Table 1 San Rafael Hazard Identification Table

| Hazard | Geographic Extent | | Likelihood of Future Occurrences | Magnitude/ Severity | Significance | Climate Change Impacts |
| --- | --- | --- | --- | --- | --- | --- |
| Climate Change | Extensive | | Likely | Limited | Medium | N/A |
| Coastal Flooding and sea level rise | Significant | | Likely | Critical | Medium | High |
| Dam Failure | Limited | | Unlikely | Negligible | Low | Low |
| Drought and Water Shortage | Extensive | | Likely | Critical | Medium | Medium |
| Earthquake (& Liquefaction) | Extensive | | Occasional | Catastrophic | High | Low |
| Flood: (100/500 year) | Significant | | Occasional/Unlikely | Critical | High | Medium |
| Flood: Localized/Stormwater | Extensive | | Highly Likely | Limited | Medium | Medium |
| Landslide, Mudslides, Hillside Erosion, and Debris Flows | Significant | | Likely | Limited | Medium | Low |
| Levee Failure | Significant | | Occasional | Limited | Medium | Medium |
| Severe Weather: Extreme Heat | Extensive | | Highly Likely | Critical | Medium | High |
| Severe Weather: Heavy Rains and Storms | Extensive | | Highly Likely | Critical | Medium | Medium |
| Tsunami | Limited | | Unlikely | Limited | Medium | Medium |
| Wildfire | Significant | | Likely | Catastrophic | High | Medium |
| **Geographic Extent**  Limited: Less than 10% of planning area  Significant: 10-50% of planning area  Extensive: 50-100% of planning area  **Probability of Future Occurrences**  Highly Likely: Near 100% chance of occurrence in next year, or happens every year.  Likely: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.  Occasional: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.  Unlikely: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years. | | **Magnitude/Severity**  Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths  Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability  Limited—10-25 percent of property severely damaged, shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability  Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid  **Significance**  Low: minimal potential impact  Medium: moderate potential impact  High: widespread potential impact | | | | |

Risk Assessment Methodology

#### Calculating Likelihood of Future Occurrence

The frequency of past events is used in this section to gauge the likelihood of future occurrences. Based on historical data, the likelihood of future occurrence is categorized into one of the following classifications:

* **Highly Likely**: Near 100% chance of occurrence in next year, or happens every year.
* **Likely**: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.
* **Occasional**: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.
* **Unlikely**: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years.

#### Calculating Vulnerability

Vulnerability is measured in general, qualitative terms, and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential:

* **Extremely Low**: The occurrence and potential cost of damage to life and property is very minimal to non-existent.
* **Low**: Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
* **Medium**: Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
* **High**: Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have already occurred in the past.
* **Extremely High**: Very widespread and catastrophic impact.

#### Defining Significance (Priority) of a Hazard

Defining the significance or priority of a hazard to a community is based on a subjective analysis of several factors. This analysis is used to focus and prioritize hazards and associated mitigation measures for the plan. These factors include the following:

* **Past Occurrences**: Frequency, extent, and magnitude of historic hazard events including resulting damages: death/injuries, property and economic damages.
* **Likelihood of Future Occurrences**: Based on past hazard events.
* **Ability to Reduce Losses through Implementation of Existing and New Mitigation Measures**: This looks at both the ability to mitigate the risk of future occurrences as well as the ability to mitigate the vulnerability of a community to a given hazard event.

Risk Assessment Summary: City of San Rafael

#### Climate Change

* The 2013 State of California Multi-Hazard Mitigation Plan stated that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state’s infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year. Climate Change has the potential to alter the nature and frequency of most hazards.
* ANY HMPC INPUT ON CLIMATE CHANGE ISSUES IN THE CITY?
* STATUS OF CLIMATE ADAPTION PLAN?
* Likelihood of Future Occurrence: Likely
* Vulnerability: Medium
* Priority Hazard

#### Coastal Flooding and Sea Level Rise

* The NCDC reported 18 events of coastal flooding for Marin County. None of these events were reported to have had a direct effect on San Rafael.
* Bay Conservation & Development Commission (2007) predicts, based on information available to date (FEMA flood zones, existing watersheds, and former tidelands/bay lands), that water levels in the San Francisco Bay will raise 16-inches by 2050 and 55-inches by 2100.
* BayWAVE SLR report Community Profile for San Rafael modeled 6 SLR scenarios that predicts water levels to rise from 10 inches (near term) to 20 inches (medium term) to 60 inches (long term) – with and without 100 year storm surge.
* ANY HMPC INPUT ON COASTAL FLOODING AND SEA LEVEL RISE IN THE CITY?
* Likelihood of Future Occurrence: Likely
* Vulnerability: High to Extremely High?
* Priority Hazard

#### Dam failure

* Only 4 dams (3 High and 1 Significant hazard rating) in vicinity of the City. The dam of potentially the greatest concern – The Phoenix Lake dam inundation area does not threaten the City.
* ANY PAST DAM FAILURE EVENTS OF CONCERN?
* Non-Priority Hazard

#### Drought and Water Shortage

* Historically California has experience multiple droughts. Data indicates there have been 3 significant droughts in the last 66 years.
* Since 2012, snowpack levels in California have dropped dramatically, with a slight increase in 2015. This year’s storms have done much to alleviate drought conditions.
* 1 federal disaster declarations in 1977; 1 state proclamation in 1976; 1 drought State of Emergency in 2014
* HMPC – CAN YOU PROVIDE DAMAGES OR RESTRICTIONS THAT HAVE OCCURRED IN THE COUNTY RECENTLY due to the current drought. What has been impacted the most? wHAT IS THE PRIMARY SOURCE OF WATER AND HOW HAS WATER SUPPLY BEEN AFFECTED IN THE cOUNTY?
* Likelihood of Future Occurrence: Likely
* Vulnerability: High?
* Priority Hazard

#### Earthquake (& Liquefaction)

* At least eight faults in the Bay Area are capable of producing earthquakes of magnitude 6.7 or larger. There are five faults that threaten the City.
* Significant number (35) of 5.0 and greater earthquake history within 90 miles of the City. There has been one federal and one state disaster declaration in Marin County. Both were related to the Loma Prieta earthquake in 1989.
* What is the City’s past earthquake history? Have there been damages, felt occurrences, other? Can we get specifics surrounding the Loma Prieta earthquake?
* WERE THERE ISSUES IN THE COUNTY FROM THE MORE RECENT EARTHQUAKES?
* Likelihood of Future Occurrence: Occasional – large, damaging earthquake; Likely – minor earthquake
* Vulnerability: Extremely High
* Priority Hazard

#### Flood Hazard

##### 100/500 year

* There are three types of freshwater flood events in the San Rafael area: riverine, flash, and urban stormwater. Regardless of the type of flood, the cause is often the result of severe weather and excessive rainfall, either in the flood area or upstream reaches.
* San Rafael is also subject to saltwater flooding and intrusions -Coastal Flooding.
* Marin County has experience multiple federal and state declarations related to flooding since 1950. 6 of the federal declarations were associated with flood events, 6 with severe storm, and 1 with coastal storm. 17 of the state declarations were associated with flood events.
* CAN WE GET INPUT ON PAST DAMAGES/IMPACTS OF HOW THE CITY WAS SPECIFICALLY AFFECTED?
* Likelihood of Future Occurrence: 100-Occasional; 500-Unlikely
* Vulnerability: High
* Priority Hazard

##### Localized/Stormwater flooding

* According to the City, numerous parcels and roads throughout San Rafael not included in the FEMA 100- and 500-year floodplains are subject to flooding in heavy rains.
* Significant localized flood history in the County – occurs annually
* CAN WE GET INPUT ON THE NATURE OF LOCALIZED FLOODING IN THE CITY? WE HAVE LOCATIONS. WHAT TYPE OF PROBLEMS DOES IT CAUSE?
* Likelihood of Future Occurrence: Highly Likely
* Vulnerability: Medium
* Priority Hazard

#### Landslides, Mudslides, Hillside Erosion, & Debris Flows

* The 2020 General Plan Background Report noted that landslides constitute a significant geologic hazard to structures, roads, and utilities in San Rafael. Flows and slides are the most common type of land movement in the City.
* There are no recorded federal or state disasters related to landslide, mudslide, or debris flows.
* The NCDC contains 6 events that have affected Marin County. However, only one of these events was reported to have had direct effects on the City of San Rafael: April 1, 2006.
* Other sources identified a mudslide in January of 1982 where heavy rains fell in much of Marin County during an El Nino event. 12 inches of rain fell in a 32-hour period. This caused mudslides throughout the County and in San Rafael. According to the Marin Independent Journal, four people died, including residents in Tiburon, Sausalito and San Rafael whose homes collapsed in mudslides.
* CAN YOU IDENTIFY OTHER PAST OCCURENCES AND SPECIFIC PROBLEM AREAS?
* Likelihood of Future Occurrence: Likely
* Vulnerability: Medium
* Priority Hazard

#### Levee Failure

* The 2016 FIS noted that there are no levees in the County or City of San Rafael that are certified as protecting against the 1% annual chance flood. It was noted that local interests have constructed approximately 75 miles of levees in the county. These levees are concentrated in the low-lying areas around Richardson Bay and the Cities of San Rafael and Novato. BUT IS THERE A CERTIFIED LEVEE IN THE COUNTY? LEVEE MAP?
* There have been no federal or state disaster declarations related to levee failure.
* HAVE THERE EVER BEEN ANY LEVEE FAILURE EVENTS IN THE COUNTY?
* Likelihood of Future Occurrence: Unlikley?
* Vulnerability: Low – Medium?
* Priority Hazard?

#### Severe weather

##### Extreme heat

* Annual occurrences – it gets hot every summer
* Record highs for the City have exceeded 100 degrees in May through October with a record high of 110 degrees recorded in September 1904.
* There have been no federal or state disaster declarations due to extreme heat.
* The NCDC database reported 5 extreme heat events for the County since 1993. These 5 events occurred on 2 dates: 2006 and 2009.
* CAN THE CITY PROVIDE ANY INPUT ON PAST HEAT EVENTS AND DAMAGES/IMPACTS TO THE CITY? HOW MANY TIMES WERE COOLING CENTERS OPENED? HOW CAN THIS HAZARD BE CHARACTERIZED IN THE CITY?
* Climate change will likely affect this hazard in the future
* Likelihood of Future Occurrence: Highly Likely
* Vulnerability: Low – Medium?
* Non-Priority Hazard?

##### Heavy rains and storms

* According to the NWS Office in Monterey, storms in the City are generally characterized by heavy rain often accompanied by strong winds and sometimes lightning and hail.
* Heavy rains and severe storms occur primarily during the late fall, winter, and spring (i.e., November through April). Damaging winds often accompany winter storm systems moving through the area. Tornadoes may also occur, but are very rare in Marin County and the City. DO YOU GET MUCH THUNDERSTORMS WITH HAIL AND LIGHTNING?
* Heavy storms can cause both widespread flooding as well as extensive localized drainage issues.
* Significant City history: annual occurrences
* Multiple state and federal disaster declarations associated with Heavy Rains and Storms
* The NCDC data shows 147 heavy rains and storm events for Marin County since 1950.
* HOW HAS THE CITY BEEN AFFECTED BY SEVERE STORM EVENTS?
* Likelihood of Future Occurrence: Highly Likely
* Vulnerability: High
* Priority Hazard

#### Tsunami

* There has been one state disaster declaration and no federal disaster declarations due to tsunami. On March 27, 1964, a 9.2 magnitude earthquake in Alaska sent a tsunami surging down the western coastline of the United States, causing $1 million damage in Marin as 8-foot waves bounced boats around Loch Lomond Marina in San Rafael and knocked out pilings at Lawson's Landing near the mouth of Tomales Bay. No deaths were recorded in the City of San Rafael, but 11 deaths were reported in Crescent City due to this event.
* DOES ANYONE HAVE ANY DATA ON TSUNAMI SPECIFIC TO THE MARIN COUNTY/CITY?
* Likelihood of Future Occurrence: Unlikely – Occasional?
* Vulnerability: Medium
* Non-Priority Hazard?

#### Wildfire

* Wildfires occur on an annual basis in the City and surrounding County.
* There have been two disaster declaration (state) events that have occurred in Marin County: Vision Fire 1995 and 1965 Fires. Neither of these fire events threatened the City of San Rafael directly.
* WHAT IS THE FIRE SEASON IN SAN RAFAEL?
* CITY-SPECIFIC - HISTORIC AND FIRE CONDITIONS DATA?
* Any ignition has the potential to become an out of control wildfire.
* Likelihood of Future Occurrence: Highly Likely
* Vulnerability: High to Extremely high?
* Priority Hazard.

Outstanding Items and Next Steps

**City and HMPC**

* Please provide input on past events and how these hazards have impacted the City (see Historic Hazard Worksheet)
* EOC activation history, other disaster history?
* Description, photos, etc. of damage/impacts from these January storms
* Completed Vulnerability/Capability Worksheets
* Other data needs: updated localized flooding layer, future development layer, tsunami data, other City input?
* Housing Element – is there a background report with data? Use of Plan Bay Area (if well sourced)
* Pictures for the plan – past disaster impacts and past mitigation type project works. Even a few pictures of the City in general

**Mitigation Strategy Meetings**

* February 21 and 22 (plan on attending both days). These are the most important meetings of this process.
* See Mitigation Action Worksheet – bring your project ideas!

**Draft Risk Assessment out for City/HMPC Review**

* Early February