

7. Environmental Hazards

For both the natural and built environment, understanding the risks and avoidance measures associated with environmental hazards is a key component of coastal planning. This chapter addresses four types of hazards: shoreline, geologic/seismic, fluvial flooding, and fire. As a fundamental update of the 1996 Local Coastal Land Use Plan (LUP), this chapter also considers the effects of climate change on each of these types of hazards and on the Planning Area as a whole, in addition to the effects of hazards that have long been known to be present in Half Moon Bay. Each hazard type includes a description of existing conditions and a broad analysis of how such hazard affects Half Moon Bay, a description of the overarching land use planning framework to address or respond to such hazard, and a series of policies that new development must meet.

The purpose of this chapter is to ensure the safety of community members and property, as well as protection of the coastal environment and coastal resources, and to avoid, or mitigate if unavoidable, potential impacts from known natural and man-made environmental hazards. This includes hazards expected to be exacerbated by climate change, especially sea level rise. It is recognized that a particular site may be subject to one or more of these hazard types, and that such hazards interact with each other (for example, creek flooding, ocean waves, and bluff erosion interact at the mouths of creeks). Therefore, it is this LUP's intent to ensure that all hazards are evaluated through required studies and analysis, and that such analysis recognize and consider how such hazards interact and relate to development.

This chapter supports the General Plan's Safety Element, which incorporates this chapter by reference in whole, including its policies. In addition to the hazards addressed here, the Safety Element considers public safety and emergency preparedness as City-specific planning matters. Together, this Environmental Hazards chapter of the LUP and the General Plan Safety Element provide comprehensive policy for this broad subject area meeting and harmonizing California Coastal Act and State General Plan law requirements.

Land Use Plan Framework

The Coastal Act seeks to ensure that development in the coastal zone minimizes risks to life and property and avoids substantial changes to natural landforms. The California Coastal Commission also acknowledges that climate change is expected to continue shifting and intensifying weather patterns around the globe. Extreme weather conditions can increase the magnitude and frequency of coastal hazards, such as erosion, flooding, and vulnerability to wildland fires. The Coastal Act provides that new development shall minimize risk to life and property in areas of high geologic, flood, and fire hazard (Section 30253), and requires that public accessways be consistent with public safety (Section 30212). The Coastal Act also

requires that the implementation of public access policies consider topographic and geologic site characteristics (Section 30214).

New development in the coastal zone must assure stability and structural integrity and not cumulatively create or contribute significantly to erosion, geologic instability, or destruction of the site or other affected areas. Thus, the Coastal Act does not permit new development that would require shoreline protective devices that would substantially alter natural landforms along bluffs and cliffs (Section 30253). Hard shoreline protection is permitted when required to serve coastal-dependent uses or to protect existing structures and public beaches from erosion. However, such allowable hard protection must be designed to eliminate or mitigate impacts on the local shoreline sand supply (Section 30235).

The Coastal Act permits channelization, dams, and other substantial alterations of rivers and streams when necessary for water supply projects, flood control projects, or development primarily intended to improve fish and wildlife habitat. To be permitted, the flood control project must be necessary for public safety or to protect existing development where it has been determined that no other method is feasible, and any impacts to coastal resources such as sedimentation or erosion must be avoided or mitigated (Section 30236).

COASTAL ACT DEFINITIONS AND POLICIES

In the context of Coastal Act hazard policies, the definitions of several terms are essential for coastal resource protection and hazard avoidance. The Coastal Act, the California Code of Regulations, and the Coastal Commission's most recent guidance documents¹ provide definitions and context for these terms. These terms are included and adopted here for consistent application within the City of Half Moon Bay, including this Environmental Hazards chapter, as follows:

“Coastal-dependent development or use” means any development or use which requires a site on, or adjacent to, the sea to be able to function at all. (Coastal Act Section 30101)

“Development” is synonymous with “new development” and means on land, in or under water, the placement or erection of any solid material or structure; discharge or disposal of any dredged material or of any gaseous, liquid, solid, or thermal waste; grading, removing, dredging, mining, or extraction of any materials; change in the density or intensity of use of land, including, but not limited to, subdivision pursuant to the Subdivision Map Act (commencing with Section 66410 of the Government Code), and any other division of land, including lot splits, except where the land division is brought about in connection with the purchase of such land by a public agency for public recreational use; change in the intensity of use of water, or of access thereto; construction, reconstruction, demolition, or alteration of the size of any structure, including any facility of any private, public, or municipal utility; and the removal or harvesting of major vegetation other than for agricultural purposes, kelp harvesting, and timber operations which are in accordance with a timber harvesting plan submitted pursuant to the provisions of the Z'berg-Nejedly Forest Practice Act of 1973 (commencing with Section 4511). As used in this section, “structure” includes, but is not

¹ Including the 2015 Sea Level Rise Policy Guidance and 2018 Science Update, as may be amended from time to time.

limited to, any building, road, pipe, flume, conduit, siphon, aqueduct, telephone line, and electrical power transmission and distribution line. (Coastal Act Section 30106)

“Redevelopment” means alteration, demolition, or replacement of 50 percent or more of the major structural components of any structure, or an addition of 50 percent or more to the floor area of such structure. Incremental changes that cumulatively amount to replacement of 50 percent or more over time shall also be considered redevelopment. In all cases, policies that apply to “new development” shall also apply to “redevelopment.” (California Code of Regulations Section 13252(b)² and California Coastal Commission 2015 Sea Level Rise Policy Guidance)

The following California Coastal Act policies are relevant to the avoidance of hazards and the preservation of public safety and are incorporated into this LUP. The Coastal Act also contains several policies addressing the need to protect public safety and consider topographic and geologic site characteristics with respect to providing public access and recreation opportunities (Sections 30212 and 30214), which are incorporated and further discussed in the Coastal Access and Recreation Chapter of this LUP.

Article 4: Marine Environment

Section 30235 Construction altering natural shoreline

Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fishkills should be phased out or upgraded where feasible.

Section 30236 Water supply and flood control

Channelizations, dams, or other substantial alterations of rivers and streams shall incorporate the best mitigation measures feasible, and be limited to (1) necessary water supply projects, (2) flood control projects where no other method for protecting existing structures in the flood plain is feasible and where such protection is necessary for public safety or to protect existing development, or (3) developments where the primary function is the improvement of fish and wildlife habitat.

Article 6: Development

Section 30253 Minimization of adverse impacts

New development shall do all of the following:

- (a) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.
- (b) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any

² Section § 13252(b) of the California Code of Regulations states that “unless destroyed by natural disaster, the replacement of 50 percent or more of a single-family residence, seawall, revetment, bluff retaining wall, breakwater, groin or any other structure is not repair and maintenance under Coastal Act Section 30610(d) but instead constitutes a replacement structure requiring a Coastal Development Permit.”

- way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.
- (c) Be consistent with requirements imposed by an air pollution control district or the State Air Resources Board as to each particular development.
 - (d) Minimize energy consumption and vehicle miles traveled.
 - (e) Where appropriate, protect special communities and neighborhoods that, because of their unique characteristics, are popular visitor destination points for recreational uses.

HALF MOON BAY GENERAL PLAN

This chapter is incorporated into the General Plan Safety Element by reference to address hazards pursuant to State General Plan requirements. Government Code Section 65302(g) requires the Safety Element to consider the protection of the community from any unreasonable risks associated with the effects of seismic and other geologically-induced hazards, flooding, and fires. The Safety Element is required to include mapping of known seismic and other geologic hazards. Where applicable, it must also address evacuation routes, peak load water supply requirements, minimum road widths and clearances around structures. As of 2014, the Safety Element must consider requirements for planning within and near very high fire hazard severity zones, when they are present. The passage of Senate Bill 379 in 2015 further requires the Safety Element to address climate adaptation and resiliency strategies applicable to the Planning Area. These topics, maps, and other requirements are included in this Environmental Hazards chapter of the LUP and are intended to function as a significant portion of the Safety Element.

Hazards and Climate Change

The Planning Area is subject to environmental hazards such as flooding, fire, and geologic instability. These hazards can occur due to shoreline processes (such as wave action, sea level rise, and tsunamis) or inland processes (such as dam or impoundment failure, landslides, and sediment transport). Comprehensive understanding of and consideration for upstream and downstream effects of these hazards, particularly as impacted by new development, is essential for holistic land use planning and hazard avoidance.

Consideration of the effects of climate change is also crucial for present-day hazard planning. Extreme weather conditions are expected to intensify worldwide as global temperatures rise, disrupting past climate patterns. For coastal communities, it is foreseeable that the effects will be especially severe because extreme weather conditions – such as severe storms - exacerbate hazards already present in coastal settings, including shoreline hazards (e.g. coastal flooding, coastal bluff erosion) and inland hazards (e.g. fluvial flooding, stream erosion, and landslides). Extreme weather conditions also include more frequent and prolonged periods of drought, which, along with temperature increases raise the risk of wildland fires.

GREENHOUSE GASES

Certain gases in the atmosphere block heat that radiates from Earth toward space from escaping, creating a greenhouse effect. The primary contributors to this greenhouse effect,

known as greenhouse gases, are water vapor, carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons. Human activities, such as vehicle emissions, burning of fossil fuels, and industrial and agricultural operations, are directly contributing to increases in atmospheric greenhouse gas concentrations, causing accelerated warming of Earth's atmosphere. Consequently, major effects such as global temperature rise, land and sea ice melt, sea level rise, and ocean acidification have been well-documented.

The California Global Warming Solutions Act of 2006, also known as AB 32, established state-wide targets for reducing greenhouse gas emissions to 2000 levels by 2010, 1990 levels by 2020, and 80% below 1990 levels by 2050. SB 32 was passed by the Legislature in 2016 to facilitate this effort, requiring the California Air Resources Board (ARB) to ensure that statewide greenhouse gas emissions are reduced to 40% below 1990 levels by 2030. In coordination with AB 32 and SB 32, the ARB has developed regulations and market mechanisms to guide efforts and local governments have been developing and adopting Climate Action Plans to work towards meeting these targets. Emission reduction methods include use of renewable energies, combined-trip and non-motorized transportation, methane capture, and carbon sequestration.

STORMS AND FLOODING

State agencies indicate that with the emergence of climate change, storm events may be more frequent and of higher intensity. For example, the "100-year storm" event is occurring more frequently than once per century.³ The trend is expected to continue. Storm impacts can have serious cumulative impacts on erosion and sedimentation and can compound both geologic and hydrologic hazards, which are discussed in the following sections of this chapter.

Storm events have direct and immediate impacts on the city's natural and manmade storm drain system (creeks, streams, swales, channels, culverts, ditches, and relevant roadways and parklands). The separate sanitary sewer system can also be overwhelmed in the event of extreme precipitation. This can cause infiltration and inflow (I and I) whereby run-off and excess water in highly-saturated soils enter the sewer system through manholes and leaky pipes. Sewer overflows have wide-ranging detrimental impacts on water quality and biological resources and can result in service interruptions and violations of Regional Water Quality Control Board (RWQCB) regulations.

Localized flooding and wind damage commonly occur during extreme storm events. City, county and other public safety agencies and utilities are called upon to maintain services which are threatened by downed trees and flooded roadways. Severe storm events can impair access to transportation routes, communications, and emergency services. The Safety Element addresses emergency preparedness and public safety, which includes ensuring the City's readiness to proactively prepare for and respond to the effects of severe storm events.

³ Safeguarding California Plan: 2018 Update, California's Climate Adaptation Strategy, January 2018, Natural Resources Agency.

DROUGHT AND FIRES

In California's Mediterranean climate, summers are typically dry and the wet season occurs from October to April. In addition to this precipitation pattern, coastal climate tends to be temperate with summer fogs moderating summer heat. Climate change is already affecting this weather pattern with earlier spring blooms, more variable dry and rainy seasons, and generally higher temperatures.

Drought conditions throughout the western States are expected to be more frequent and long-lasting. Water conservation mandates are often enforced during periods of drought, including the five-year drought event that ended with the unusually wet 2017 winter. Even absent such acute drought conditions, local water supplies—including municipal water and private wells—must be conserved for the community, visitors, and priority coastal resources including agricultural and biological resources.

Wildland fires in the west have become prevalent and much more difficult to contain with prolonged drought periods and increasing temperatures. Fire hazard is typically more prevalent in inland areas which do not benefit from moist marine climatic conditions; however, with climate change, even coastal settings may become extremely dry during extended periods of drought.

SEA LEVEL RISE

Higher sea levels will directly affect coastal resources and development by exacerbating existing hazards such as erosion, flooding, and seawater intrusion. Sea levels are already rising. In concert with storm events and high tides, more frequent and dramatic damage has been occurring along the Planning Area coastline. Sea level rise is considered in more detail in the following section of this chapter.

Policies – Hazards and Climate Change

The LUP requires new development to be sited and designed to minimize risks of and contribution to environmental hazards. The LUP also requires the City to take a holistic planning approach and consider upstream and downstream hazard potential from new development. Policies acknowledge that the risk potential of these hazards should be expected to increase with the compounding effects of climate change over time and that more resilience planning, mitigation and adaptation measures will be needed to reduce the impacts of such hazards. The LUP also requires that disclosures should be made about the presence of hazards on a site. Specific policies addressing shoreline hazards, erosion, flooding, fire hazards and sea level rise are discussed later in this chapter.

- 7-1. Hazard Avoidance.** All new development shall be sited, sized, and designed to minimize risks to life and property and protect coastal resources from geologic, flood, and fire hazard over the life of the development. Coastal resources to be protected may occur on- or off-site, upstream or downstream. Development standards shall anticipate that hazards may be compounded by climate change.

- 7-2. Subdivisions.** Limit subdivisions in areas vulnerable to environmental hazards, including as may be exacerbated by climate change, by prohibiting any new land divisions, including subdivisions, lot splits, and lot line adjustments that create new building sites unless specific criteria is met that ensure that when the subject lots are developed, the development will not be exposed to hazards, pose any risks to protection of coastal resources, or create or contribute to geologic instability.
- 7-3. Emergency Warning System.** Update, maintain, and improve the City’s emergency warning system as consistent with local, state, and federal standards.
- 7-4. Disclosure of Hazard Presence.** Require, as a condition of approval for a coastal development permit on property containing any shoreline, geologic, flood, or fire hazards, the recordation of a deed restriction to ensure the current and any future owners of the property understand the presence and assume the risks of such hazards and any property defects or vulnerabilities related to such hazards, including information about known current and potential future vulnerabilities to hazards as may be exacerbated by climate change and sea level rise.
- 7-5. Long-Term Adaptation.** Consider long-term climate change and sea-level rise for hazard mitigation and incorporate adaptive strategies in planning for future private development, public facilities and infrastructure, and coastal resources.
- 7-6. Replacement Following Disaster.** Allow the replacement of structures destroyed by disasters provided that the replacement conforms to all current LCP development standards, is the same use and general size of the destroyed structure pursuant to Coastal Act Section 30610(g), and avoids or sufficiently mitigates any coastal resource impacts and future hazard risks.
- 7-7. Building Codes and Standards.** Establish and implement building codes and standards for development siting and construction that avoid or minimize risks from environmental hazards and increase the development’s ability to respond and adapt to climate change impacts. Provide additional development controls in areas that are identified in the LCP as hazard areas.

Shoreline Hazards

This section describes hazards associated with the interface of shoreline and ocean, including coastal flooding, coastal bluff erosion, tsunami events, and seawater intrusion. These shoreline hazards are all anticipated to be exacerbated by sea level rise and will necessitate adaptive management strategies.

SEA LEVEL RISE

Concurrently with preparation of the LUP update and in cooperation with the California Coastal Commission and the Ocean Protection Council, the City of Half Moon Bay has conducted detailed analysis of sea level rise scenarios and their impacts on existing development, assets, sensitive resources, and hazards/safety. The Sea Level Rise Vulnerability Assessment (2016) may be referenced for further information on anticipated sea level rise impacts in the Planning Area. San Mateo County’s Sea Level Rise Vulnerability

Assessment (2018) and Sea Change efforts serve as an additional resource for understanding sea level rise impacts along the coast, and complement the City's own adaptation planning.

Over time, the potential impacts of sea level rise are anticipated to increase the Planning Area's exposure to shoreline hazards. Rising sea levels are likely to affect the amount of area in the city at risk of coastal flooding, the rate of erosion along the shoreline and bluffs, the area of the City's tsunami inundation zone, and potential seawater intrusion into riparian systems and groundwater supplies. Loss of shoreline due to rising waters may also threaten the stability of coastal habitats, recreation areas, public access, and infrastructure. Thus, planning for sea level rise impacts is an essential responsibility for coastal communities to ensure that adaptation occurs in a way that protects both coastal resources and public safety.

Projections

Sea level rise science is an evolving field and understanding of the various processes involved will continue to change as new information comes to light. Decision-making related to sea level rise thus relies on the best available science and planning for uncertainties by examining the potential impacts of different scenarios. The best available science on sea level rise in California at the time of the 2020 LUP update was the Ocean Protection Council's State of California Sea-Level Rise Guidance (2018 update) and the California Coastal Commission's Sea Level Rise Policy Guidance (2018 update), which present scenario-based sea level rise projections for the California coast. These projections consider the probability of sea level rise occurring under several scenarios,⁴ with the year 2000 as the established baseline:

1. **Likely Range:** There is a 66% probability that sea level rise will be in this range. This range may be used for projects that would have limited consequences or a higher ability to adapt, such as public trails and other non-structural development.
2. **The 1-in-200 chance:** There is a 0.5% probability that sea level rise will meet or exceed this scenario. This scenario should be used for projects with greater consequences and/or a lower ability to adapt, such as habitable development.
3. **The Extreme Ice Loss Scenario:** There is no associated probability for this scenario at this time due to its high level of uncertainty. This scenario should be used for projects with little to no adaptive capacity that would be irreversibly destroyed or significantly costly to repair, and/or would have considerable public health, public safety, or environmental impacts should that level of sea level rise occur, such as major public infrastructure and critical facilities.

Table 7-1 below presents the sea level rise projections for the San Francisco tide gauge. Given the uncertainty in the magnitude and timing of future sea level rise, it is important to use scenario-based analysis to examine a range of possible shoreline changes and sea level rise risks. It is also important to note that the level of uncertainty in sea level rise modeling increases as the projected time period increases, especially beyond the year 2100.

⁴ California Coastal Commission, 2018. Sea Level Rise Policy Guidance Final Adopted Science Update, November 7, 2018.

Table 7-1: Sea Level Rise (SLR) Projections for San Francisco

Year	<u>Likely Range</u>		<u>1-in-200 Chance</u>	<u>Extreme Ice Loss Scenario</u>
	<i>66% probability SLR is between...</i>		<i>0.5% probability SLR meets or exceeds...</i>	<i>Probability unknown</i>
2030	0.3 feet (0.1 meters)	0.5 feet (0.15 meters)	0.8 feet (0.25 meters)	1.0 foot (0.3 meters)
2040	0.5 feet (0.15 meters)	0.8 feet (0.25 meters)	1.3 feet (0.4 meters)	1.8 feet (0.5 meters)
2050	0.6 feet (0.2 meters)	1.1 feet (0.33 meters)	1.9 feet (0.6 meters)	2.7 feet (0.8 meters)
2060	0.8 feet (0.25 meters)	1.5 feet (0.5 meters)	2.6 feet (0.8 meters)	3.9 feet (1.2 meters)
2070	1.0 foot (0.3 meters)	1.9 feet (0.6 meters)	3.5 feet (1.1 meters)	5.2 feet (1.6 meters)
2080	1.2 feet (0.4 meters)	2.4 feet (0.7 meters)	4.5 feet (1.4 meters)	6.6 feet (2.0 meters)
2090	1.4 feet (0.4 meters)	2.9 feet (0.9 meters)	5.6 feet (1.7 meters)	8.3 feet (2.5 meters)
2100	1.6 feet (0.5 meters)	3.4 feet (1.0 meter)	6.9 feet (2.1 meters)	10.2 feet (3.1 meters)
2110	1.9 feet (0.6 meters)	3.5 feet (1.1 meters)	7.3 feet (2.2 meters)	11.9 feet (3.6 meters)
2120	2.2 feet (0.7 meters)	4.1 feet (1.2 meters)	8.6 feet (2.6 meters)	11.9 feet (3.6 meters)
2130	2.4 feet (0.7 meters)	4.6 feet (1.4 meters)	10.0 feet (3.0 meters)	16.6 feet (5.1 meters)
2140	2.6 feet (0.8 meters)	5.2 feet (1.6 meters)	11.4 feet (3.5 meters)	19.1 feet (5.8 meters)
2150	2.8 feet (0.8 meters)	5.8 feet (1.8 meters)	13.0 feet (4.0 meters)	21.9 feet (6.7 meters)

Sources: Ocean Protection Council, 2018; California Coastal Commission, 2018.

COASTAL FLOODING

Flood hazards in the Planning Area are typically associated with storms or other events resulting in coastal flooding from waves or tsunamis. Sea level rise can also result in flood impacts in low-lying coastal areas and cause the inland extents of 100-year floods to increase. Higher water levels at the coast may cause water to back up along waterways and drainages

and cause upstream or inland flooding.⁵ Inland flooding is discussed further in the Fluvial Flood Hazards section of this chapter.

Figure 7-1 maps a 100-year storm event under five sea level rise scenarios: 0 feet, 0.8 feet (0.25 meters), 1.6 feet (0.5 meters), 3.3 feet (1.0 meters), and 6.6 feet (2.0 meters). Mapping was conducted using data from the Our Coast Our Future (OCOF) sea level rise mapping tool.⁶ According to the Ocean Protection Council's sea level rise projections shown in Table 7-1, the low-end 0.8 feet scenario could occur as early as 2030 and the high-end 6.6 feet scenario could occur by 2080.

Flooding under these sea level rise scenarios would mainly impact the Planning Area's beaches with some inundation at the outlets of waterways and drainages that will likely be more pronounced with higher sea levels, particularly the outlet of Pilarcitos Creek. Flooding along the waterways under the sea level rise scenarios was not mapped, because OCOF does not provide inundation conditions along inland creeks. However, data from FEMA regarding current conditions shows flood potential along waterways such as Frenchmans Creek that could be exacerbated with higher sea levels. Sea level rise is also anticipated to cause downcutting of creeks, which will impact bank stability and sediment transport balance, as well as cause the mouths of creeks to retreat inland, which will affect habitat. This eventuality will result in loss of riparian corridor area, which is a coastal and community resource. The protection of these coastal resources is mandated by the Coastal Act, and this LUP incorporates policies to facilitate habitat retreat planning.

San Mateo County's 2018 sea level rise vulnerability assessment ("SeaChange") considered longer term and more severe projections for 2100, assuming 66-inches with a 100-year storm. The City's and County's assessment indicate that 91 cm (3 ft.) of sea level rise is enough to cause most of the significant impacts and that near-term planning is critical.

SHORELINE EROSION

Along the shoreline, sources of erosion are related to waves acting upon the steep bluff features, surface flow across the bluff face, and exposure and weakening of soil through use of informal trails near blufftop edges. While bluffs naturally retreat incrementally dependent on a variety of factors, erosion can also occur episodically during a significant storm event or an extreme winter. It is anticipated that higher sea levels will result in an increase in wave heights, producing greater wave energy to erode the coastline at a higher rate.⁷ Such erosion in turn could destabilize the landforms and threaten development on and near blufftops and man-made structures along the coast.⁸ Higher sea levels could also cause the landward

⁵ Heberger, Matthew et. al., 2009. The Impacts of Sea-Level Rise on the California Coast. California Climate Change Center.

⁶ Ballard, G., Barnard, P.L., Erikson, L., Fitzgibbon, M., Higgason, K., Psaros, M., Veloz, S., Wood, J. 2014. Our Coast Our Future (OCOF). [web application]. Petaluma, California. www.pointblue.org/ocof. (Accessed: Date [e.g., August, 2014]).

⁷ National Research Council (NRC), 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future (2012). http://www.nap.edu/catalog.php?record_id=13389.

⁸ California Coastal Commission, 2015. California Coastal Commission, Sea Level Rise Policy Guidance, unanimously adopted on August 12, 2015.

migration of beaches over time.⁹ In cases where development or other hardened shorelines are present, landward migration is halted, resulting in a process known as coastal squeeze where sandy beaches, intertidal habitat, and other habitat areas are lost due to a fixed shoreline and rising sea levels.

Although the Coastal Act permits shoreline protective devices for structures built prior to the Coastal Act, “soft engineered” approaches (e.g. living shorelines, dune restoration) that allow natural beach migration should be first considered and used where feasible. If these devices are “hard engineered” (e.g. seawalls, rock revetments), they should be removed as soon as possible. If open space for recreation, habitat, and agriculture is to be maintained, there may be a need to allow for relocation of infrastructure for habitat retreat.

Erosion impacts were also mapped for the City’s vulnerability assessment; however, the available data did not take the effects of sea level rise into account. Thus, mapping for these impacts showed erosion projections based on historical rates of erosion (up to two feet of bluff retreat per year) based on the shoreline and cliff retreat data from OCOF and the U.S. Geological Survey (USGS). Table 7-2 below contains coastal bluff retreat projections based on OCOF modeling for three areas of the city, as included in the City’s vulnerability assessment: Miramar, the northern point of West of Railroad, and the southern point of West of Railroad. These projections have implications for impacts to Highway 1, the Coastal Trail, and sensitive habitat areas as early as 2030. It is important to note that as with sea level rise projections, erosion rate projections contain many uncertainties and assumptions based on wave energy, geologic stability, and tide levels.

Table 7-2: Coastal Bluff Retreat Projections

<u>Location</u>	<u>2030</u>	<u>2050</u>	<u>2100</u>
Miramar	35.7 feet (11.4 meters)	70.3 feet (21.4 meters)	157.0 feet (47.9 meters)
West of Railroad (northern point)	35.2 feet (10.7 meters)	70.3 feet (21.4 meters)	158.3 feet (48.2 meters)
West of Railroad (southern point)	35.2 feet (10.7 meters)	71.1 feet (21.7 meters)	161.0 feet (49.1 meters)

Source: USGS, 2015; NCI, 2015.

Within the city, the following areas are especially vulnerable to shoreline erosion:

Miramar Neighborhood and Mirada Road. In January 2016, a section of the cliffs along Mirada Road eroded to the beach below. This led to a road closure pending efforts by the City and San Mateo County to implement an interim shoreline protective project and more long-term solutions. In that same time frame, at the terminus of Mirada Road, the Coastal Commission permitted emergency shoreline hardening with rip rap to protect a residential structure known as Casa Mira; however, within a year this approach was already being undermined by tidal action. Additional dramatic events, including the loss of approximately 27 inland feet of coastal bluff face further south at the terminus of Alcatraz Avenue between

⁹ National Research Council (NRC), 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future (2012). http://www.nap.edu/catalog.php?record_id=13389.

November 2016 and February 2017, fully exposed the foundation of a State Parks ranger residence. The residence was demolished, and the remaining foundation stabilized. Future consideration of shoreline hardening in this area should consider the effects of reflected wave energy up and down coast from shoreline armoring and riprap installations.

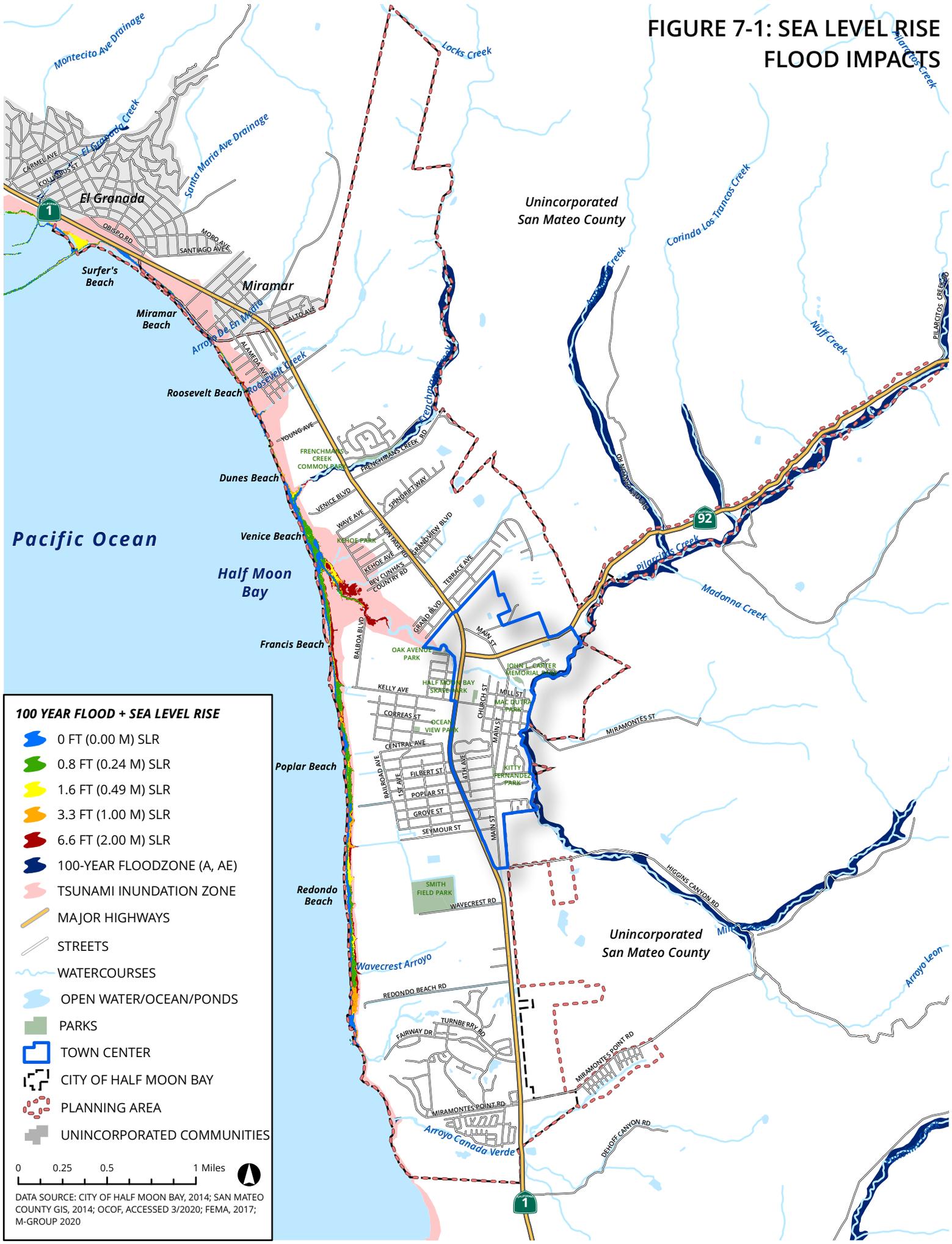
California Coastal Trail. The Coastal Trail is a significant public access and recreation resource in Half Moon Bay. The State Parks Department is anticipating realigning a span of the Coastal Trail between Mirada Road and Alcatraz Avenue farther away from the eroding bluff top edge. Unimproved areas of the trail in North Wavecrest are also at risk of bluff erosion. The Coastal Trail and parallel equestrian trail may also be at risk of erosion caused by undercut culverts, such as at the Pullman watercourse, and by channel outflows, such as at the end of Kelly Avenue.

Poplar Beach Blufftop Park. Following preparation of the Sea Level Rise Vulnerability Assessment in 2016, the City conducted an erosion study of the Poplar Beach Blufftop Park area between Kelly Avenue and the Seymour Ditch. The study indicated that in addition to the future effects of sea level rise, human activities along the Coastal Trail and blufftops cause patterns of impactation that affect drainage patterns¹⁰. New drainage channels created through this inadvertent process are causing bluff erosion at rates higher than anticipated based solely on sea level rise. It is the City's assumption that the combined effects of erosion resulting from drainage issues at the top of the bluffs will be compounded by forthcoming effects of sea level rise eroding the base of the bluffs and result in more severe bluff loss than predicted in studies available at the time of the LUP update. Based on this newly acquired information, the City will be working to address the effects that are within its control in order to reduce the overall loss of blufftop lands and protect the highly significant Coastal Trail.

Potentially relevant to sediment planning in Half Moon Bay is the Pillar Point breakwater just north of the Planning Area at Pillar Point Harbor in Princeton. The breakwater was constructed by the U.S. Army Corps of Engineers between 1956 and 1960. Since then, erosion and sedimentation impacts have been associated with the breakwater and are the subject of studies and planning efforts at the county level. The presence of the breakwater has been linked to erosion along the Princeton shoreline and at Surfer's Beach, as well as excessive sediment deposition within the harbor. Any future alterations in the dynamics at Pillar Point could have implications for sediment movement along the coast of Half Moon Bay.

¹⁰ Half Moon Bay Coastal Trail Existing Conditions and Trail Planning Recommendations, Nichols Consulting Engineers for City of Half Moon Bay, March 2, 2017

FIGURE 7-1: SEA LEVEL RISE FLOOD IMPACTS



100 YEAR FLOOD + SEA LEVEL RISE

- 0 FT (0.00 M) SLR
- 0.8 FT (0.24 M) SLR
- 1.6 FT (0.49 M) SLR
- 3.3 FT (1.00 M) SLR
- 6.6 FT (2.00 M) SLR
- 100-YEAR FLOODZONE (A, AE)
- TSUNAMI INUNDATION ZONE
- MAJOR HIGHWAYS
- STREETS
- WATERCOURSES
- OPEN WATER/OCEAN/PONDS
- PARKS
- TOWN CENTER
- CITY OF HALF MOON BAY
- PLANNING AREA
- UNINCORPORATED COMMUNITIES

0 0.25 0.5 1 Miles

DATA SOURCE: CITY OF HALF MOON BAY, 2014; SAN MATEO COUNTY GIS, 2014; OCOF, ACCESSED 3/2020; FEMA, 2017; M-GROUP 2020

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TSUNAMI EVENTS

Tsunamis are large waves caused by seismic or landslide events in the ocean floor. Tsunamis can result from off-shore earthquakes near the Planning Area coastline or from far distant events. Although tsunamis are more typically generated by subduction faults (e.g. the Cascadia subduction zone in the Pacific Northwest), local tsunamis may result from strike-slip faults along the San Andreas fault running along the coast of the San Francisco Peninsula.¹¹ In general, tsunamis along the west coast of the United States and the Planning Area, in particular, are considered to be rare. Most of the recorded tsunami events in the vicinity of the Planning Area have been small with many possibly misinterpreted from other wave-related phenomena such as storm-generated waves or seiches.¹²

Despite their relative rarity, even small tsunami events have the potential to result in coastal flooding. In 1859, a tsunami resulted in 15-foot wave heights near the Planning Area. Teletsunamis (tsunamis originating from sources more than 620 miles away) in 1946, 1960, and 1964 resulted in minor damage along the coastline. Recent tsunami events in Japan and Thailand have increased awareness of the potential for damage associated with such events. The Pacific Tsunami Warning System based in Hawaii monitors wave activity and generates tsunami warnings when seismic events of sufficient magnitude occur. The USGS, National Oceanic and Atmospheric Administration (NOAA), California Geological Survey, and others, are currently working to develop a Pacific Basin Tsunami Scenario. This effort would model inundation patterns, currents and shoreline damage patterns to determine impacts of a Pacific Tsunami event.

The Association of Bay Area Governments (ABAG) in partnership with the City of Half Moon Bay has adopted a Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP) that includes hazard mapping and a tsunami evacuation planning map identifying a potential extreme scenario, aggregated from all potential sources of tsunamis, measuring the highest potential wave height from any tsunami event along the coast. This mapping, produced by the California Emergency Management Agency, included ground truth surveys to incorporate features that may impede inundation, and is shown on Figure 7-1.

Tsunami risk within the Planning Area is mapped along the entirety of the Half Moon Bay shoreline, typically ranging inland only as far as the large bluffs (over 30 feet in elevation in most areas) along the coastline. Areas subject to greater risk are located along Pilarcitos Creek where inundation ranges approximately 3,000 linear feet inland from the coast, adjacent to Naples Beach ranging inland approximately 1,300 linear feet, and adjacent to Miramar Beach, Vallejo Beach, Half Moon Bay State Beach, and El Granada Beach. These areas include residential, commercial, and recreational developed land uses, as well as public facilities (e.g., California Coastal Trail) and critical facilities (e.g., Highway 1 and the Sewer

¹¹ Association of Bay Area Governments (ABAG), 2010, Taming Natural Disasters, Multi-Jurisdictional Local Hazard Mitigation Plan for the San Francisco Bay Area, Publication Number: P09001EQK.

¹² Lander, J.F., Lockridge, P.A., and Kozuch, M.J., 1993, Tsunamis Affecting the West Coast of the United States 1806-1992: National Geophysical Data Center Key to Geophysical Record Documentation No. 29, NOAA, NESDIS, NGDC, 242 p.

Authority Mid-Coastside (SAM) wastewater treatment facility).¹³ Though data was not available for tsunami impacts under sea level rise scenarios for the City's vulnerability assessment, it would be expected that a tsunami would impact areas farther inland at higher sea levels.¹⁴

Mitigation of tsunami risk consists mainly of improved early warning systems and evacuation routes and information, rather than restrictions on development for infill development sites. However, other planning considerations may apply for PDs or new subdivisions. In 2005 the City installed two emergency warning sirens within the city limits and updated its evacuation plan. The City has also obtained its TsunamiReady certification from NOAA.

SEAWATER INTRUSION

Several creeks—including Roosevelt Creek, Frenchman Creek, Pilarcitos Creek, and Canada Verde Creek—flow through Half Moon Bay into the ocean. These creeks are separated from the ocean by berms and beaches and have little water flow during most days. As a result, seawater intrusion for these freshwater resources would be considered negligible. Over time and under certain conditions, it is possible that seawater may enter habitats at the mouths or channel beds of waterways. This could occur as a result of failure of the protection provided by the berms and beaches due to erosion, damage from shoreline hazards, channel incision and downcutting of creeks, or extreme tides or flooding combined with higher sea levels. To fully understand the potential for seawater intrusion and any impacts on the habitats in those areas, further study would be required of the strength and elevation of the berms and the channels, potential frequency of occurrence given tides and storm strengths, and whether seawater would subsequently flow out of the waterways or remain in them. Additionally, further study would be required to understand the sensitivity of coastal habitats exposed to potential seawater intrusion to that impact. Thus, while seawater intrusion impacts are expected to be negligible over the planning period, further study is required to understand the potential for seawater intrusion in the long-term.

As discussed in Chapter 6. Natural Resources, seawater intrusion has not been well documented in the Planning Area except at the SAM Plant, which was found to be already subject to seawater intrusion by the County of San Mateo's Sea Level Rise Vulnerability Assessment (2018). Seawater intrusion is a potential concern in Half Moon Bay due to proximity to the ocean, especially if groundwater withdrawals increase, if groundwater recharge rates fall, and if groundwater levels were to drop below sea level for a prolonged period of time. Sea level rise could lead to seawater intrusion into groundwater aquifers, potentially rendering existing wells unusable and decreasing the total groundwater supply. Agricultural wells located close to shoreline or in lower lying areas may be vulnerable to seawater intrusion when wells are drawn down during periods of drought. The full impacts of sea level rise on seawater intrusion into groundwater in the Planning Area are not currently known.

¹³ City of Half Moon Bay (HMB), 2011, Annex to 2010 Association of Bay Area Governments Local Hazard Mitigation Plan, Taming Natural Disasters, April 15, 2011.

¹⁴ California Coastal Commission, 2015. California Coastal Commission, Sea Level Rise Policy Guidance, unanimously adopted on August 12, 2015.

Policies – Shoreline Hazards

Policies related to shoreline hazards in the LUP address potential impacts to development and coastal resources occurring at the shoreline, as exacerbated by sea level rise. Policies in this chapter mainly consider hazard avoidance and adaptation measures required to protect coastal resources and development in Half Moon Bay. As sea level rise projections will likely continue to be revised over the course of the 2040 planning horizon, it is important for land use policies to consider triggers, thresholds, and various scenarios rather than specific sea level rise amounts or timing. Additional policies regarding sea level rise and public access and recreation may be found in other chapters of the LUP including Coastal Access and Recreation, Natural Resources, Scenic and Visual Resources, and Cultural Resources.

Blufftop and Beachfront Development

The LUP limits development on and near blufftops and beaches. Policies require new blufftop development and redevelopment to demonstrate stability of the site over its anticipated life span without relying on protective devices; establish performance standards for construction adjacent to beachfronts and blufftops to prevent negative impacts such as runoff and erosion and to restore already-impacted areas; and require setbacks to prevent erosion impacts over the life of the structure. Policies apply the industry standard for determining if and where a blufftop site is stable for development, called a factor of safety, of at least 1.5 for the static condition and 1.1 for seismic conditions. Factors of safety at increasing values above 1.0 lend increasing confidence in the stability of a slope. The factor of safety generally increases with distance from the bluff edge, so the point at which the minimum required factor of safety is reached typically constitutes a minimum blufftop setback. Erosion, wave runup, and sea level rise must also be considered.¹⁵

“Blufftop and beachfront development” is defined as development within 300 feet landward of a bluff line or edge or 300 feet landward from the inland extent of the beach, pursuant to California Code of Regulations Section 13577(g) and (h). Typically, policies for beachfront development and beach setbacks apply where there are sand dunes or other low-lying areas rather than coastal bluffs. “Anticipated life span” is defined as the period over which a development is expected to be usable, with normal repairs and maintenance, for the purpose for which it was designed. The anticipated life span may range from a minimum of 100 years for residential and commercial development to approximately 150 years for critical infrastructure. Certain types of development and public access facilities such as trails that are sited and designed in a manner to facilitate relocation may have a lesser anticipated life span. The anticipated life span is not an entitlement to maintain development for that amount of time, particularly where hazards or public safety risks are present, but rather is a planning tool for sea level rise adaptation, structure siting, and permitting purposes. The actual life of the development is dictated by on-the-ground conditions in the future, and any conditions of approval for the development. Policies require that new blufftop and beachfront development address the potential for flooding, erosion, and other sea level rise impacts over time. The LUP calls for including sea level rise impacts as an area of study in required geological reports in potentially vulnerable areas and adopting sea level rise avoidance and

¹⁵ California Coastal Commission Local Coastal Program Update Guide, Part 1 – Section 8. Coastal Hazards.

adaptation measures for new development. The LUP calls for the anticipation of future impacts on public facilities and the development strategies for eventual managed retreat with sea level rise. Policies establish criteria for nonconforming structures and prohibit substantial redevelopment of at-risk structures, providing for managed retreat and rolling easements, thereby allowing coastal lands to migrate inland over time.

Policies also allow additional protections for critical facilities in the Planning Area to ensure that essential services are continuously provided to the community. The City defines “critical facilities” as public utilities including water tanks, municipal wells, and major sewer and water service mains and pumps; communications infrastructure; the SAM Wastewater Treatment Plant; Highways 1 and 92; emergency preparedness and response facilities including the Emergency Operations Center and fire station; and schools. The city does not have any hospitals; however, large-scale medical care facilities would qualify as critical facilities.

Shoreline Protection

Several policies cover the topic of shoreline protection, which is known to have negative impacts on coastal processes in the long-term. Hard shoreline protection devices alter natural shoreline processes by preventing natural bluff retreat and reducing sources of sand supply. As a result, these devices can cause loss of beach area which may be accelerated by sea level rise. Policies limit the construction of new hard shoreline protection to only that which is required to protect existing structures, and critical facilities in danger from erosion, and require the use of soft protection where feasible as a preferred alternative to hard protection when protection is needed.

The LUP also calls for the gradual removal of protective devices as they are no longer used or fall into disrepair, and restoration of the bluff and beach area when protective devices are removed. The LUP provides for the monitoring of and mitigation for impacts of shoreline protection over time, and requires the City to prevent and remove illegal or unpermitted protection. Finally, the LUP calls for establishing a shoreline management plan. Such a plan would take a long-term, comprehensive approach to addressing changes in the shoreline from coastal processes such as erosion and sea level rise, with an emphasis on soft strategies, such as beach nourishment and sediment management.

Policies – General

- 7-8. Shoreline Hazards and New Development.** Ensure that new development, including land division, is sized, sited and designed to be safe from shoreline hazards such as coastal flooding, shoreline erosion, tsunami inundation, seawater intrusion, and other sea level rise impacts without requiring a shoreline protection device at any time over the anticipated life span of the structure.
- 7-9. New Development in Tsunami Inundation Zone.** Limit the creation of new building sites in the tsunami inundation zone. Infill development on existing building sites may be permitted in the tsunami inundation zone, provided that a disclosure of hazard presence and a hold harmless clause indemnifying the City from any harm caused to permitted development by tsunami inundation are recorded against the property.

- 7-10. Shoreline Hazard Mapping.** Maintain and update shoreline hazard maps to incorporate significant updates in best available science and information when such significant updates are available, including areas subject to wave action, flooding, tsunamis, and erosion due to sea level rise.
- 7-11. Dynamic Sea Level Rise Adaptation Strategy.** Continue to review and use current and best available sea level rise science and projections and periodically identify coastal resources, development, infrastructure, and communities that are vulnerable to sea level rise impacts. Use this information to continue to develop or adjust adaptation strategies.

Policies – Blufftop and Beachfront Development

- 7-12. Site-Specific Shoreline Hazards Evaluation.** All new development proposed in areas that may be subject to shoreline hazards, including all beaches and beachfronts, blufftops, and areas mapped in Figure 7-1, shall require the submittal of a site-specific evaluation report of shoreline hazard risks over the anticipated life of the proposed development. Analyses shall be conducted by a qualified professional with expertise in coastal processes and shall establish the appropriate setback from the beach or bluff edge based on the anticipated life of the structure, best available science including utilizing the highest projected sea level rise amounts appropriate for the type of proposed development with a 100-year storm event and for blufftop development, a demonstrated factor of safety greater than or equal to 1.5 for static conditions and greater than or equal to 1.1 for seismic conditions. The evaluation shall include an analysis of the following:
- a. Historic and projected rates of erosion over the anticipated life span of the proposed development, including potential erosion considering future sea level rise, and possible changes in shore configuration and sand transport. Sources to be investigated include recorded land surveys and tax assessment records, historic maps and photographs where available, and best available science on sea level rise and erosion projections such as that developed by USGS, the National Academy of Engineering, the National Academy of Science, the California Geological Survey, and the California Coastal Commission;
 - b. Cliff geometry and site topography, extending the surveying work beyond the site as needed to depict geomorphic conditions that might affect the site and the proposed development;
 - c. Geologic conditions, including soil, sediment and rock types and characteristics in addition to structural features such as bedding, joints, and faults;
 - d. Evidence of past or potential landslide conditions, the implications of such conditions for the proposed development, and the potential effects of the development on landslide activity;
 - e. Wave and tidal action, including effects of marine erosion on bluffs;
 - f. Ground and surface water conditions and variations, including 100-year riverine flooding and its impact/interaction with bluff erosion and ocean forces at creek mouths and low-lying areas, changes to groundwater resulting from rising sea levels, and hydrologic changes caused by the development (e.g., introduction of irrigation water to the ground- water system; alterations in surface drainage);

- g. Potential effects of seismic forces resulting from a maximum credible earthquake;
 - h. Effects of the proposed development including siting and design of structures, landscaping, drainage, grading, and impacts of construction activity on the stability of the site and adjacent area;
 - i. Any other factors that may affect slope stability; and
 - j. Potential erodibility of site and mitigating measures to be used to ensure minimized erosion problems during and after construction (i.e., landscaping and drainage design).
- 7-13. Blufftop Development Setbacks.** Permit new blufftop development only if, as demonstrated by the site-specific evaluation required by Policy 7-12:
- a. Design and setback provisions are adequate to assure stability and structural integrity for the anticipated life span of the development, taking into consideration long-term future erosion and short-term episodic erosion including the influence of sea level rise, plus an added geologic stability factor of safety greater than or equal to 1.5 for the static condition and greater than or equal to 1.1 for the seismic condition, without reliance on existing or proposed shoreline protective devices; and
 - b. The development (including associated stormwater runoff, foot traffic, grading, irrigation, and septic tanks) will neither create nor contribute to erosion, geologic instability of the site or surrounding area, or otherwise harm coastal resources.
- Setbacks may also be needed to protect visual resources as well as ESHA. In such cases, the most protective setback requirement applies. Setbacks shall also include room for buffers from hazards and/or ESHAs as applicable.
- 7-14. Beach Setbacks.** Ensure that new beachfront development is set back far enough inland from the beach and other low-lying areas, as demonstrated by the required Shoreline Hazards Evaluation, such that the development will not be endangered by coastal flooding, seasonal and long-term erosion (including sea level rise induced erosion), and other shoreline hazards over the anticipated life span of the structure without the use of an existing or proposed shoreline protective device. Setbacks may also be needed to protect visual resources and/or the presence of ESHA, and, in such cases, the most protective setback requirement applies.
- 7-15. Land Divisions near Beachfront and Blufftops.** Land divisions, including subdivisions, lot splits, and lot line adjustments that create new lots near beaches or blufftops, shall not be permitted unless the lots can be developed in accordance with the bluff and beach setback policies in this LCP and without requiring a current or future shoreline protective device.
- 7-16. Grading near Beachfront or Blufftop.** Require that any grading necessary to establish proper drainage, install minor improvements (e.g. trails), restore eroded areas, restore habitat, or provide permitted accessways directs water runoff away from the beach or edge of the bluff or requires runoff to be handled so as to prevent damage to the beach or bluff from surface and percolating water.
- 7-17. Beachfront or Blufftop Vegetation.** Require the installation and maintenance of drought-tolerant native coastal vegetation capable of enhancing bluff and dune

stability within 100 feet from the bluff or foredune edge as part of any new development near the beachfront or blufftops.

- 7-18. Assumption of Risk.** As a condition of approval for all coastal development permits that may be subject to shoreline hazards, require a deed restriction to ensure that property owners understand and assume the risks, and mitigate the coastal resource impacts, of new development and redevelopment in a hazardous area. Recorded assumptions of risk shall include a waiver of claim of damage or liability against the City of Half Moon Bay, waiver of rights to future shoreline armoring, acknowledgement that the development may need to be removed and the site restored in response to future hazard conditions, and any other acknowledgements and mitigation measures necessary to internalize risk decisions. In the event that development is threatened by shoreline erosion or other hazards and needs to be removed or relocated, the owner shall bear full responsibility for all costs and must work with the City to implement the mitigation in a timely manner.
- 7-19. Non-conforming Development.** Consider a structure non-conforming when its seaward edge no longer meets the standards or setback that would be required for new development at the location. Allow repair, maintenance, and modifications only if such actions do not increase the intensity of use or increase the size or degree of non-conformity of the structure. Additions to existing non-conforming structures are considered new development that must conform to the standards for new development, including but not limited to avoiding the need for future shoreline protective devices and sufficient beach or blufftop setbacks.
- 7-20. Redevelopment Standards.** Redevelopment in areas subject to shoreline hazards shall not be approved unless the entire structure meets the current standards for new development, including beach or blufftop setback requirements, based on an up-to-date, site-specific shoreline hazards evaluation. If the structure proposed for redevelopment is protected by a shoreline protective device, require the device to be removed and the site to be restored as a condition of redevelopment.
- 7-21. Repair and Retrofit of Existing Structures.** When it is necessary to repair damage to or retrofit existing structures, require materials and improvements that will better withstand shoreline hazard impacts, such as stronger materials, elevated bridges or sections of roadways, and larger or additional drainage systems to address flooding and erosion sedimentation concerns. Such repair, maintenance, and additions shall protect visual resources and other coastal resources while minimizing hazards.
- 7-22. New or Replacement Foundations and Basements.** Where an existing foundation or basement is located seaward of the blufftop or beach setback appropriate for assuring site stability for at least 100 years, replacement or substantial improvements that constitute redevelopment is prohibited. New foundation or basement work, replacements, or substantial improvements are permitted only when it is located inland of the blufftop or beach setback line for new development. Require that new foundation and basement designs for blufftop and beachfront development will not preclude future incremental relocation or managed retreat as the structural elements become exposed to avoid future impacts to coastal bluffs, beaches, and other coastal resources.

Policies – Infrastructure and Public Facilities

- 7-23. Infrastructure and Public Facilities.** Site, design, and upgrade infrastructure and public facilities, including roads, trails, parks, and other public access and recreation facilities with consideration for shoreline hazards including sea level rise impacts that may occur over the anticipated life of the development. Ensure that the connectivity of infrastructure is preserved in the event of ongoing erosion or wave run-up, and ensure adequate egress/evacuation is preserved during storm events. In cases where facilities cannot be sustainably maintained, removal or abandonment of infrastructure should be evaluated, and the least environmentally damaging approach shall be implemented. Where facilities can be safely sited for the near term but future impacts are likely, require an adaptive management plan detailing steps for maintenance, retrofitting, and/or relocation.
- 7-24. Coastal Trail Improvements.** Consider sea level rise projections, planned retreat and other adaptive measures in the siting and design of new and existing Coastal Trail areas at risk of erosion, flooding or wave run-up. New or re-aligned trail segments shall be set back a sufficient distance from bluff edges to avoid impacts from erosion and sea level rise, generally 50 feet, unless there is inadequate space to accommodate the Coastal Trail in this area.
- 7-25. State Parks Facilities.** Require maintenance and improvement projects at State Parks facilities such as beach parking lots, the Francis Beach Campground, Coastal Trail segments, State Parks Beach corporation yard, and State Parks workforce housing to plan and adapt for long-term shoreline hazard impacts as exacerbated by sea level rise, including retrofitting or inland relocation to maintain public access and recreation opportunities. When necessary to provide continued public access or to protect coastal-dependent State Parks facilities from shoreline hazards, shoreline protection may be permitted only if consistent with Coastal Act Sections 30235 and 30253 and if no feasible alternative exists.
- 7-26. Existing Critical Facilities.** Identify existing critical facilities that are vulnerable to shoreline hazards, such as the Sewer Authority Mid-Coastside Wastewater Treatment Plant, and establish measures to protect continued function of critical infrastructure, or the basic facilities, service, networks, and systems needed for the functioning of a community, including:
- a. Developing strategies for the managed retreat (retiring, moving, or replacing) of infrastructure and public facilities at risk of damage from shoreline hazards including sea level rise impacts that may occur over the economic life of the structure (at least 150 years for critical facilities);
 - b. Providing for functional continuity of the critical services provided by infrastructure at risk from shoreline hazards and extreme weather events; and
 - c. Providing for the use of protective devices, if necessary to ensure the continuation of needed services, as a temporary option while longer-term strategies are identified and implemented.
- 7-27. Shoreline Hazard Avoidance for New Critical Facilities.** Avoid locating new or expanded critical facilities in areas susceptible to shoreline hazards. If no feasible alternative exists and a new or expanded critical facility must be located in a shoreline

hazard area, require the new development to incorporate siting and design measures based on worst-case sea level rise projections and extreme weather event scenarios to promote continued functionality and public services, resist structural damage, facilitate evacuation on short notice, and minimize risk to life, property, and coastal resources.

Policies – Shoreline Protective Devices

- 7-28. Shoreline Protective Device Limitations.** Unless otherwise provided for in Policy 7-29. Protection for Critical Facilities or Policy 7-40. Property Protection Plans, shoreline protective devices shall be permitted only to serve a coastal-dependent use or to protect an existing structure in imminent danger from erosion (i.e., when substantial evidence indicates that the structure will be significantly damaged by coastal flooding or erosion hazards within two to three storm cycles, or approximately three years); when found to be the least environmentally damaging feasible alternative (e.g., if relocation or soft armoring approaches cannot mitigate the hazard); and when all coastal resource impacts are appropriately and proportionally mitigated.
- 7-29. Protection for Critical Facilities.** Notwithstanding the shoreline protective device limitations of Policy 7-28, shoreline protective devices may be permitted to protect critical public infrastructure and facilities, including the SAM Wastewater Treatment Plant, that may require shoreline protective devices or other shoreline hazard adaptation measures in order to continue providing needed services to the community. Such protection shall be permitted on a temporary basis only, with required check-ins and trigger points to determine when it is feasible to relocate such critical infrastructure inland and away from shoreline hazard risks in the future. As a CDP condition, a long-term adaptation plan that identifies relocation options shall be required.
- 7-30. Geotechnical Reports for Shoreline Protection.** Require applications for hard shoreline protection to include a geological and engineering report prepared by a qualified professional indicating that the structure has been designed to stabilize that portion of the shoreline which is subject to severe erosion, wave run-up, or other shoreline hazards and will minimize the potential for aggravating erosion in other shoreline areas.
- 7-31. Shoreline Protective Device Siting and Design.** Allowable shoreline protective devices shall be sited and designed to avoid impacts to coastal resources to the maximum extent feasible, including through preserving the maximum amount of existing beach, protecting lateral public access along the shoreline, protecting and enhancing public views, minimizing alteration of and visually blending with the surrounding natural shoreline; avoiding impacts to archaeological resources; and not encompassing an area larger than that necessary to protect the coastal-dependent use, existing structure, or critical facility.
- 7-32. Soft Protection Devices.** Require development to use “soft” or “natural” solutions or “living shorelines” where feasible and appropriate as a preferred alternative to the placement of hard shoreline protection in order to protect development or other resources and to enhance natural resource areas. Examples of soft solutions include vegetative planting, dune restoration, and sand nourishment.

- 7-33. Mitigation and Monitoring for Shoreline Protection Impacts.** Require as a condition of approval of any shoreline protective devices, including hard devices and soft alternatives, a plan to mitigate all unavoidable impacts to shoreline sand supply, public access and recreation, and any other relevant coastal resources. The mitigation and monitoring plan shall be phased in 20-year increments and shall, at a minimum, address the following:
- a. Impacts on local shoreline sand supply including sand and beach area that are lost through the shoreline protective device's physical encroachment on a beach, fixing of the back beach, prevention of new beach formation in areas where the bluff or shoreline would have otherwise naturally eroded, reflected wave energy up and down coast from the device, and the loss of sand-generating bluff or shoreline materials that would have entered the sand supply system absent the device;
 - b. Impacts to public access and recreation resulting from loss of beach area;
 - c. Impacts to any other relevant coastal resources; and
 - d. Form of mitigation and preliminary plans as applicable (e.g. sand replenishment, mitigation banking, on- or off-site restoration, construction of new public access and recreation opportunities, or payment of fees to fund such projects). Mitigation measures shall be planned for long-term resiliency with sufficient setbacks such that sea level rise will not impair their efficacy over time.
 - e. A plan for the periodic monitoring for structural damage, excessive scour, or other impacts to the device from shoreline hazards and sea level rise, as well as for impacts to shoreline processes and beach width both at the project site and the broader area and/or littoral cell as feasible. Monitoring reports shall include an analysis of any changed site conditions (e.g. periodic Mean High Tide Line surveys) and the need for additional mitigation.

Prior to expiration of each 20-year mitigation and monitoring period, a coastal development permit amendment shall be required for retention of the shoreline protective device beyond the preceding 20-year period. Such application shall include analysis of potential modifications to the shoreline protective device that would lessen its impacts on coastal resources, including potential removal, as well as any proposed modifications to the previously approved mitigation measures and monitoring program.

- 7-34. Accessory Structure Protection Prohibited.** Do not permit shoreline protection structures for the sole purpose of protecting an ancillary or accessory structure or use. Such accessory structures shall be removed if they are in danger from erosion, flooding, or wave run-up or if the bluff edge encroaches to within 10 feet of the structure as a result of erosion, landslide, or other form of bluff collapse. New accessory structures shall be constructed and designed to be removed or relocated in the event of threat from erosion, bluff failure, or wave hazards.
- 7-35. Removal of Existing Shoreline Protection.** Require removal of existing shoreline protective devices when the structure requiring protection is redeveloped, removed, or no longer requires a protective device, whichever occurs first.

- 7-36. Shoreline Protection Permit Expiration.** Permits for new shoreline protective devices shall be tied to the life of the structure it has been authorized to protect and shall expire when the structure requiring protection is redeveloped, is no longer present, or no longer requires a protective device, whichever occurs first. As a condition of approval for such permit, require the protective device to be removed and the beach area to be restored for public use upon permit expiration.
- 7-37. Maintaining Existing Shoreline Protection.** Allow repair and maintenance of existing, legally permitted shoreline protective devices only if such activities do not result in an enlargement or extension of armoring, and if mitigation measures are included as necessary. Any proposed enlargement, extension, or repair and maintenance that replaces 50 percent or more of the protective device shall be subject to provisions applicable to new shoreline protective devices, including mitigation requirements. Establish conditions that provide for potential future removal of the armoring in coordination with surrounding development.
- 7-38. Permit Tracking.** Develop a permit tracking and monitoring system to identify and prevent illegal and unpermitted construction of shoreline protective devices (e.g. protection is no longer warranted by changed site conditions, the anticipated life span of the structure being protected has expired, the structure being protected has redeveloped or is no longer present).
- 7-39. Shoreline Protective Device Inventory.** Develop an inventory to track and map all shoreline protective devices in coordination with permit tracking and monitoring efforts.

Policies – Managed Retreat, Relocation, and Removal

- 7-40. Property Protection Plans.** In association with a coastal development permit approval, the City shall require owners of any property with a principle structure, such as a primary residence, closer than 100 feet to the blufftop edge, or located in an area subject to potential risk of shoreline hazards during the anticipated life span of the structure, to develop a property protection plan and submit it to the City for review and approval. In addition, at any time a landowner may voluntarily submit a property protection plan to the City for review and approval. The property protection plan shall:
- a. Provide an estimate of when the structure may be permanently unsafe for occupancy due to wave action, bluff failure, or erosion, including as may be exacerbated by sea level rise;
 - b. Identify measures that could make the structures suitable for habitation without the use of bluff or shoreline protective devices, including necessary steps and thresholds for how and when to retrofit, remove or relocate the structure before it becomes permanently unsafe for use or occupancy or otherwise poses a threat to public safety; and
 - c. Be recorded against the property once it has been approved by the City.

In the event that the approved plan identifies there is no feasible alternative that could make the structure(s) suitable for habitation while the approved plan is being implemented, a shoreline protective device may be allowed if the shoreline protective device is only in place for the time needed to retrofit, remove or relocate the structure

pursuant to the approved plan and if all coastal resources impacts are appropriately and proportionally mitigated and the site is fully restored upon removal of the protective device.

- 7-41. Incremental Removal.** When a lot is not large enough to accommodate development that avoids shoreline hazards and/or the inland migration of the public trust boundary for the anticipated life of the development, develop a project option that minimizes hazards from the identified sea level rise scenarios and/or avoids encroachment into the public trust boundary for as long as possible, and then requires incremental retreat once certain triggers are met. Triggers for relocation or removal of the structure would be determined by changing site conditions such as when erosion is within a certain distance of the foundation; when monthly high tides are within a certain distance of the finished floor elevation; when building officials prohibit occupancy; when essential services to the site can no longer feasibly be maintained (e.g. utilities, roads); or when a wetland buffer area decreases to a certain width. It will be the property owner's responsibility to remove the structure(s) and restore the site such that the public trust and coastal resources are protected.
- 7-42. Rolling Easements.** Utilize rolling easements or other strategies to limit or restrict development on lands within 300 feet of the beach or bluff edge (i.e. lands that are most vulnerable to shoreline hazards) as a condition of approval for new development or new subdivisions located in such areas to allow coastal lands and habitats, including beaches and wetlands, to migrate landward over time as the mean high tide line and public trust boundary moves inland with sea level rise.
- 7-43. Shoreline Management Plans.** Develop shoreline management plans for shoreline areas subject to wave hazards, sea level rise and erosion, prioritizing armored areas such as Surfers Beach and Mirada Road, in coordination with Caltrans, San Mateo County and the Harbor District. Any plans should include:
- a. Short and long-term goals for the Half Moon Bay coast, the management actions and policies necessary for reaching those goals, any necessary monitoring to ensure effectiveness and success, and any necessary strategies to manage and adapt to changes in wave, flooding, and erosion hazards due to sea level rise;
 - b. An examination of local and regional annual erosion rates and natural and man-made sediment supplies in order to reflect current shoreline changes;
 - c. Identified priority areas where shoreline protection structures should be phased out or removed if they are no longer needed or if in a state of great disrepair, including areas where structures threaten the survival of wetlands and other habitats, beaches, trails, and other recreational areas;
 - d. An examination of opportunities to maximize public beach area and enhance or provide new lateral and vertical public beach accessways;
 - e. An examination of locations where beach nourishment may be appropriate, with recommended criteria and protocols for design, construction, and management to minimize potential biological impacts;
 - f. Procedures for preparing an alternatives feasibility analysis for all hazard response projects and hard engineered shoreline protective device projects. The analysis should require, but not be limited to, the use of technical evaluations of

the site (geotechnical reports, engineering geology reports, wave uprush reports etc.), an examination of all other options (removal, relocation, sand replenishment, no action etc.), and a conclusion that a shoreline protective device would be the best option (most protective of the public trust, best long-term solution etc.) for the subject site;

- g. Engineering plans and analyses defining the specific types of armoring that would be acceptable or preferable for specific areas if otherwise allowed by the Coastal Act and this LCP, and where appropriate, identification of the types of armoring that should not be considered for certain areas or beaches, in order to minimize risks and impacts from armoring to public access and scenic resources along the shoreline and beach recreation areas;
- h. Conditions and monitoring requirements that should include mechanisms to ensure shoreline protection effectiveness and public safety with provisions for the removal or ineffective or hazardous protective structures as well as programs to address beach replenishment and sand supply; and
- i. Procedures to address emergency armoring, such as: coordination with property owners and for field inspections before and after storm seasons; guidance for types of temporary protective structures preferred; mitigation requirements; and a provision for removal of temporary structures if no follow up permit is filed.

Geologic and Seismic Hazards

This section describes the geologic and seismic hazards that can occur within the City upland of the shoreline, including erosion and sedimentation, landslides, subsidence, seismicity, and liquefaction.

GEOLOGY AND SOILS

A majority of the Planning Area consists of a gently sloping marine terrace, containing watercourses and wetlands. The western edges of the Planning Area consist of coastal bluffs, and sandy shoreline. The northeastern section of the Planning Area contains steep hills with erosion potential. The city is underlain with poorly consolidated shallow marine sands, silts, and gravels resting on top of an ancient wavecut bedrock platform. Most soils are derived from alluvial sources, as the geology of the Planning Area is defined to a large extent by the sea, the San Gregorio Fault, and wetlands and watercourses.

Elevations within the Planning Area range from a high of approximately 1,100 feet above mean sea level in the hills on the northeastern end of the Planning Area, to sea level along the shore. Much of the development within the Planning Area occurs at elevations between approximately 40-80 feet above mean sea level. The Planning Area generally slopes downward in a westerly direction towards the ocean. Prominent geologic features in the city include the hills east of Nurserymen's Exchange and the Frenchmans Creek neighborhood; the nine drainage sub-areas (Roosevelt, Pullman, Frenchmans, Pilarcitos, Kehoe, Beachwood, Kelly-Metzgar, Seymour, and Canada Verde); and the shoreline, including the steep coastal bluffs along Wavecrest, Redondo Beach, and Miramontes Point Road.

The following paragraphs outline geologic hazards and identify particular concerns for existing and future population and development.

GEOLOGIC HAZARDS

Erosion and Sedimentation

Erosion is a natural process by which wind and water move across the earth and break down existing geologic features and structures. Human alteration of the natural environment can accelerate the pace of erosion, and/or create unnatural patterns of erosion. Accelerated erosion can cause instability in geologic structures, and water quality concerns in receiving waters. Erosion can be created by point sources, such as utility and industrial discharge points and mining and agricultural operations, or by non-point sources, such as impervious surfaces (paving and developed land uses), unpaved roads, and unsound grading or construction practices.

There are different sources of and risks related to erosion within the interior of the Planning Area. In the interior of the Planning Area, sources of erosion include concentrated surface runoff, reduced absorption by soils and vegetation, and channelized drainages. Soils in Half Moon Bay are generally considered to have low to moderate erosion potential, but evidence of substantive erosion has been documented along the shoreline, including bluff erosion along much of the shoreline of the Planning Area, as well as along the city's creek banks, drainages, and other water courses.

In the cases of these watercourses, erosion can be caused by the action of flowing water. Erosion occurs when the force of flowing water exceeds the ability of the soil to remain aggregated. Water moving in higher volumes or speeds can accelerate the rate of erosion, such as when watercourses are channelized or when excessive runoff enters a watercourse during a storm event. This process is exacerbated by numerous factors, including improperly sloped culverts, disruption of subsurface flows, vegetation removal, and changes in land use within the watershed that lead to greater amounts of runoff. Furthermore, the eastern hillsides have erosion potential that can be exacerbated by effects of velocity and accelerated channel flow. For the most part, these areas are not developed; however, erosion of these slopes contributes sedimentation to the various drainage courses. Erosion impacts within watercourses can be remedied through proper maintenance practices including meander belt restoration, invasive plant removal, and limiting increases in upland impervious surfaces.

The emptying of culverts carrying upland flows has destabilized downstream drainages in some basins. In some cases, excessive erosion has led to stream channel incising - the lowering or widening of a stream channel due to excessive erosion, as observed along watercourses like Seymour Watercourse and the arroyo outflow from the swale adjacent to Kelly Avenue. Figure 7-2 illustrates the Channel Evolution Model developed by Simon and Hupp (1986), showing how erosion along a channel can lower a streambed, degrading it and causing undercutting along the banks, leading to bank collapse, and resulting in widening and eventual stabilization. This model assumes that topsoil erodes more swiftly than subterranean soils. In places like the Seymour Watercourse where this is not the case, bank retreat can occur much faster.

Sedimentation occurs when soil-heavy waters slow down, allowing solids to settle on the bottom of a watercourse. This can increase flood risk to development in or too close to the floodplain by reducing the immediate carrying capacity of a watercourse. Storm and seasonal rain events may then cause overflow and contribute to downstream erosion. The City has undertaken several studies of its watercourses in order to assess flood risk and establish approaches to reduce erosion.

Erosion can also occur where an incremental intensification of use causes devegetation and compaction of gently sloping soils to create a watercourse where precipitation was historically absorbed by vegetation and soils. Foot traffic attempting to avoid eroded (and in winter, flooded) trail areas expand the compacted and devegetated area, as can be seen along several lateral trails between the Casa del Mar and Miramar neighborhoods and the California Coastal Trail. Loss of stabilizing vegetation can further contribute to erosion in these areas and along stream banks.

Within the city, the following areas are especially vulnerable to erosion:

Drainages and Culverts. There are nine drainage sub-areas defined in the City's 2016 Storm Drain Master Plan. Channelized watercourses in these sub-areas are producing erosion, including the channel directing water around the Grandview Terrace Subdivision, the Seymour Watercourse, and the Pullman Watercourse. Culverts placed in watercourses have also been subject to undercutting and collapse due to erosion. Of note, the Kehoe Watercourse has been assessed as an abrading stream as the channel banks are eroding, and the Pullman Watercourse has eroded such that the outflow channel west of Naples Avenue has widened and damaged the culverts that passed under the State Parks access road to Dunes Beach parking lot.

Hazardous Materials Sites. The Safety Element addresses hazardous materials sites throughout the city. Very few sites remain that have not been remediated. However, two of these open cases are located in areas subject to erosion and thus are at risk for upset in the event that the hazardous materials become exposed in the future.

- Closed Half Moon Bay Landfill. The closed Half Moon Bay Landfill is owned by San Mateo County and is located on approximately 14 acres along Railroad Avenue between Metzgar and Seymour streets. It is traversed by the California Coastal Trail. It was operational in the 1960s and 70s and capped in 1978. The landfill is of special concern due to its location on the coastal bluff. In the early 1990s, a portion of the landfill was exposed when wave action eroded the bluff face. The exposed area was secured with a concrete block and steel chain mat and is inspected regularly. At the time of the LUP update, San Mateo County was studying the potential impacts of sea level rise on the landfill and considering options for safely securing the property over the long-term.
- Landfill Near SAM Plant. A portion of an abandoned landfill located on City property upstream from Sewer Authority Mid-Coastside (SAM) Plant and Caltrans mitigation wetland immediately east of Pilarcitos Creek was remediated in 1996. Remediation included removal of landfill refuse and establishment of a wetland restoration area where the 2.5-acre landfill had been located. Another portion of this same landfill is located

upstream on private property and has not been remediated. Because it is immediately adjacent to the creek which is subject to erosion, it is a potential coastal hazard.

Figure 7-2: Channel Evolution Model

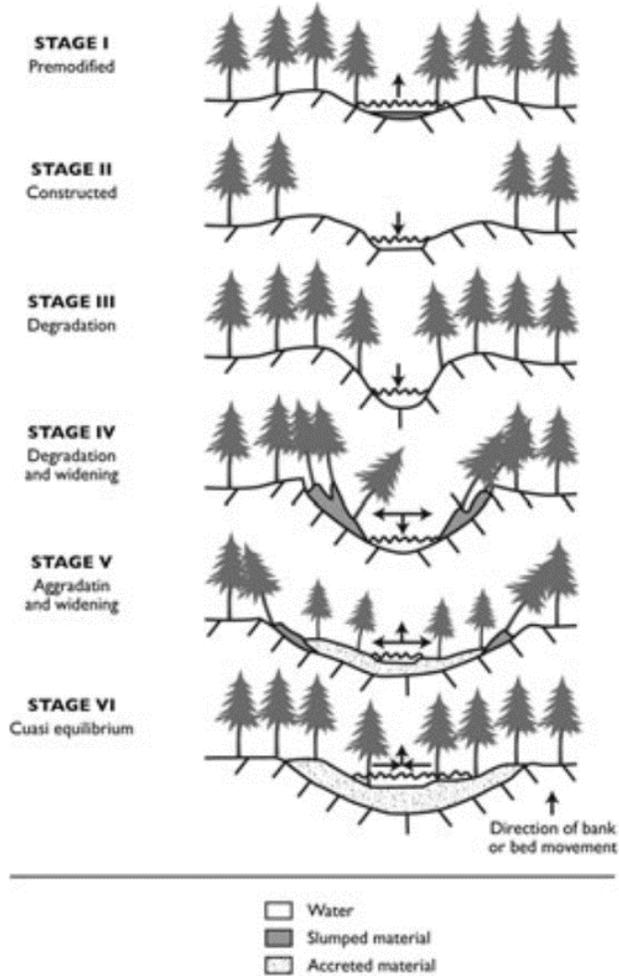
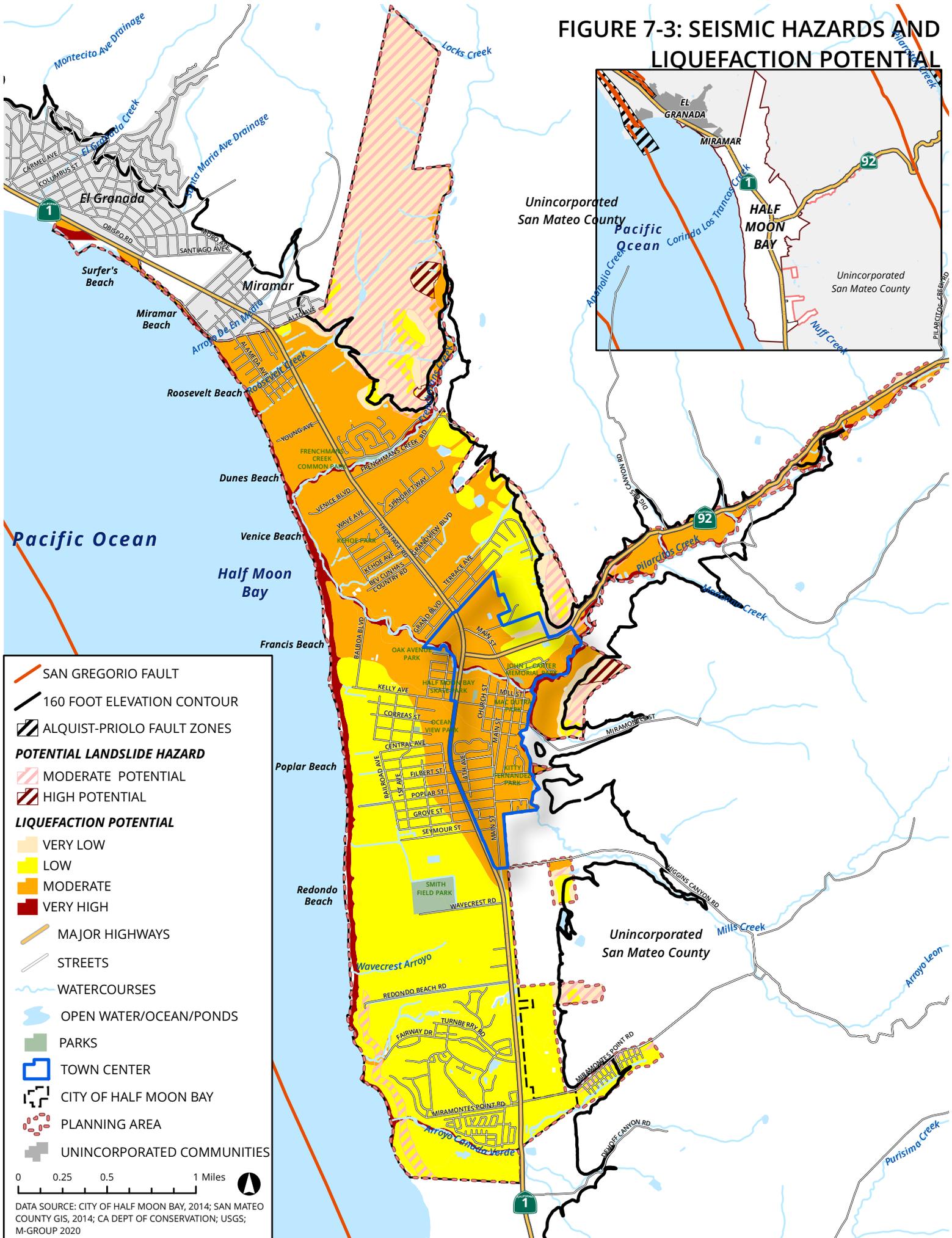


Image Source: Cluer and Thorne, 2013.

FIGURE 7-3: SEISMIC HAZARDS AND LIQUEFACTION POTENTIAL



- SAN GREGORIO FAULT
- 160 FOOT ELEVATION CONTOUR
- ALQUIST-PRIOLO FAULT ZONES
- POTENTIAL LANDSLIDE HAZARD**
- MODERATE POTENTIAL
- HIGH POTENTIAL
- LIQUEFACTION POTENTIAL**
- VERY LOW
- LOW
- MODERATE
- VERY HIGH
- MAJOR HIGHWAYS
- STREETS
- WATERCOURSES
- OPEN WATER/OCEAN/PONDS
- PARKS
- TOWN CENTER
- CITY OF HALF MOON BAY
- PLANNING AREA
- UNINCORPORATED COMMUNITIES

0 0.25 0.5 1 Miles

DATA SOURCE: CITY OF HALF MOON BAY, 2014; SAN MATEO COUNTY GIS, 2014; CA DEPT OF CONSERVATION; USGS; M-GROUP 2020

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Landslides

The Planning Area is mapped with localized landslide hazards in the following areas: hills rising out of the Frenchmans Creek valley; hills north and south of Highway 92 along the eastern edge of the Planning Area; and hills east of the Rice Trucking Soil Farm on Highway 1 near the intersection with Redondo Beach Road, in the southern portion of the Planning Area (Figure 7-3). In addition to hill slope, the potential for landslides is also influenced by soil moisture content, vegetative cover, and the physical characteristics of the underlying geologic formations. Landslide potential is generally considered low for much of the Planning Area, except in those portions of the planning area adjacent to hillsides, coastal bluffs, and shorelines. Mitigation of landslide risk is achieved through proper evaluation of underlying site conditions, structural components, and avoidance of active landslide areas. Different types of landslides are shown in Figure 7-4.

Figure 7-4: Landslide Types

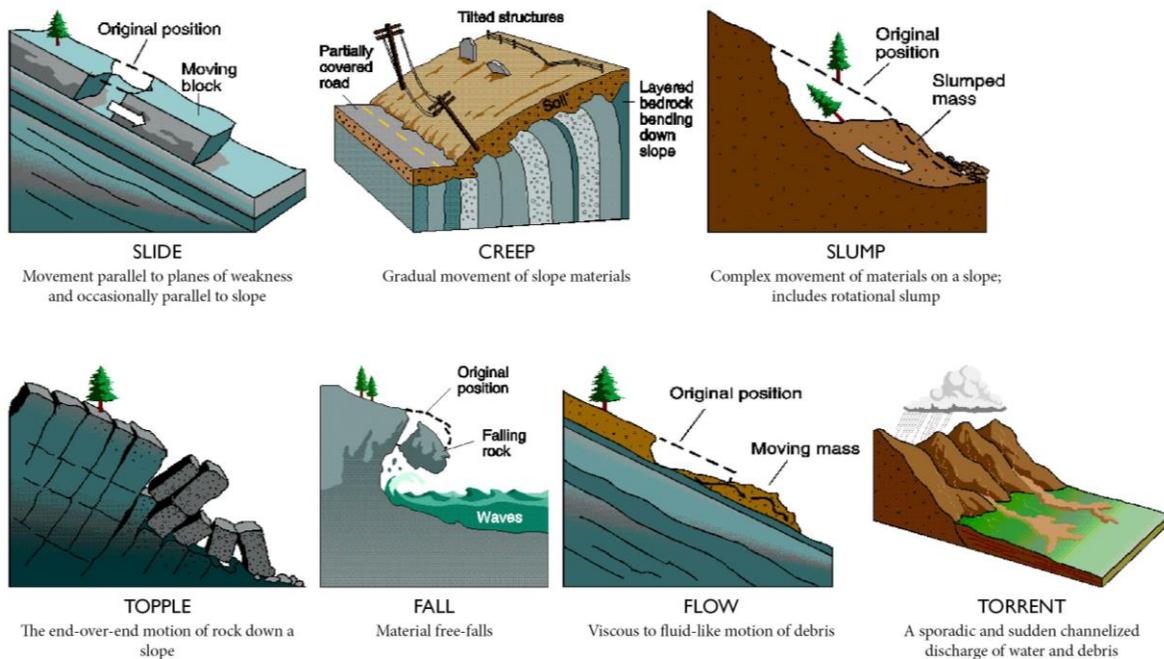


Image source: British Columbia Geological Survey (1997)

Subsidence

Subsidence occurs where water, gas, or other material is removed from intergranular spaces, resulting in compaction of soils. In extreme circumstances, this phenomenon can cause severe lowering of the soil surface, causing damage to overlying structures and placing lives at risk. Piping-induced subsidence occurs when erosion removes soil from a tunnel into a stream bank without eroding the exposed face of the stream bank. Leaking infrastructure pipes can also remove surrounding soils, creating subsidence. Subsidence is most common in areas underlain by loose, compressible clay rich soils, where water or oil is withdrawn in excessive amounts. Subsidence may also occur within landfill areas, as the underlying

materials compact over time. The potential for subsidence in the Planning Area is considered low. However, the use of private wells for agriculture may become more of a concern as climate change causes more severe drought cycles and more ground water is extracted over longer periods of time to maintain irrigation needs.

Soil Expansion

The shrink-swell potential of soils, or expansion potential, denotes the amount the volume of a particular soil type in response to presence or lack of moisture. Expansion and contraction of soils over time can damage slabs, foundations, and structures if the site is not properly prepared or if the slab or structure is not designed to withstand or accommodate such forces. The expansion potential of soils underlying the Planning Area varies depending on the clay content. Soil expansion and shrink-swell is typically addressed through preparation of site-specific soil engineering reports and compliance with the Uniform Building Code. Methods to address expansive soils include over-excavation and replacement or amendment of fill materials, moistening of fill materials, and special specifications for concrete materials and reinforcement.

SEISMIC HAZARDS

Faults

There are several significant faults that could be the source of a seismic event in the Planning Area (Figure 7-3). The extent of the effect depends in part on the source fault and epicenter location. The San Andreas Fault system, located approximately 5 miles east of the Planning Area, is considered the most likely source of a major earthquake event in California's future. The southern end of the Planning Area is within 0.5 miles of the San Gregorio Fault. The San Gregorio Fault and smaller faults including Denniston Creek and Seal Cove that are part of this system are mapped Alquist-Priolo Special Studies Zones and are considered active. Not much is understood about this fault system, since little of the fault is exposed onshore. However, it is considered active, with a potential earthquake moment at a magnitude of 7 or greater. Specific hazards associated with seismic events and features are discussed below.

Groundshaking

Groundshaking potential throughout the Planning Area is mapped as very strong to violent (based on a major event along the San Andreas Fault).¹⁶ An event of sufficient magnitude would damage even strong, modern buildings in the area. The extent of potential damage depends on a number of factors, including the location of the earthquake epicenter, and the intensity of shaking on a given site. Groundshaking associated with a major event along the San Andreas or San Gregorio Fault systems would have severe effects in the Planning Area.

¹⁶ California Seismic Safety Commission, California Geological Survey, Governor's Office of Emergency Services, and United States Geological Survey. 2003. Earthquake Shaking Potential for California, California Seismic Safety Commission Publication No. 03-02. Accessed January 16, 2014 Located at: http://www.seismic.ca.gov/pub/intensitymaps/sfbay_county_print.pdf.

Ground Failure

Settlement

Seismic settlement is the displacement of surface geologic structures associated with a seismic event. Settlement can cause unexpected changes in grade, interrupt utilities, and damage structures. The potential for seismic settlement has not been mapped for the Planning Area; however, considering the alluvial nature of most soils within the Planning Area, there is potential for seismic settlement.

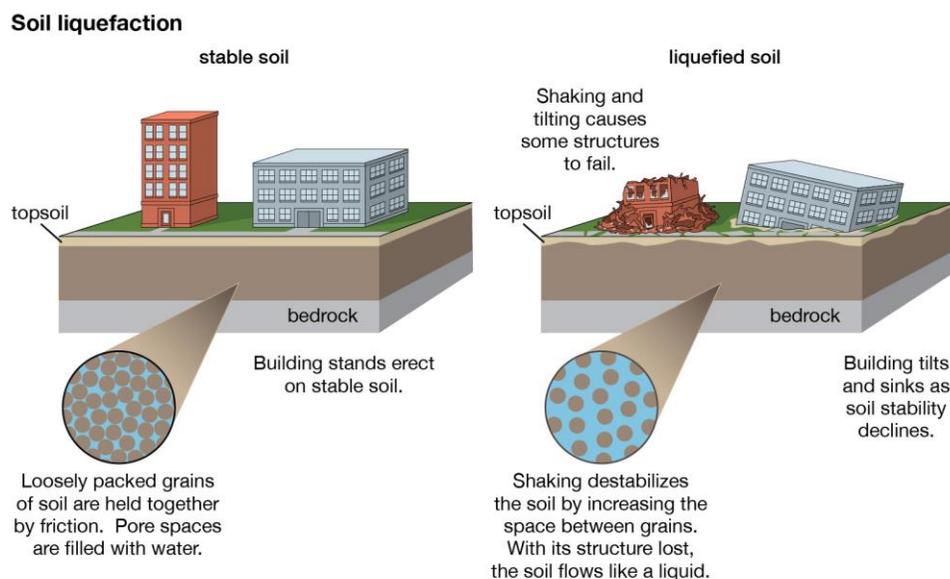
Rupture

Rupture occurs when movement on a fault breaks through to the surface. Areas overlying active faults are among those areas at risk of rupture during a seismic event. There are no known faults that go through the Planning Area and therefore rupture is considered to be a low risk hazard.

Liquefaction

Liquefaction is the condition by which saturated soils lose cohesion during seismic events and settle, lose stability or amplify the effects of groundshaking (See Figure 7-5). Liquefaction is most associated with alluvium and other young soil types with high sand content. The potential for liquefaction in the Planning Area is mapped as low to very high, depending on location (see Figure 7-3). Areas of very high hazard exist along the shoreline sand beaches within the Planning Area. Areas of high hazard include the areas surrounding the Frenchman's Creek, Pilarcitos Creek, and Arroyo Leon watersheds. Areas of low to moderate hazard comprise of most of the Planning Area.

Figure 7-5: Soil Liquefaction



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Image source: Encyclopedia Britannica Online, 2012.

Slope Failure

Seismic events can cause landslides, failure of slopes, and exacerbation of existing slope instability. The Planning Area is generally gently sloping, except for the northeastern section of the Planning Area and areas along the shoreline bordered by bluffs and revetments.

Risk of Upset

As previously noted, there are a limited number of hazardous materials sites in the city that have not been remediated. Seismic events can affect the security of these sites. The Half Moon Bay Landfill site may be particularly vulnerable because of its location on the eroding coastal bluff.

Inundation

In addition to impoundments within the Planning Area, portions of the City of Half Moon Bay are downstream from bodies of water created by the Pilarcitos Dam or the Johnston Dam. Ground shaking could pose a threat of inundation caused by seiche (waves within closed water bodies) or by dam failure. These risks are addressed as flood risks later in this chapter.

Policies – Geologic and Seismic Hazards

The LUP's policies serve to minimize exposure to geologic and seismic hazards by limiting development in areas potentially subject to such hazards. Policies require geological reports for development in potentially hazardous areas that identify any necessary mitigation measures, as well as the review of development applications based on threats from and impacts on geologic and seismic hazards. Additionally, geologic event analyses are required to document the factors involved in a damaging event such as a landslide.

- 7-44. Minimize Geologic Hazard Consequences.** New development in areas of high geologic and seismic hazard shall minimize risk to life and property and neither create nor contribute to geologic and seismic hazards. Geologic and seismic hazards are defined to include soil stability, erosion, sedimentation, landslides, subsidence, seismicity, and liquefaction.
- 7-45. Seismic and Geologic Hazard Mapping.** Maintain and update maps of geologic and seismic hazard areas in response to significant updates in best available science and information.
- 7-46. Geological Reports.** Require submittal of a site-specific geologic hazards report prepared by a qualified professional for new development proposed in areas of high geologic hazard risk, including as indicated on the Seismic Hazards and Liquefaction Potential map (Figure 7-3). The report shall describe the threats and impacts from geologic hazards arising from, for example, seismic events, watercourse erosion, landslides, expansive soils, and subsidence areas. Reports shall identify appropriate hazard setbacks, siting and design options, and mitigation measures where necessary to minimize potential impacts to life and property.
- 7-47. Hillside Construction Slope Limitation.** Require submittal of a soils and slope stability report prepared by a qualified professional for all new development on

slopes 20 percent or greater. Development of new structures on hillside slopes 30 percent or greater shall be prohibited, with the exception of critical facilities and public infrastructure that cannot be located elsewhere.

- 7-48. New Critical, High-Occupancy, and Public Facilities in Geologic Hazard Areas.** Prohibit the siting of new critical facilities, structures involving high occupancies, and public facilities in areas of high geologic hazard unless such location is deemed essential to the public welfare. Where permitted, these structures will be sited, designed, and constructed to minimize and mitigate potential for damage due to ground deformation, seismically triggered subsidence, landslides, or other geologic hazards. Public access and recreation facilities, such as trails, may be located in such areas when geologic hazards are appropriately avoided or mitigated to the extent feasible.
- 7-49. Landslide Remediation and Stabilization.** Permit the remediation or stabilization of landslides that affect existing structures or that threaten public health or safety except along coastal bluff or other eroding edges, such as streambanks. Permit remediation or stabilization to the extent necessary where an existing landslide prevents development of private property and remediation does not shift risk to other property, and the remediation project includes mitigation monitoring and reporting. Alternative remediation or stabilization techniques shall be analyzed to determine the least environmentally damaging alternative. Maximum feasible mitigation shall be incorporated into the project in order to minimize adverse impacts to resources.
- 7-50. Geologic Event Analysis.** Require a detailed study to be conducted in the event that a substantial landslide or seismic event may have caused significant damage to a foundation or structure to document the geologic materials, foundations, or structures involved.

Fluvial Flood Hazards

This section describes fluvial flood hazards in the City's watercourses that occur upland from the shoreline. Several creeks and drainages pass through the city and are subject to fluvial flooding. Fluvial flooding can be exacerbated by sedimentation, which reduces carrying capacity, and by coastal flooding, as wave run-up reduces discharge capacity. Figure 7-6 maps flood hazards for the Planning Area pursuant to the Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Map (FIRM) for San Mateo County. Data shown in this figure reflects the most recent flood hazard mapping for the Planning Area at the time of the LUP update. However, it is important to note that FIRMs are based on historical flooding and do not include consideration of future flooding impacts that would be exacerbated by sea level rise. As such, sea level rise projections and LUP policies, including as mapped on Figure 7-1, should also be considered for new development projects along watercourses as applicable.

FLOOD HAZARD ZONES

According to the FIRM, several portions of the Planning Area are mapped within flood hazard zones. The entirety of the coast typically landward to the nearest coastal bluff or just inland

is within a coastal high hazard area, designated Zone VE. Zone VE denotes coastal areas subject to the 100-year flood with additional hazards associated with storm-induced waves for which Base Flood Elevations (BFEs) have been determined. BFEs are the computed elevations to which floodwater is anticipated to rise during the 100-year flood (a flood having a 1 percent chance of being equaled or exceeded in any given year), as calculated by FEMA. Along Half Moon Bay's coast, the BFEs range from 19 to 38 feet relative to the North American Vertical Datum of 1988 (NAVD 88).

In addition to coastal high hazard area, a special flood hazard area (Zone A, 100-year flood; no BFE determined) is mapped along the entirety of Frenchmans Creek and along portions of Arroyo Leon Creek and Pilarcitos Creek in the eastern portion of the Planning Area. With the exception of these creek spans, FEMA mapping for the Planning Area has been primarily limited to the shoreline and does not indicate flood hazards further inland such as those that may be associated with other watercourses, or for dam inundation. However, there is the potential for such hazards to exist as flood zone changes occur over time.

Existing state and local regulations generally guide development within the 100-year flood hazard zone. The City has participated in the National Flood Insurance Program (NFIP) since 1986 and adopted a floodplain management program into the local ordinance in 2002.

LOCALIZED FLOODING, EROSION AND SEDIMENTATION

Urban development and impervious surfaces typically change the distribution of storm impact intensities and related hydrology. At development sites with traditional storm drainage infrastructure (e.g. pipes and culverts), water quickly flows into the system, potentially causing a more severe localized storm impact and adversely impacting natural hydrology. Because the stormwaters are not allowed to recharge, over time traditional stormwater management systems can contribute to lowering the water table. At the other end of the storm drainage system, however, the flow of water is accelerated, and property near the outflow might also experience a larger storm impact. Such hydromodification can result in degradation of natural and man-made features, as well as localized flooding, erosion or sedimentation where existing features (natural or man-made) are not sized, designed, or maintained in a manner sufficient to handle storm flow quantities and maintain a balanced sediment transport.

The City's storm drainage system typically conveys run-off to various natural or man-made drainage features. Much of this drainage system consists of a network of man-made ditches or swales originally constructed prior to 1948 (earliest imagery available for review) or by the mid-1950s as roadside or agricultural drainage features. The primary function of these drainage features is to convey run-off from the east side of Highway 1 through culverts to the network of ditches and swales located along the coastal terrace and eventually to the ocean. Between the 1960s and 1980 large portions of agricultural lands in the Planning Area were developed with residential uses with much of the Planning Area resembling current conditions in the late 1990's. Much of the drainage infrastructure has not been updated and many features are not suitable for current development flows, resulting in localized flooding that damages or threatens property and infrastructure. Lack of maintenance of existing drainage infrastructure can also result in localized flooding as culverts are blocked or sediment or debris accumulates reducing capacity.

Areas within the Planning Area where previous events or studies have identified that localized flooding may be a concern include, but are not limited to, the Casa del Mar neighborhood near Kehoe Watercourse, Miramar neighborhood near Roosevelt Drainage and Pullman Watercourse, and the Grandview and Highland Park neighborhoods below impoundments. Many of the studies are outdated or limited to small portions of the Planning Area.

Flooding, erosion and sedimentation risks can all be reduced by protecting watercourses. The primary objective is to manage the volume and speed of flows to levels that the watercourse, whether natural or manmade, can sustainably convey. Restoring the capacity in upper watersheds can reduce flood risk in lower watercourses. Factors that contribute to increased flows and speed include accelerated stormwater from upper watershed infrastructure; development and reduction in vegetation along the extents of the watercourse and in the flood plain that drains into the watercourse; and channelization and channel hardening.

Green Infrastructure

Development almost always reduces pervious surface area and thereby contributes to a cumulative increase in stormwater run-off throughout the Planning Area. The City has been implementing stormwater management requirements conforming to federal, state, and local regulations. In 2019, the City adopted a Green Infrastructure Plan to further improve stormwater management and to ensure consistent incorporation of green infrastructure into public and private development projects. As discussed further in Chapter 6. Natural Resources, green infrastructure is an approach to stormwater management that uses natural systems such as swales and rain gardens to retain run-off on-site, and meandering watercourses that sustainably transport flows that charge the riparian corridor and beach. These systems allow for natural filtration to the water table, or controlled release of stored water into the storm drain system. With green infrastructure design, stormwater is viewed as a resource with many potential purposes, including groundwater recharge and habitat restoration.

Vegetation and Riparian Habitat

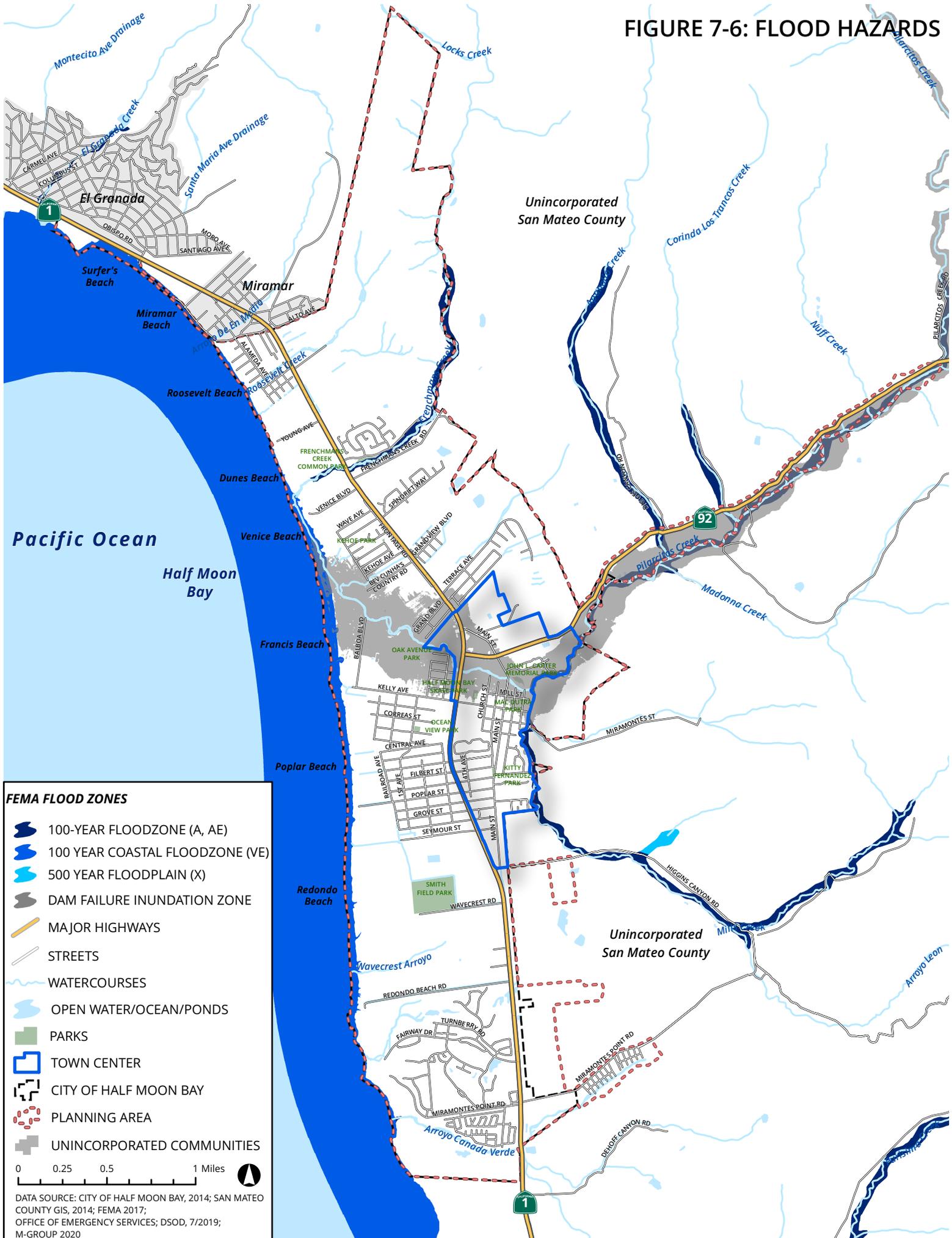
With respect to vegetation, riparian and other plant materials are highly effective at slowing flows and reducing the volume of runoff. Trees are especially effective at absorbing run-off and uptake capacity is quantified for some species. The presence of vegetation in the flood plain adjacent to a watercourse slows the arrival of surface flows at the stream bank and absorbs additional stormwater. When vegetation is enriched along any span of a watercourse, flow volume and speed will decrease which can reduce localized flooding downstream.

Channel Hardening

Engineered solutions to address flood control include concrete channels, paved gutters, culverts, and piping systems. Hardening of a natural or manmade drainage, including creeks, ditches and other watercourses, can in the short term improve the stability of the hardened portion of the drainage and protect it from erosion. However, often these types of improvements have unintended consequences of increasing flow speed and disrupting

natural drainage systems. This can also consequently result in erosion and increased flood risk downstream, as well as flanking erosion and hydrostatic pressure that can undercut hardened banks. For emergency situations, temporary hardening systems may be appropriate; however, most of the City's drainages are not hardened and a planning objective is to use restoration techniques to avoid future hardening. Where channel hardening is necessary, design should carefully consider how to avoid contributing to erosion and other downstream impacts.

FIGURE 7-6: FLOOD HAZARDS



FEMA FLOOD ZONES

-  100-YEAR FLOODZONE (A, AE)
-  100 YEAR COASTAL FLOODZONE (VE)
-  500 YEAR FLOODPLAIN (X)
-  DAM FAILURE INUNDATION ZONE
-  MAJOR HIGHWAYS
-  STREETS
-  WATERCOURSES
-  OPEN WATER/OCEAN/PONDS
-  PARKS
-  TOWN CENTER
-  CITY OF HALF MOON BAY
-  PLANNING AREA
-  UNINCORPORATED COMMUNITIES

0 0.25 0.5 1 Miles 

DATA SOURCE: CITY OF HALF MOON BAY, 2014; SAN MATEO COUNTY GIS, 2014; FEMA 2017; OFFICE OF EMERGENCY SERVICES; DSOD, 7/2019; M-GROUP 2020

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INUNDATION CAUSED BY DAM OR IMPOUNDMENT FAILURE

Dams can be damaged resulting in possible dam failure from several natural or man-made hazards such as large storms, earthquakes, slope failures, design flaws, and erosion. Dam failure is a concern for many reasons. Most important, dam failure can result in substantial inundation of downstream areas endangering public health, safety, and property as well as loss of water storage for significant time periods. There are no records of dam failure within the Bay Area.¹⁷ Two dams located in the vicinity have the capacity to endanger lives and property within the Planning Area in the event of failure; Johnston Dam and Pilarcitos Dam. Johnston Dam is relatively small, and no inundation area data is available. As shown on Figure 7-6, inundation from Pilarcitos Dam could be substantial with areas adjacent to the creek experiencing inundation from 200-600 feet in width covering an area of approximately 247 acres within the Planning Area (approximately 176 acres of urban land)¹⁸ as well as portions of Highway 92 and the SAM wastewater treatment facility. The Pilarcitos Dam is operated by San Francisco Water Department (SFWD) and is located outside of the study area and bounds of Figure 7-6.

Dam inundation mapping typically occurred during the 1970s. Such mapping represents a best estimate and typically assumes that the dam is full during failure, does not account for potential run-off from storms or other contributing factors, and does not indicate inundation depths. Similar to tsunami mapping, dam failure mapping is generally for evacuation planning and risk assessment or future safety upgrades or planning.¹⁹

The Planning Area also includes several impoundments. Most of them are manmade ponds presently or previously used for agricultural purposes. They are not large enough to be regulated by the State and no inundation data is available for these water storage facilities. Impoundments contribute flows to various drainages and other watercourses. Several are located in the eastern hillsides, including at Pacific Ridge and facilities higher up the hill outside the Planning Area. Some of these impoundments have been observed to overtop during severe storm events which can adversely affect water quality. Failure at these higher elevations could result in a surging conveyance of large volumes of water to lower lying areas in a short period of time. Impoundments can also improve public safety by retaining water during significant storm events, and can be sensitive habitat areas (reference Figures 6-2 through 6-4 in Chapter 6. Natural Resources). Future study of City drainages should consider the potential risks associated with these impoundments during natural disasters including severe storm conditions. Such study can lead to implementation of water level management policies and other avoidance and mitigation measures for safe on-going maintenance of these facilities.

¹⁷ Association of Bay Area Governments (ABAG), 2010, Taming Natural Disasters, Multi-Jurisdictional Local Hazard Mitigation Plan for the San Francisco Bay Area, Publication Number: P09001EQK.

¹⁸ ABAG, 2014b Land Use and Infrastructure in Hazard Areas Data, Accessed 1/24/2014 at <http://quake.abag.ca.gov/mitigation/landuse/>.

¹⁹ Association of Bay Area Governments (ABAG), 2010, Taming Natural Disasters, Multi-Jurisdictional Local Hazard Mitigation Plan for the San Francisco Bay Area, Publication Number: P09001EQK.

Policies – Fluvial Flood Hazards

The LUP seeks to reduce the risk to life and property from flood hazards. It requires the City to maintain updated information on flood hazards for planning purposes, including flood and dam/impoundment inundation hazard areas. Policies are in place to limit development in flood hazard zones and require mitigation for any permitted development in those areas. Development in adjacent areas is required to increase site performance and address biological and water quality issues. Development of critical facilities is also limited in dam inundation areas. No development is permitted that would cause or contribute to flood hazards, and existing hazards should be abated through a variety of potential measures. Additionally, the LUP requires the City to update its Citywide Drainage Master Plan to improve the capacity of the stormwater system, protect floodplains, and maintain balanced sediment transport.

Policies – General Fluvial Flood

- 7-51. Flood Hazard Avoidance for New Development.** Ensure that no new permitted development causes or contributes to flood hazards.
- 7-52. New Development in Flood Zones.** Prohibit new development, except for those uses allowed within the watercourse itself or its buffer zone pursuant to Chapter 6. Natural Resources (e.g. restoration), within the 100-year flood hazard zone of a watercourse. If no alternative building site exists, proper mitigation measures shall be provided to minimize or eliminate risks to life and property from flood hazard, and to ensure the development would not constitute a public nuisance, decrease watercourse capacity, or direct flows outside of the watercourse.
- 7-53. New Development Adjacent to Flood Zones.** Require new development in areas outside of the identified 100-year flood hazard zones to identify opportunities to improve site drainage, address biological resource and water quality issues, and reduce contributions to flood hazards.
- 7-54. Flood Hazard Mapping.** Maintain and update flood hazard mapping (flooding and dam or impoundment inundation) to incorporate significant updates in best available science and information, including but not limited to the most current official FEMA FIRM to determine the general location of flood hazard areas. Support and pursue study and mapping of inland watercourses, prioritizing Pilarcitos Creek, as well as updated dam inundation and local impoundment mapping.
- 7-55. Flood Protection.** Prohibit habitable space at elevations subject to flood risk. New development that must be located in areas subject to current or future flooding shall be sited and designed to be capable of withstanding such impacts in compliance with FEMA, NFIP, and Coastal Act requirements. This shall include elevating all finished floor elevations at least 2 feet above the 100-year flood event, taking into account future climate change and projected storm events. Allow retrofitting for existing development in areas subject to current or future flood, including through elevation of habitable areas, use of break-away walls, etc. Ensure that flood protection measures are consistent with the visual and other coastal resource protection policies of this LCP in the siting and design of raised development and other adaptation measures.

- 7-56. Flood Hazard Abatement.** Flood hazard abatement projects that require a coastal development permit shall be designed with performance standards that consider the following:
- Removal or relocation of development from flood hazard areas;
 - Prioritizing green infrastructure approaches;
 - Restoration of flood plains and meander belts of drainages that were channelized;
 - Construction of impoundments or channel diversions when necessary, provided that adequate mitigation of environmental impacts can be demonstrated; and
 - Debris clearance and silt removal conducted in a manner so as not to disrupt existing riparian communities.
- 7-57. Flood Protection Evaluation.** Require new development proposals to evaluate potential impacts to adjacent or downstream properties from all proposed structural flood protection measures to ensure that the flood protection measures will not create adverse direct and/or cumulative impacts either on-site or off-site.

Policies – Localized Flood

- 7-58. Dam Inundation Impact Avoidance.** Update the Pilarcitos Dam inundation evaluation periodically to account for changes in localized flood risk. Establish setbacks and minimum building pad elevations for new development to avoid and mitigate flooding impacts in the event of dam failure, in coordination with SFWD dam management.
- 7-59. Impoundment Impact Avoidance.** Where a new or modified impoundment project requires a coastal development permit, require avoidance measures and on-going maintenance to minimize risk of flood and water quality impacts and protect ESHAs associated with impoundments, such as proof of flood insurance. Study the condition and function of the impoundments located within and on the hills above the city limits, and assess the cumulative impacts of anticipated development within watersheds.
- 7-60. Development in Dam Failure Inundation Zone.** Except for public works and critical facilities or within established neighborhoods as identified in Chapter 2. Development, do not permit new non-coastal dependent structures in areas at risk of flooding due to dam or impoundment failure, unless a technical study demonstrates all of the following:
- The hazard no longer exists or has been or will be reduced or eliminated by improvements or design adaptations incorporated into the proposed development (e.g. raised foundation) which are consistent with the policies of this Plan; and
 - The development will not contribute to flood hazards; and
 - The development will not require the expenditure of public funds for flood control works.

In the case that a technical study demonstrates these findings, require as a condition of approval a hold harmless to be recorded against the property that indemnifies the

City from any harm caused to permitted development by dam or impoundment failure.

Fire Hazards

This section describes fire hazards present in the Planning Area.

URBAN FIRE HAZARD

Urban fires are fires that begin in buildings in urban centers. They are typically localized but have the potential to spread to adjoining buildings. The risk of urban fires is highest where single-family homes, multifamily residences and business facilities are clustered close together, increasing the possibility of rapid spread to an adjoining building. The risk to life and property can be reduced by adopting and funding adequate levels of fire protection, siting new buildings a sufficient distance from high fire risk areas, ensuring new buildings are built to include fire resistive features which conform to modern fire and building codes, and implementing fuel management strategies such as removal of dead and dying brush.

WILDLAND FIRES

Wildland fires are fires that start in a wooded or undeveloped area. Their potential for damage is dependent on the extent and type of vegetation, known as surface fuels, as well as weather and wind conditions. Wildland fires occur infrequently but typically cause more damage than urban fires.

The Wildland-Urban Interface (WUI) is any area where structures and other human developments meet or intermingle with wildland vegetative fuels. The shrubs, trees and grasses that make Half Moon Bay's hills so beautiful have evolved to burn. Some invasive exotic species such as Cape ivy and Blue gum eucalyptus are prominent in the Planning Area and are both highly invasive and fire-prone. Parts of the Planning Area located in the natural vegetation of the foothills are in the WUI and are thus inherently at risk from wildfires.

The California Department of Forestry and Fire Protection (Cal Fire) maps areas of significant fire hazards in the state. These areas are identified based on weather, terrain, fuels, and other factors. According to Cal Fire, Very High Fire Severity Zones (VHFSZ) are located in the vegetated hills in the north of Half Moon Bay east of Nurserymen's Exchange and the Frenchmans Creek and Sea Haven neighborhoods, as well as the Carter Hill PD area and both sides of Highway 92 as it leaves the city. Portions of the Planning Area outside city limits along Highway 92 and Miramontes Point Road are generally mapped as Moderate Fire Hazard Zones, with areas north of Highway 92 mapped as Very High hazard. East of city limits, the land north of Miramontes Street is generally mapped as Very High hazard, while land to the south is mapped as High or Moderate.

Cal Fire also designates land as either a State or Local Responsibility Area (SRA and LRA). The SRA is the area of the state where the State of California is financially responsible for the prevention and suppression of wildfires. SRA does not include lands within city boundaries, which are considered LRAs. The City of Half Moon Bay is an LRA while the small areas of the

Planning Area outside city limits are in the SRA. Fire hazard severity zones are shown in Figure 7-7.

Historically, wildland fires have occurred in and around the Planning Area. Cal Fire maintains records of these fires, including the specific location, land area involved, the cause if known, as well as details about the overall event and response. Large historic wildland fires on the San Mateo County coastside are summarized below in Table 7-3. Four wildland fires occurred after 1976, ranging in affected area from 7 to 20 acres. These smaller areas of impact reflect improvements in fire prevention and suppression. Historic wildland fires occurring between 1929 and 2008 are mapped on Figure 7-8. This historic information informs fire prevention and emergency services policies.

Table 7-3: Historic Large Wildland Fires – Fire Area Greater than 100 Acres

<i>Year</i>	<i>Approx. Size (Acres)</i>	<i>Location</i>
1929	400	San Pedro Valley/Montara
1929	3,000	Montara, San Francisco Watershed
1930	Not known	Gazos Creek, El Moore Camp
1936	1,500	Pedro Ridge and San Gregorio
1943	600	San Mateo Rd, Skyline, marsh Ranch
1946	650	El Granada Highlands, Goldberg
1949	100	Lobitas, Tunitas
1952	100	Pedro Mountain
1955	200	El Granada Highlands, Goldberg
1958	300	Vallemar
1976	150	Tunitas Canyon

Source: Cal Fire Santa Cruz office, August 2017, fires greater than 100 acres 1929 - 2008

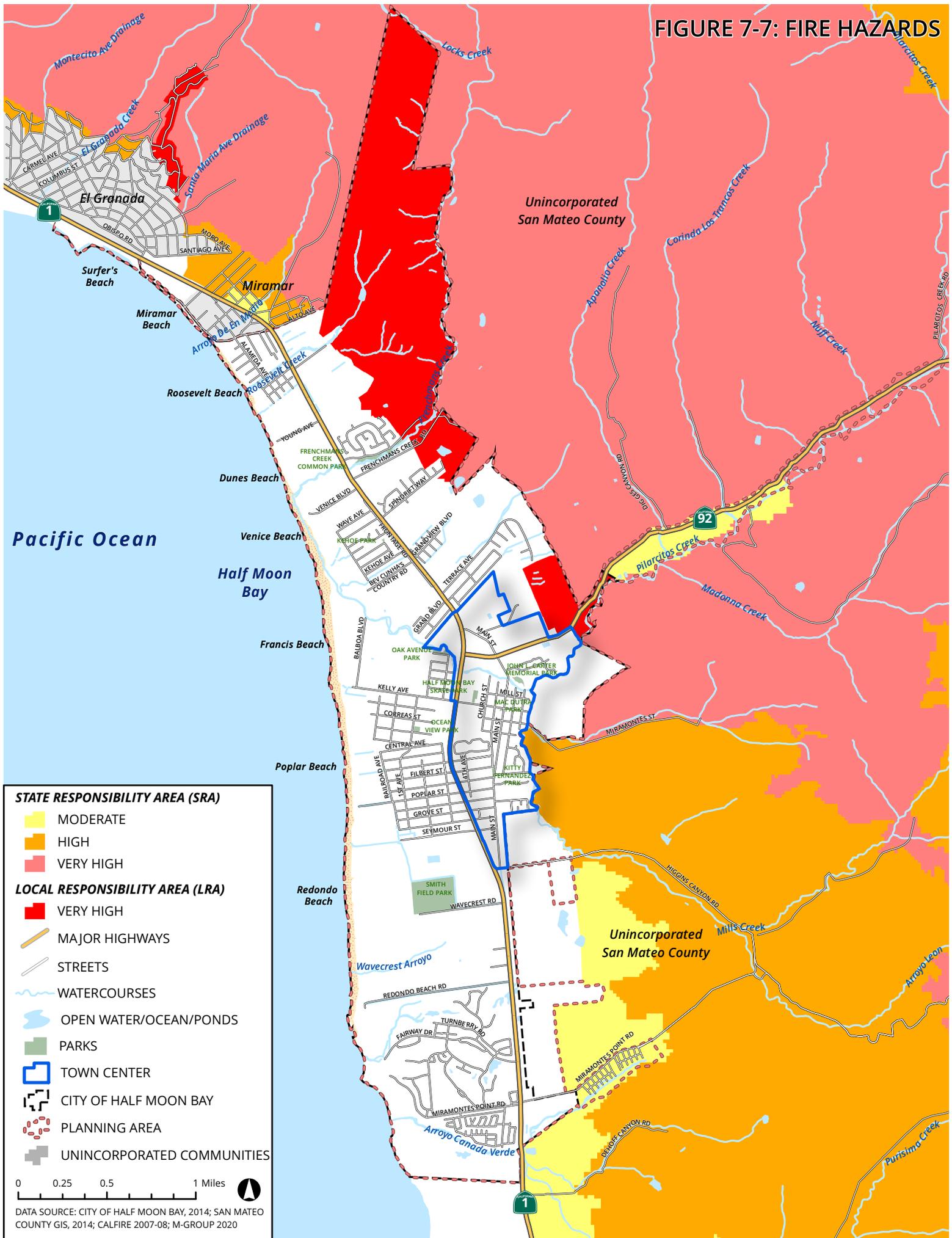
FIRE PROTECTION SERVICE

The Coastside Fire Protection District (CFPD) provides fire protection services in the Planning Area, neighboring communities and surrounding unincorporated areas, a territory covering approximately 50 square miles along the San Mateo County coast and a population of approximately 30,000. In addition to Station 40 on Main Street near Highway 1, CFPD also operates Station 41 immediately north of the Planning Area in El Granada. CFPD is staff and managed by Cal Fire. As such, CFPD provides coverage within and all around the Planning Area and can direct response needs across multiple stations. In the event that more support is required, mutual aid is available from Belmont and other peninsula fire districts. CFPD staff receive the same training as Cal Fire employees and are therefore especially well prepared to prevent and quickly repress wildland fires. CFPD also conducts routine inspections of properties within or near VHFSZs, specifically ensuring that defensible space is provided around structures and that access for emergency response vehicles and critical fire breaks are maintained. CFPD indicated that as of 2017 there are no gaps in coverage and that service

levels and response times are well within established standards throughout the Planning Area.²⁰

²⁰ Discussion with Battalion Chief/Fire Marshall, CFPD, August 2017.

FIGURE 7-7: FIRE HAZARDS



STATE RESPONSIBILITY AREA (SRA)

- MODERATE
- HIGH
- VERY HIGH

LOCAL RESPONSIBILITY AREA (LRA)

- VERY HIGH

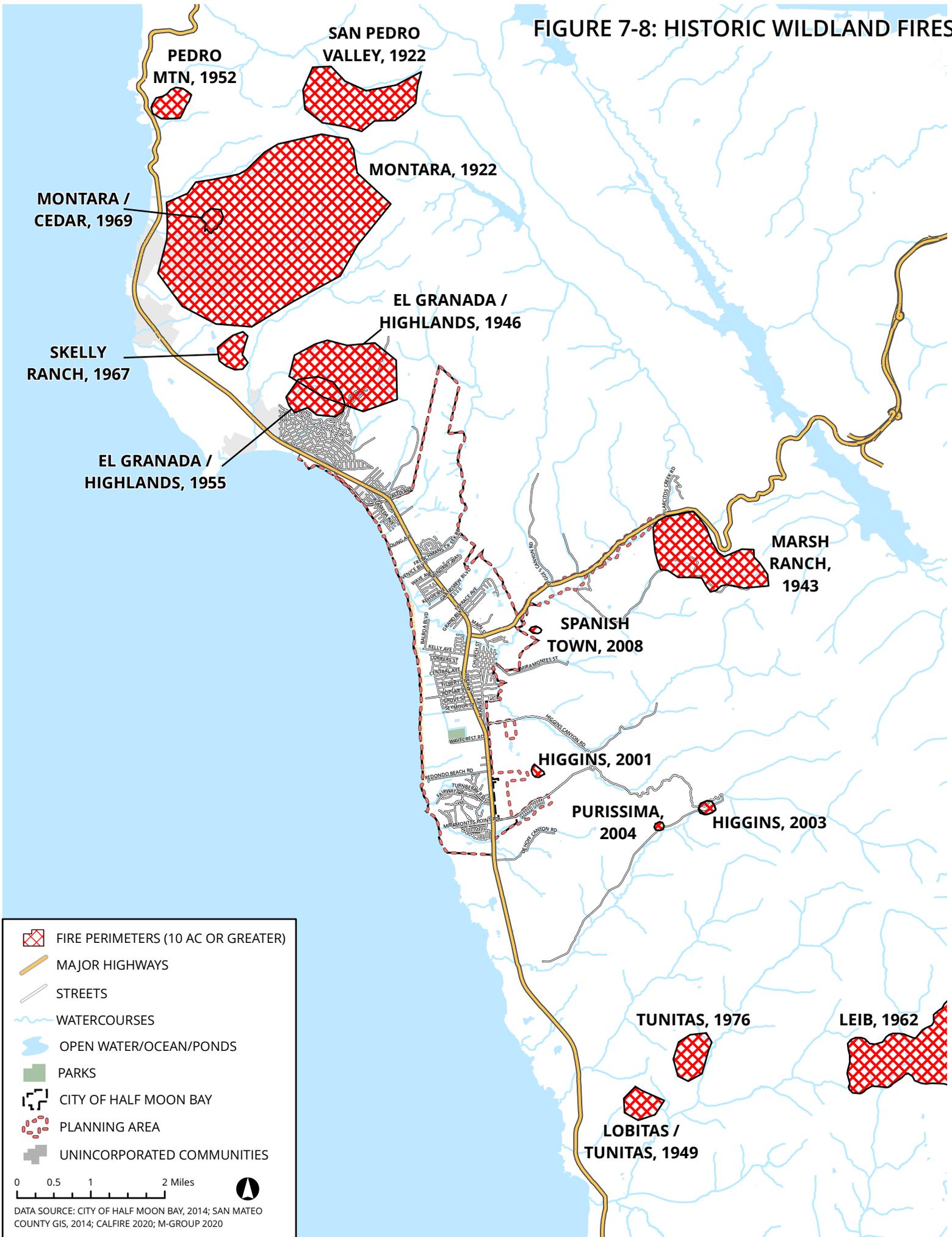
- MAJOR HIGHWAYS
- STREETS
- WATERCOURSES
- OPEN WATER/OCEAN/PONDS
- PARKS
- TOWN CENTER
- CITY OF HALF MOON BAY
- PLANNING AREA
- UNINCORPORATED COMMUNITIES

0 0.25 0.5 1 Miles ▲

DATA SOURCE: CITY OF HALF MOON BAY, 2014; SAN MATEO COUNTY GIS, 2014; CALFIRE 2007-08; M-GROUP 2020

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FIGURE 7-8: HISTORIC WILDLAND FIRES



-  FIRE PERIMETERS (10 AC OR GREATER)
-  MAJOR HIGHWAYS
-  STREETS
-  WATERCOURSES
-  OPEN WATER/OCEAN/PONDS
-  PARKS
-  CITY OF HALF MOON BAY
-  PLANNING AREA
-  UNINCORPORATED COMMUNITIES

0 0.5 1 2 Miles 

DATA SOURCE: CITY OF HALF MOON BAY, 2014; SAN MATEO COUNTY GIS, 2014; CALFIRE 2020; M-GROUP 2020

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Policies – Fire Hazards

The LUP seeks to reduce the risks to life and property from fire hazards in Half Moon Bay by setting conditions for new development and encouraging cooperation with the CFPD. Policies require that new development be limited in areas of high fire risk and that any new development use siting and design and fuel modification to minimize risks. They also require new development to pay impact fees to contribute to the provision of fire protection services. Where fuel modification is necessary, the LUP requires that it is done in a manner that minimizes impacts to vegetation, ESHA, and parkland, as well as effects such as erosion, runoff, and sedimentation. Policies require that development is reviewed by the CFPD to ensure compliance with fire safety regulations and that development must be accessible to fire services. The City must also coordinate with the CFPD to ensure consistency between its fire hazard policies and fire regulations and ensure that the community is adequately covered by fire protection and prevention services. The LUP also requires that the City plan for fire risks that may arise in the future due to factors such as climate change.

- 7-61. Minimize Fire Hazards.** Minimize fire hazards in the city by appropriately siting development and managing fuels and ensuring adequate firebreaks and buffers around high-risk areas.
- 7-62. Fire and ESHA Protection Policy Consistency.** Balance the need for fire protection for existing structures with the need to protect environmental resources. Examples of such measures include sprinkler system retrofits, smart landscaping, restoring ESHAs for better biological function and defensible fire-fighting space, surrounding ESHAs with fire breaks, and limiting activities in areas adjacent to ESHAs.
- 7-63. Siting and Design for Fire Hazard Avoidance.** Require that both new development and redevelopment, including remodeling and additions, minimize risks to life and property from fire hazard through siting and design considerations. Specifically require that:
- Development is sited and designed to avoid hazardous locations, including to avoid the need for fuel modification within ESHA and ESHA buffer zones;
 - Site-specific characteristics such as topography, slope, vegetation type, and wind patterns are assessed and considered in development plan review;
 - Appropriate building materials and design features to ensure the minimum amount of required fuel modification are utilized; and
 - Landscaping consists of fire-retardant, native plant species.
- 7-64. Fire Hazard Avoidance Conditions for New Development.** Require, as a condition of approval for new development and redevelopment, that risks to life and property from fire hazards are minimized for the life of the development through:
- Incorporation of fuel modification and brush clearance techniques for the development site and adjacent private or public roads in accordance with applicable fire safety requirements, carried out in a manner which avoids impacts to ESHA and does not diminish its buffer area;
 - Providing adequate ingress and egress for fire equipment access; and

- c. Landscaping maintenance, including removal of fire-prone, non-native and invasive species such as Cape ivy and Blue gum eucalyptus to reduce fuel load where appropriate, avoiding adverse impacts to sensitive habitats and replacing with fire-retardant, native species of higher habitat value.
- 7-65. Fuel Modification Zones.** For new habitable structures requiring fuel modification, establish two fuel modification zones as follows: Zone 1 shall extend 30 feet from the exterior walls and requires thinning, pruning, or removal and replacement of vegetation; Zone 2 shall extend between 30 and 100 feet from the exterior walls and requires thinning of non-native vegetation and removal of dead vegetation. The City retains discretion to consider project alternatives, including for siting, design, and use, if either zone includes ESHA.
- 7-66. Fire Marshal Review.** All discretionary permit applications for new habitable structures shall be reviewed by the City Fire Marshal to determine if fire safety regulations are met, if any thinning or clearing of vegetation is required for fuel modification, and if there is potential for any impacts to existing fire protection services or need for additional and expanded services. The City Fire Marshal retains the discretion to modify the fuel modification requirements on a case-by-case basis, upon finding that such changes are necessary to protect public safety due to site-specific factors such as building material, topography, vegetation type, and fuel load. However, the City retains discretion to consider project alternatives that would not require such modifications.
- 7-67. Unavoidable Fuel Modification in ESHA.** Where fuel modification within ESHAs is unavoidable or there is potential to impact habitat for protected species, require the following:
- a. Fuel modification plans for review and approval by the City that incorporate measures to minimize impacts; consider environmental and risk reduction benefits of one-time versus recurring fuel modification approaches; and include mitigation, monitoring and reporting requirements as consistent with the ESHA policies of Chapter 6. Natural Resources;
 - b. Proposed methods for protecting sensitive species, such as those required by Policy 6-35. Standards in Non-Aquatic Habitat for Special Status and Unique Species; and
 - c. Use of environmentally responsible and nature-based approaches to remove fire-prone vegetation and avoid impacts to ESHA (e.g. hand crews; grazing sheep or goats penned away from the highest value habitat area).
- 7-68. Fire Hazard Avoidance for New Subdivisions.** Ensure that new subdivisions are established with adequate emergency vehicle access, evacuation standards for residential development, and can be maintained without requiring fuel modification within ESHAs and their buffer areas. Prohibit the creation of new developable lots within high fire hazard zones.
- 7-69. Fire Hazard Avoidance of Critical Facilities.** Locate, where feasible, new critical facilities outside of high fire risk areas, including, but not limited to, hospitals and health care facilities, emergency shelters, emergency command centers, and

emergency communications facilities. If no feasible alternative exists, identify construction methods or other methods to minimize risk.

- 7-70. Emergency Vehicle Accessibility of New Development.** Require new development to assure that it can be adequately served by the CFPD, provide adequate access for fire protection vehicles, and guarantee sufficient water supply and fire flow. Development in rural or high fire hazard areas should be clustered near major roads to ensure access.
- 7-71. Street Identification and Visibility.** Ensure that all roads, streets, and major public buildings are identified in a manner that is clearly visible to fire protection and other emergency vehicles.
- 7-72. Impact Fees.** Continue to require new development to pay a fee and/or participate in an Assessment District for CFPD equipment, facility expansions, additional man power, and other capital improvements when the need arises to accommodate the increased service demand of new development and/or provide for needed capital improvements through future Capital Improvement Programs.
- 7-73. Fire Flow Upgrades.** Work with the CFPD and Coastside County Water District to establish and maintain a priority list for upgrading fire flow capabilities in neighborhoods that may have inadequate fire flows. Fire flow upgrades may require upsizing water mains solely for the purpose of establishing and maintaining adequate fire flow to protect existing development; and not for accommodating future growth. This distinction shall be acknowledged and documented for each such upgrade and restrictions limiting future use of expanded capacity to fire protection shall be implemented.