Cause
1945	No Name	4,568	Unknown / Unidentified
1946	No Name	761	Unknown / Unidentified
1949	No Name	533	Unknown / Unidentified
1950	Smith	945	Lumber mill waste burner / wind
1952	Mazzini/Sink Winery	334	Grass, brush, woodland
1961	Roadside #4	368	Unknown / Unidentified
1962	Groves	299	Unknown / Unidentified
1988	River	1,205	Welder's spark in barn
2007	Highway	35	Equipment Use
2007	West	37	Vehicle
2013	Dutcher	21	Miscellaneous
2017	Geysers	13	Unknown / Unidentified
2017	Pocket	17,359	Unknown / Unidentified
Sources: CAL FIRE Fire and Resource Assessment Program (FRAP); National Interagency Fire Center (NIFC)			

FIGURE 10-24: CLOVERDALE AREA FIRE PERIMETERS 1945 TO 2020



10.10.3 Frequency / Probability of Future Occurrences

The probability of fires occurring is typically determined by a variety of variables, including the season, the presence of fuels (e.g., vegetation, structures), topography, and the presence of barriers to fire spread (e.g., ridges, rocky slopes, wide drainages, roads, other fuel breaks). Historically, most of the major wildfires in Sonoma County have taken place during the summer or fall, but changes in climatic conditions and drought cycles will likely extend the "fire season" throughout the year.

In Cloverdale, fire risk stands to grow as more people build in WUI areas or if these areas go without appropriate maintenance (e.g., fuel management), which increases fuel loads and the risk of human-caused fires. Fuel is generally classified by type and volume. Sources are diverse and include everything from dead tree needles and leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Structures and other combustibles associated with human occupancy may also be fuel sources. The type of prevalent fuel directly influences the behavior of wildfire. Light fuels such as grasses burn quickly and serve as a catalyst for fire spread. The volume of available fuel is described in terms of “Fuel Loading.” Certain areas in and surrounding Cloverdale are extremely vulnerable to fires from dense grassy vegetation and high fuel loads combined and hilly topography, which increases susceptibility to wildfire spread. Fire intensities and rates of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The natural arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes.

10.10.4 Severity and Extent

The hilly areas to the west of Cloverdale, which are generally characterized by steep slopes, difficult fire suppression access, spotty water supply, and high fuel loads, contain the major wildland fire hazard risks for residential structures and other development. To help better refine areas of wildfire concern, CAL FIRE establishes and maps Fire Hazard Severity Zones (FHSZ), or areas of significant fire hazards based on factors such as fuel, weather, terrain, and the number of days of moderate, high and extreme fire hazard. These zones define the application of various mitigation strategies to reduce risk associated with wildfires. The FHSZ model accounts for frequency of fire weather, ignition patterns, expected rate-of-spread, and past fire history. It also accounts for flying ember production based on the area of influence where embers are likely to land and cause ignitions. The FHSZ model is built from existing data and hazard constructs, and thus does not necessarily take into consideration significant land use and structural resiliency.

As discussed above and as depicted in Figure 10-23, ~~shows~~ the wildfire risk exposure ratings within the Cloverdale city limits~~. As it shows,~~ show that the only VHFHSZ areas in Cloverdale are on the western edge of the city, ~~; they are~~ on the eastern margins of a much larger VHFHSZ area that extends well into the unincorporated hills west of Cloverdale. This margin is Cloverdale’s most defined WUI. ~~Most of the rest of the city is classified as “Moderate,” except for a few spots on the western edge of the city and in the Vista View area classified as “High.” The fact that all of Cloverdale is designated as Moderate Fire Hazard or high underscores the point the entire city is subject to wildfire encroachment.~~

Note that the Tubbs Fire in 2017 provided a stark reminder that lands outside of any designated fire hazard severity zones are also vulnerable under extreme circumstances. Wind gusts of close to 60 miles per hour threw embers from more than a mile ahead of the burning wildland areas into the Coffey Park neighborhood and other heavily urbanized areas in Santa Rosa, destroying thousands of homes and causing extensive destruction and numerous deaths. These erratic winds were symptomatic of climate change-related changes in weather behavior.

10.10.5 Warning Time

Regardless of the circumstances around the ignition of a wildfire, warning time can be very short. Wildfires are often caused by humans, intentionally or accidentally, and there is no way to predict when a human-caused fire might break out. There are, however, seasonal determinants that increase the likelihood of fires. For instance, the Fourth of July can be a time of heightened concern and outreach around wildfires, since illegal fireworks can cause fires. Dry seasons and droughts greatly increase fire likelihood. Severe “fire weather” can be predicted, so special attention can be paid during weather events that may include lightning or high winds and low humidity. Strong northeast “Diablo winds” are a regular occurrence from September to November. Reliable National Weather Service lightning or high wind warnings (including “Red Flag” warnings) are available 24 to 72 hours prior to a significant event.

10.10.6 Secondary Hazards

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses by destroying structures and reducing harvestable timber and indirect economic losses in reduced tourism and commerce. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff, weakening soils, and causing slope failures. Major landslides can occur several years after a wildfire. Wildfires that burn hot and for long durations that can bake soils, especially those high in clay content, thus creating hydrophobic soils that repel water. When it rains in burned areas, more soil washes off the hills and into roads, ditches, and streams and increases flooding.

Wildfires also produce indirect impacts on ecosystem services and the built environment. For example, following the Tubbs fire, benzene—a toxic chemical—was released from melted plastic piping and entered Santa Rosa’s drinking water system. As a result, the city implemented a water advisory that lasted for 11 months until the contaminated portions of the system could be replaced.

Most of the fires affecting Sonoma County in recent years were caused by failure of electrical transmission and distribution facilities owned by Pacific Gas and Electric (PG&E), the area’s electricity provider. Consequently, in 2019 and 2020, energy utilities throughout the state, including PG&E, responded to the growing threat and severity of catastrophic wildfires by proactively shutting down their power distribution systems in anticipation of high wind events. These “public safety power shutoffs” or PSPS events affected communities across the state, including Sonoma County and the City of Cloverdale. In 2019, about 2.7 million people statewide experienced extended power outages during PSPS events. The impacts from PSPS events can acutely affect the broader community, particularly low-income individuals and persons experiencing food insecurity.

Smoke from wildfires also has adverse health impacts in areas far away from the actual fire, sometimes affecting areas over a hundred miles away. These effects are particularly pronounced on outdoor workers and individuals with underlying health conditions.

10.10.7 Vulnerability Assessment

This section describes vulnerabilities to wildfire in terms of population, property, and infrastructure. Wildfire-vulnerable population, parcel value, critical facilities and lifeline exposure numbers were generated by overlaying the inventory outlined in Section 10.3 with CAL FIRE High and Very HIgh Wildfire Hazard Severity Zones. Figure 10-25 shows a snapshot of wildfire vulnerability in Cloverdale.

Population

Wildfire is of greatest concern to populations residing in the high and very high fire hazard severity zones. Figure 10-25 and Table 10-29 indicate that 1,790 Cloverdale residents are estimated to be live in such areas. This estimate was generated by analyzing County assessor and parcel data that intersect with wildfire hazard areas identified by CAL FIRE. Using GIS, U.S. Census Bureau information was used to intersect wildfire hazards to develop an estimate of population by weighting the population within each census block with the percentage of hazard areas. As a practical matter, far fewer residents are likely to live in high and very high wildfire hazard areas. The more indicative level of population at risk is the number of parcels directly affected, as shown in Figure 10-25, which is only 143, and many of these parcels are undeveloped.

FIGURE 10-25: WILDFIRE RISK EXPOSURE

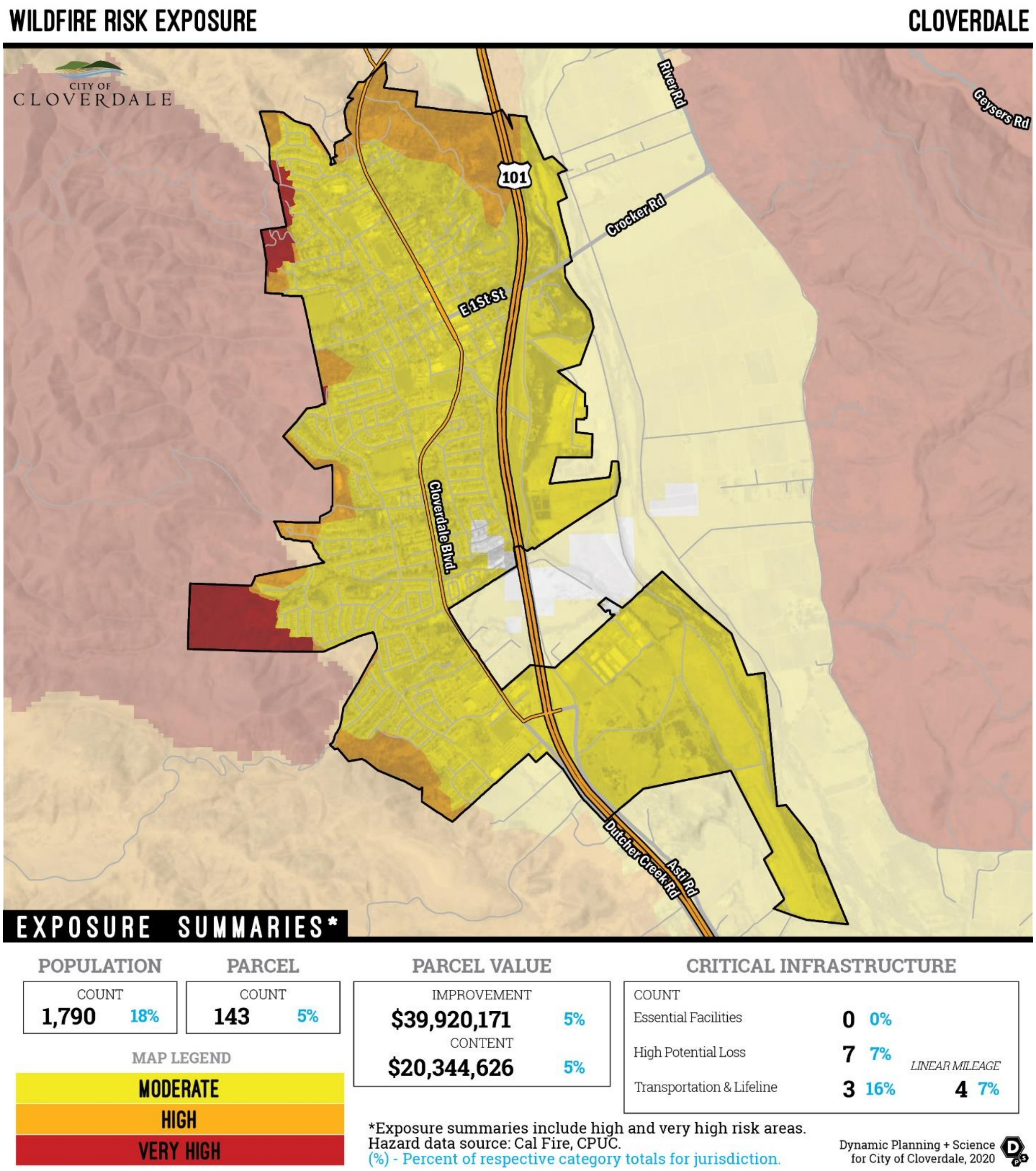


TABLE 10-29: POPULATION EXPOSURE TO WILDFIRE HAZARDS

Wildfire Severity Zone	Population Count	% of Total
Very High	550	5.7%
High	1,240	12.9%
Moderate	7,850	81.4%
Total	**9,640**	**100.0%**

In addition to posing a direct risk to those who live in high fire hazard areas, wildfires can have severe effects on those who exposed to smoke and air pollution resulting from remote fires. Smoke generated by wildfire contains visible and invisible emissions that contain particulate matter such as soot, tar, water vapor, and minerals; gases such as carbon monoxide, carbon dioxide, and nitrogen oxides; and toxins such as 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. Smoke and fire-related air pollution present a health hazard to all who are exposed, but especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility. First responders likewise are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Private Property

As Figure 10-25 and Table 10-30 indicate, 143 privately-owned properties in Cloverdale are located within high and very high fire hazard areas. This represents approximately 4.9 percent of the private parcels in the city. These at-risk properties account for a land value of approximately $39.9 million, with an associated content value estimated at $20.3 million, for a total of $60.2 million in property exposure (approximately 5.3 percent of the citywide value).

TABLE 10-30: PRIVATE PROPERTY EXPOSURE TO WILDFIRE HAZARDS

Fire Hazard Severity Zone	Parcel Count	% of Total	Market Value Exposure ($)	Content Value Exposure ($)	Total Exposure ($)	% of Total
Very High	43	1.5%	$11,170,900	$5,585,500	$16,756,400	1.5%
High	100	3.4%	$28,749,300	$14,759,200	$43,508,400	3.8%
Moderate	2,780	93.8%	$686,465,500	$395,659,600	$1,082,125,100	94.1%
Total	**2,923**	**98.6%**	**$726,385,700**	**$416,004,300**	**$1,142,389,900**	**99.3%**

Critical Facilities and Infrastructure

As Figure 10-22 indicates, no essential facilities are directly at risk from fire hazards, and ten high potential loss facilities or transportation and lifeline facilities are ~~at~~ located in high fire hazard areas~~risk~~, including three water tanks, a communications tower, and a healthcare center. No such facilities are located in very high fire hazard severity zones. As Figure 10-22 also shows, approximately four miles of linear lifelines are located in high ~~or very high~~ wildfire hazard areas, most of which are roadways serving those areas.

10.11 HAZARDOUS MATERIALS

A hazardous material is defined in Title 22 of the California Code of Regulations (CCR) as follows:

> A substance or combination or substances which, because of its quantity, concentration, or physical, chemical or infectious characteristics, may either (1) cause, or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported or disposed of otherwise managed" (CCR, Title 22 Section 66260.10).

10.11.1 Policies, Plans, and Regulatory Environment

The transportation, storage and disposal of hazardous materials are subject to a variety of Federal, State and local regulations. The Federal Hazardous Materials Transportation Act (49 USC Section 1801 et seq.) aims to ensure the safe transport of hazardous materials via water, rail, highway, air, or pipeline. Subtitle C addresses hazardous waste generation, storage, treatment, and disposal. Subtitle I requires monitoring and containment systems for underground storage tanks that hold hazardous materials.

The State Health and Safety Code (Chapter 6.5), regulates the transport, treatment, and disposal of hazardous wastes. Chapters 6.67 and 6.75 respectively deal with above ground and underground petroleum storage tanks, while Chapter 6.7 regulates underground storage of other hazardous substances. The California Department of Toxic Substances Control (DTSC) issues policies and regulations concerning hazardous materials. The County's Division of Environmental Health is the local enforcement agency for issuing permits and regulating hazardous materials operations.

In Sonoma County, the Hazardous Materials (Haz Mat) Division is responsible for the enforcement of the regulatory-based Hazardous Materials Business Plan Program, Hazardous Waste Program, Underground Tank Program, Accidental Release Program, and the sections of the Uniform Fire Code that addresses hazardous materials. The Haz Mat Division inspects businesses on a routine basis, often working in conjunction with the Environmental Health and Permit and Resource Management Departments. The Haz Mat Division also prepares the County's Hazardous Materials Area Plan.

10.11.2 Use, Storage, and Transportation of Hazardous Materials

Various commercial and industrial activities within the City and surrounding area use and/or store hazardous materials for various operations. Businesses that require the storage of hazardous materials must submit a Hazardous Materials Business Plan to the County's Permit Resource Management Department (Environmental Health Division), and the Sonoma County Department of Emergency Services. The most common hazardous materials used and stored by many businesses include new and used oils, gasoline, diesel fuel, propane, antifreeze, solvents, etc.

The transportation of hazardous materials is also an issue of concern. State Route 101, which runs along the east side of the city, and State Route 128, northwest of the city are non-restrictive transit routes for hazardous materials. The most common hazardous materials transported along Highway 101 tend to be petroleum products such as gasoline, diesel fuel, and liquefied petroleum gas (LPG), which are destined for various points north of Cloverdale, typically to destinations in Mendocino, Humboldt, and Del Norte counties. Other hazardous materials transported in significant amounts include formaldehyde, liquefied oxygen, sulfuric acid, carbon dioxide, lead acid batteries, and other acids and caustics.

Another potential source of hazardous materials release would be rupture of pipelines, with sewage and natural gas pipelines a primary concern. Rupture of these lines would contaminate adjacent soils and waters, particularly with bacteria and other organic substances. A major natural gas pipeline traverses northern Sonoma County from the San Francisco Bay Area and into central Mendocino County, with various distribution lines delivering natural gas to users along the route. Generally, responsibility for managing pipeline ruptures falls on the agency that owns and operates the line (Pacific Gas & Electric (PG&E)). Other agencies may, however, become involved if the efforts of the rupture become extensive.

10.11.3 Hazardous Waste and Substance Sites

DTSC maintains a Hazardous Waste and Substance Sites List, also known as the "Cortese List." The Cortese List records contaminated or potentially contaminated hazardous waste sites, leaking underground storage tank sites, and sanitary landfills that have evidence of groundwater contamination. As of October 2020, there were no Cortese List sites in the Cloverdale city limits, but DTSC did identify two sites of concern in the immediate Cloverdale area based on historic use and past or ongoing cleanup activity. These are the MGM Brakes site and the Masonite Corporation site, which are described below.

MGM Brakes

The MGM Brakes site covers approximately five acres at the southwest corner of the intersection of Santana Drive and South Cloverdale Boulevard. From 1962 until operations ceased in 1982, the MGM Brakes facility manufactured and cast aluminum brake components for large motor vehicles. The facility consisted of a casting plant building, seven above ground tanks, a cooling tower, and a storage shed. From 1965 until 1972, hydraulic fluids containing polychlorinated biphenyls ("PCBs") were used in the casting machines. These hydraulic fluids leaked from the casting machines in the normal course of plant operations and were then collected, together with water used to cool the dies between castings, in floor drains. Following gravity separation of oils and grease, the wastewater containing PCBs was discharged, via a drain line, to the ground adjacent to the casting plant. The use of hydraulic fluid containing PCBs was gradually discontinued in 1973, but wastewater containing ethylene glycol (the hydraulic fluid later used in the casting machines) continued to be discharged in the same manner until 1981. The practice of discharging wastewater onto the vacant fields surrounding (mostly to the south) of the casting plant building is believed to be the main cause of contamination at the site.

In August 1981, the California Regional Water Quality Control Board, North Coast Region 1 ("RWQCB") and the California Department of Fish and Game conducted a site inspection in response to a citizen complaint. During the inspection they noted the presence of oily soil. The soil was found to contain PCBs. The State ordered MGM Brakes to stop all discharge activity and to investigate the nature and extent of contamination. Sampling was conducted under State oversight from 1981 to 1983. PCB contamination was detected in surface water runoff, surface and subsurface soil, and inside the casting plant building.

The USEPA assumed lead agency responsibility for oversight of Site investigation and cleanup activities in 1983 when the Site was added to the National Priorities List ("NPL"). A Remedial Investigation and Feasibility Study under USEPA and State oversight were conducted from 1983 to 1988. In September 1988, USEPA issued a Record of Decision ("ROD") which selected excavation and off-Site disposal of soils with PCB concentration above 10 milligrams per kilogram ("mg/kg"), demolition of the casting plant and decontamination of PCB contaminated equipment and materials. In addition, PCBs in surface soil, defined as the uppermost 10 inches, could not exceed 1 mg/kg.

In 1986, volatile organic compounds ("VOCs") were detected in groundwater. For groundwater, the ROD included activities to locate the source of VOCs, installation of additional wells to evaluate the extent of VOC contamination and groundwater monitoring. The ROD provided for development and implementation of additional remedial measures, if warranted, to ensure that groundwater was restored to Maximum Contaminant Levels ("MCLs").

In 1992, the cast plant equipment was removed, and the casting building was demolished and disposed off-site. Soil excavation began in 1993. Twenty-seven well points were installed and connected to an extraction system to transfer groundwater to an on-site treatment plant. Concrete drainage channels were constructed, and the surface was graded to direct runoff into the channels, helping to mitigate erosion of the clean soil cover by stormwater flow. After completion of the soil remediation, surface runoff samples were collected for four years and the remedial goal was achieved. Groundwater was sampled on a semi-annual basis until October 2013 when concentration targets were met.

In December 2018, the U.S. Environmental Protection Agency published Final Close Out Report (FCOR) documenting that the criteria for site completion had been met as all remedial decision documents and response actions had been completed at the site. The FCOR concluded that no further Superfund response was needed to protect human health and the environment. Based on its review of the FCOR, DTSC concurred with the proposed deletion of the site from the National Priorities List.

Masonite Corporation Site

The former Masonite Wood Treatment Facility is located approximately 0.5 mile east of Highway 101, approximately 1,500 feet west of the Russian River. The site falls within the area proposed for a golf course as part of the Alexander Valley Resort Specific Plan. The treatment facility occupied approximately four acres and consisted of an operations building, chemical storage tanks, two pressure vessels or retorts, an unlined recycling pond, and wood storage areas. The facility operated from the late 1950s to 1975, treating wood with oil-based pentachlorophenol and water-based chromated copper arsenate. In 1976, the facility was dismantled.

In January 1988, the Masonite site was first identified as a site of concern. Groundwater and soil were contaminated with pentachlorophenal, arsenic, chromium, and copper. In September 1990, DTSC approved a Remedial Action Plan requiring excavation and off-site disposal of contaminated soil, as well as groundwater monitoring. Approximately 37,803 tons of material (mainly soil, including 695 tons of building debris) contaminated with chromium, pentachlorophenal, arsenic, and copper were removed from the site. Soil removal to residential cleanup levels was completed, and in 1991 the site was "Certified" as completed. In June 1992, one year after monitoring the site, no levels of contamination were found on the site.

In October 2002, International Paper Company (as the successor in interest to Masonite Corporation) submitted a report of waste discharge to conduct treatment of soil and groundwater contaminated with pentachlorophenol and arsenic at the former Masonite Wood Treatment Facility. The areas treated were adjacent to the rail line and in the area of a groundwater monitoring well, where excavation of contaminated soils could not be conducted. In March 2003, the North Coast Regional Water Board adopted orders declaring that the treatment project and associated groundwater monitoring had been completed and that no further treatment was necessary. International Paper continues to monitor groundwater on a semi-annual basis for the presence of chemicals from the wood treatment operations. As of October 2018, the site did not qualify for closure because contaminant levels in some monitoring wells exceeded required thresholds.

10.11.4 Underground Storage Tanks

The Sonoma County Local Oversight Program (LOP) oversees the investigation and cleanup of fuel releases from underground storage tanks in all areas of the county with the exceptions of Santa Rosa and Healdsburg. Sites are entered into the LOP when a release from the underground storage tank is ruptured. This typically happens when an underground tank is removed and signs of release are either obvious or else reported in laboratory sample results. Releases are also reported when contamination is found while repairing fuel delivery systems or when environmental site assessments are done at the time of property sales. The LOP is authorized to regulate underground storage tank releases by the State Water Control Board (SWRCB).

Table 10-31 contains a list that has been compiled by the Sonoma County Local Oversight Program in cooperation with the SWRCB for Leaking Underground Storage Tanks (LUSTs). As the status field in the table suggests, of the 41 sites listed, only 3 are open, with cleanup for the other 38 having been completed. Table 10 28 lists the sites of underground fuel storage tanks within the study area.

TABLE 10-31: LEAKING UNDERGROUND STORAGE TANKS

Site Name	Address	Status
A & M Enterprises	590 Santana Dr	Completed - Case Closed
All Coast Forest Products	250 Asti Rd	Completed - Case Closed
Andersen Excavating	1175 Cloverdale Blvd S	Completed - Case Closed
Anderson Valley Equipment	28313 Highway 101	Completed - Case Closed
Boddy, Mildred	819 Cloverdale Boulevard, North	Completed - Case Closed
Caltrans	232 East St	Completed - Case Closed
Cash Oil (Former)	324 Cloverdale Blvd N	Completed - Case Closed
CDF - Cloverdale	28930 Redwood Hwy	Completed - Case Closed
City of Cloverdale ROW	132 Cloverdale Blvd, S	Open - Assessment & Interim Remedial Action
Cloverdale Ambulance Service	213 Main St N	Completed - Case Closed
Cloverdale Corporation Yd	700 Asti Rd	Completed - Case Closed
Cloverdale Disposal	222 East St	Completed - Case Closed
Cloverdale Fire/Police St	116 Broad St	Completed - Case Closed
Cloverdale High School	509 Cloverdale Blvd N	Completed - Case Closed
Cloverdale Land Partners II	200 Hot Springs Road	Completed - Case Closed
Cloverdale Mobil (Former)	101 Cloverdale Blvd N	Open - Eligible for Closure
Cloverdale Railroad Sta.	1 Railroad Ave	Completed - Case Closed
Cloverdale Redwood/Jake's (Former)	235 Cloverdale Blvd S	Completed - Case Closed
Dick's Union 76 (Former)	465 Cloverdale Blvd S	Completed - Case Closed
Exxon Station (Former)	330 Cloverdale Blvd S	Completed - Case Closed
Fast & Easy Mart	418 Cloverdale Blvd S	Completed - Case Closed
Gasco (Former)	337 Cloverdale Blvd S	Completed - Case Closed
Hamburger Ranch	31195 Redwood Highway, North	Completed - Case Closed
Jet Trucking	28181 Redwood Hwy	Completed - Case Closed
Louisiana Pacific/Kelly Gate	27821 Dutcher Creek Road	Completed - Case Closed
Louisiana Pacific/Cloverdale	26800 Asti Road	Completed - Case Closed
Matovich Property	850 Cloverdale Blvd N	Completed - Case Closed
McNeill, Barbara	26972 Asti Road	Completed - Case Closed
Old Feed Store (Formerly)	228 East St S	Completed - Case Closed
Pellegrini Service Station (Former)	206 Cloverdale Blvd S	Completed - Case Closed
Redwood Empire, Inc.	31401 Mccray Rd	Completed - Case Closed
Renner Cloverdale	28181 Old Redwood Highway	Open - Site Assessment
Reuser, Inc.	370 Santana Drive	Completed - Case Closed
Richardson Engineering	524 Santana Dr	Completed - Case Closed
Seghesio Property River Road	29533 River Road	Completed - Case Closed
Shelton Paving Company	33355 River Road	Completed - Case Closed
Texaco (Former)	690 Cloverdale Blvd S	Completed - Case Closed
Torvick Chevrolet	27000 Asti Rd	Completed - Case Closed
Vimark Vineyards	28901 River Rd	Completed - Case Closed
Washington Elementary School (2)	129 Washington St S	Completed - Case Closed
Source: Sonoma County Local Oversight Program/Env. Health Div.		

TABLE 10-32: SITES OF UNDERGROUND FUEL STORAGE TANKS

Site Name	Address
Cloverdale Chevron	1165 S. Cloverdale Blvd.
Cloverdale Patriot Gasoline	690 S. Cloverdale Blvd.
Cloverdale Sinclair	1194 S. Cloverdale Blvd.
Fast N Easy Mart	418 S. Cloverdale Blvd.
Golden Gate Petroleum (former Cash Oil)	324 Cloverdale Blvd.
L&M Renner-Jet	1313 S. Cloverdale Blvd.
Quick Stop Market #141	601 N. Cloverdale Blvd
Source: Sonoma County Local Oversight Program/Env. Health Div.	

10.12 TRANSPORTATION SAFETY

10.12.1 Access and Emergency Evacuation

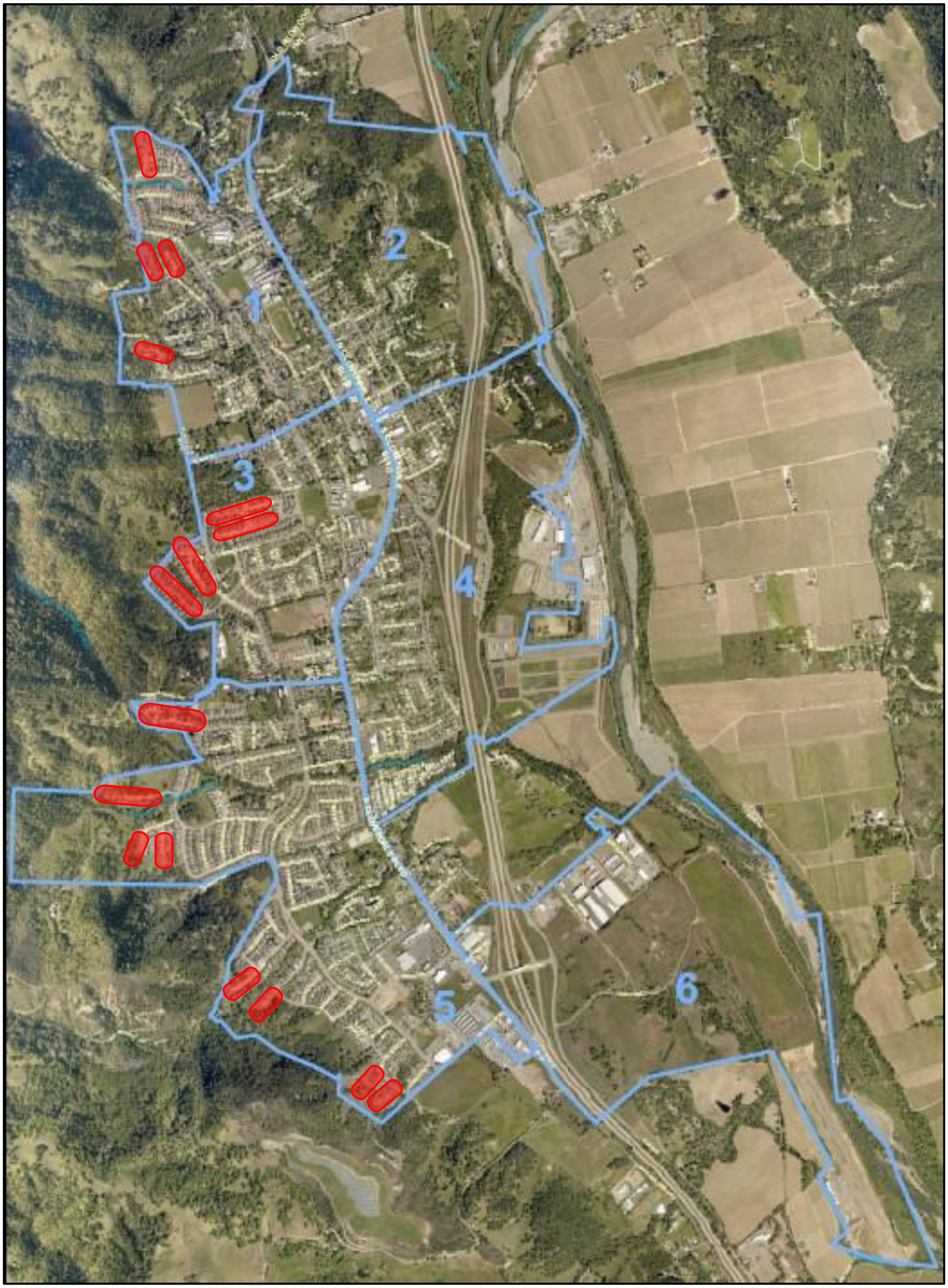
The ability to sustain ground transportation is an important component of emergency response. The Sonoma County Operational Area Emergency Operations Plan identifies Highways 101 and 128 as major highway routes as critical to emergency operations. Because of its high traffic volumes, Highway 101 carries traffic with the greatest potential of hazard.

In October 2019, the Governor signed Assembly Bill 747, which requires the safety element to be reviewed and updated as necessary to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios. In 2021, through a collaborative effort lead by Sonoma County, the City of Cloverdale established an emergency evacuation zone structure and identified evacuation routes for each of the zones. Table 10-33 describes the zones and their designated primary and secondary evacuation routes and Figure 10-26 shows the zone structure.

TABLE 10-33: EVACUATION ZONES AND ROUTES

Zone	**Boundaries** North-South (N-S) and East-West (E-W)	Primary Route	Secondary Route
1	N-S: City limits to W 2nd St E-W: Cloverdale Blvd to city limits	North Street to Cloverdale Blvd to Hwy 101	West Third St to Cloverdale Blvd To Hwy 101
2	N-S: City limits to E 1st St E-W: Cloverdale Blvd to city limits	East Fourth St to Cloverdale Blvd to Hwy 101	East First St to Cloverdale Blvd to Hwy 101
3	N-S: W 2nd St to Cherry Creek Rd E-W: City limits to Cloverdale Blvd	Healdsburg Ave to Cloverdale Blvd to Citrus Fair to Hwy 101	West First St to Cloverdale Blvd to Citrus Fair to Hwy 101
4	N-S: E 1st St to Lile Ln E-W: City limits to Cloverdale Blvd	Tarman Dr to Cloverdale Blvd to Citrus Fair to Hwy 101	Hillview Dr to Cloverdale Blvd to Citrus Fair to Hwy 101
5	N-S: Cherry Creek Rd to Sandholm Rd E-W: Cloverdale Blvd to city limits	Del Webb Dr to Cloverdale Blvd to Hwy 101	Elbridge Ave to Cloverdale Blvd to Hwy 101 or Treadway Dr to Cloverdale Blvd to Hwy 101
6	N-S: Buck Rd to city limits E-W: City limits to Cloverdale Blvd	Teresa Dr to Cloverdale Blvd to Hwy 101 or Dutcher Creek	Asti Rd Frontage Rd to Hwy 101 or Asti Rd South
*If Hwy 101 is not passable, Hwy 128, Dutcher Creek Road, and Asti Road will be alternates exits			

FIGURE 10-26: EVACUATION ZONES AND STREETS WITH LIMITED ACCESS



While Table 10-33 identifies primary and secondary evacuation routes for each of the evacuation zones, the North Jefferson neighborhood in Zone 1, the Vintage Meadows neighborhood in Zone 3, and the Clover Springs and Furber Ranch neighborhoods in Zone 5 all have streets that provide only one direction of egress. These streets, most of which are cul-de-sacs, are depicted in Figure 10-26. The most significant concern in these areas would be evacuation in the case of wildfires originating in the high wildfire risk areas in the unincorporated hillsides to the west of the city; the neighborhoods themselves are classified as moderate risk. While the eastward egress would allow evacuation away from the most likely fire areas, these neighborhoods would need to be considered for early evacuation under circumstances that might result in wildfire encroachment.

Air transportation can also be vital by providing sole or supplemental capabilities or improving response time to the scene of an emergency event or staging area. Aircraft can be used to assist with evacuations, supply transport and medical assistance, receive assistance from other regions, and serve other functions. The City's airport is located southeast of the City off of Asti Road, which could be utilized in case of emergency.

10.12.2 Airport Safety

The City of Cloverdale owns and operates the Cloverdale Municipal Airport, which is located in the southeastern-most area of the city. In December 2005, the City prepared and adopted a master plan for the airport (Cloverdale Municipal Airport Master Plan 2025). That plan was updated and revised in December 2007. A major emphasis of the plan is safety, with a focus on land use compatibility. In addition to considering noise as a compatibility, the plan considers safety from two different perspectives: people who may live or work in the area around the airport and pilot/aircraft safety. The Airport Master Plan 2025 does not propose any major changes to the runway or airspace, so it would not negatively affect safety and off-airport land use. The plan does, however, recommend lengthening the runway from 3,146 feet to 3,160 feet (the Federal Aviation Administration (FAA) standard) and adding standardized runway safety areas at each end. Both of these measures would enhance safety for pilots and their passengers. The Master Plan does not anticipate increased land use incompatibilities in either the surrounding unincorporated area or within the city limits. To ensure this continues to be the case, the Master Plan recommends that no land in the very immediate airport vicinity be designated or zoned for incompatible uses such as residences, schools, and hospitals.

The City of Cloverdale does not have an airport land use commission (ALUC), which is the usual vehicle for reconciling the overlapping interests of government agencies regarding land use. The Sonoma County ALUC has, however, addressed safety concerns at the airport by identifying safety zones within the “Cloverdale Municipal Airport Referral Area” (see Figure 10-27). In doing so, the ALUC acknowledged that there is little existing land use incompatibility in the vicinity of the airport, noting that the airport environs consists primarily of agricultural and industrial uses, with future uses projected to be similar. The ALUC did, however, observe that planned visitor-serving commercial and recreation areas (i.e., Alexander Valley Resort) are expected to be developed near the airport, noting that any proposed development, particularly residential uses, would need to be examined very critically. It further noted that the rising terrain northeast of the airport is a concern because the hillside peaks at over 300 feet above the airport elevation, and aircraft typically fly over at altitudes of only 500 to 700 feet above the ground.

FIGURE 10-27: CLOVERDALE MUNICIPAL AIRPORT SAFETY ZONES