

**Sonoma County  
Hazard Mitigation Plan**

**APPENDIX C: METHODOLOGY**

**APRIL 2017**

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# APPENDIX C: METHODOLOGY

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This section describes the methods utilized to individually assess the hazards and risks of the Plan.

The Sonoma County Permit and Resource Management Department (PRMD), Department of Information System GIS division, was involved in the initial and final analysis of the earthquakes, floods, wildfires, and landslides hazards. PRMD GIS was solely responsible for data research and acquisition, and subsequent, review per quality assurance/control, data modeling and unilateral decisions regarding minor content/format changes to remain consistent with the presentation of specific hazards such as flooding.

Apart from PRMD GIS, the HAZUS risk assessment was graciously forwarded by the California Department of Conservation, Geological Survey. The California Geological Survey prepared two earthquake scenarios HAZUS lost estimates in 2011 based on improved modeling of earthquake effects.

All methods and data sources utilized by PRMD GIS and the California Department of Conservation, Geological Survey are described separately in Appendix C.

Key =

 *Dataset readily available in PRMD's GIS repository; it is assumed that all datasets included per exhibit if not mentioned within the contents of this document are current and reside within PRMD's GIS repository (ex. City Limit, Main Arterials, etc.)*

❖ Data analysis carried forward from the 2011 Hazard Mitigation analysis; those resources will be cited as such


## Earthquakes, Floods, Wildland Fires and Landslides Analysis

This section describes how exposure and vulnerability assessments were conducted for earthquake, wildfire and landslide hazards for critical facilities and other important community elements.

The following content clarifies the data sources utilized during the HMP analysis per hazard.

### Earthquakes

- **Major Earthquake Faults & Areas of Liquefaction (Figure 8.1)**

The Sonoma County Areas of Liquefaction feature class dataset was obtained from the United States Geological Survey (USGS) geospatial data gateway, Association of Bay Area Governments (ABAG) *Resilience Program* at <http://resilience.abag.ca.gov/open-data/> (Earthquake Basics – Liquefaction Susceptibility, version 2006). 

The Sonoma County Alquist-Priolo Zones feature class dataset was obtained from the California Department of Conservation (version 2001). 

- **Earthquake Shaking Potential (Figure 8.2)**

The Sonoma County Shaking Potential feature class dataset was obtained from the California Department of Conservation on 08/29/2011. The source of the dataset: Branum, D., Kalkan, E., Petersen, M. & Wills, C., "Earthquake Shaking Potential for California", California Geological Survey, Map Sheet 48 (revised 2008). The "Map Sheet 48" PDF can be viewed at


[http://www.conservation.ca.gov/CGS/information/publications/ms/Documents/MS48\\_revised.pdf](http://www.conservation.ca.gov/CGS/information/publications/ms/Documents/MS48_revised.pdf).

The map illustrates the expected relative intensity of ground shaking and damage in Sonoma County from anticipated future earthquakes. The potential is calculated as the level of ground motion that has a 2% chance of being exceeded in 50 years, which is the same as the level of ground-shaking with about a 2500 year average repeat time.

❖ Map carried forward from 2011 Hazard Mitigation Plan (no changes to supporting dataset)

- **Earthquake Vulnerability of Emergency Service Facilities (Figure 8.3)**

The Sonoma County Vulnerable Areas feature class dataset was created from accessing the potential for liquefaction, seismic shaking, and soils that have the potential for becoming highly or easily saturated within a 20-mile radius of the active earthquake faults.

Using GIS feature class datasets already stored and available in PRMD's repository  a site-suitability analysis determined areas of low to extreme vulnerability. By overlaying several GIS feature class datasets including liquefaction, seismic shaking, soil composition, and a distance buffer and weighting certain datasets higher than others, a site-suitability analysis was derived.

Next, the seismic shaking analysis layer was reclassified. This layer represents the percentage of probability that a certain area's crust will shift. The field, SOURCETHM, provides the procedure. To begin, the liquefaction layer was reclassified based on the field, LIQ, which contained attributes describing the level of liquefaction for a particular polygon. Those levels are Very Low, Low, Medium, High, Very High, Water, and Not Mapped. Very Low was reclassified with a value of 1, Low a value of 2, Medium a value of 3, High a percentage probability for crust movement. These attributes were classified into six categories. 10 – 30% were given a value of one, 30-40% a value of 2, 40-50% a value of 3, 50-60% a value of 4, and 60-70% a value of 5. Any attributes with the attribute of less than 10% or had no data were given a value of zero.

Next, soils classified as hydric, or soils that are highly saturated or easily saturated were given a reclassified value of five. Soils classified as less hydric to non-hydric were given values ranging from four to one. Soils that were not rated were given a reclassification value of zero.

Finally, a buffer was created around major fault lines. These faults include the San Andreas Fault, Rodgers Creek Fault, and the Mayacama Fault. 1-mile buffer rings were created for the first 20 miles. This was chosen because typically, seismic shaking intensity tends to drop off after 20 miles from the epicenter, according to USGS historic records. Each buffer ring was then reclassified to the following values: 1 mile to 5 miles were given a reclassification value of five, 6 to 9 miles a value of four, 10 to 13 miles a value of 3, 14 to 17 miles a value of 2 and 18 to 20 a reclassification value of one.

Following the reclassification of the four layers, the layers were then overlaid and the reclassification values were calculated. The calculation is as follows:

$$(((\text{LiquefactionReClassValue}] + [\text{ShakeReClassValue}]) * 3) + (([\text{SoilsReClassValue}] + [\text{BufferReClassValue}]) * 2))$$

The soils layer and the buffer layer were weighted less than the liquefaction and seismic shaking layers because the potential damage from an earthquake based on the soils and distance from a fault is difficult to determine accurately.

The final outcome represents six different classification values for earthquake vulnerability in Sonoma County. Six classification values instead of five were selected because it showed greater contrast between areas of low vulnerability and areas of severe and extreme vulnerability.

The Sonoma County Alquist-Priolo Zones feature class dataset was obtained from the California Department of Conservation (version 2001). □

The Sonoma County Emergency Facilities feature class datasets of Hospital (07/2015), Police Station (no metadata available) and Fire Station (07/2016) were obtained from the Sonoma County's enterprise GIS server. The respective datasets are kept current per Emergency Operation Center (EOC) activation. □

The map illustrates areas in Sonoma County that are the most vulnerable to a strong earthquake in relationship with active faults and emergency facilities.


## Floods

- **Watersheds (Figure 8.4)**

The Sonoma County Watershed feature class dataset was obtained from the United States Department of Agriculture (USDA geospatial data gateway at <http://datagateway.nrcs.usda.gov>, watershed zones (version wbdhu8\_a\_ca097, 08/16/2011). The watershed zones are categorized by "Gualala-Salmon", "Russian", "San Pablo Bay", and "Tomales-Drake Bays."

❖ Map carried forward from 2011 Hazard Mitigation Plan (no changes to supporting dataset)

- **100-Year Flood Zone (Figure 8.5)**

The Sonoma County Flood Zone feature class dataset represents the floodplain (F2) combining zoning district. The dataset assists to enforce land use regulations for properties situated in floodplains (a plain bordering a river and subject to flooding) to safeguard against hazards and damage which may result from flood waters. The dataset is used in administering the National Flood Insurance Program by the Federal Emergency Management Agency (FEMA) and represents FEMA's Digital Flood Insurance Rate Map effective 10/02/2015 yet adopted by the Sonoma County Board of Supervisors on 01/05/2016 per Official Zoning Database Technical Correction Round No. 5. The dataset is stewarded by PRMD GIS and is modified on a regular basis per adopted zoning ordinances. 

- **Repetitive Flood Loss Properties in Lower Russian River (Figure 8.6)**

The Sonoma County Flood Zone feature class dataset represents the floodplain (F2) combining zoning district. Please refer to previously discussed Figure 8.5 data detail for further source information.

The Sonoma County repetitive loss feature class dataset was obtained from the Federal Emergency Management Agency (FEMA)/DHS Region IX on 11/02/2015. The dataset was augmented with Sonoma County PRMD Permits Plus computerized permit tracking system data, elevated structures [G\_POSTFIRM] as of 06/09/2016.

The map illustrates the differentiation of repetitive loss elevated properties and repetitive loss non-elevated properties in the concentrated area of the Lower Russian River.

- **Dam Failure Inundation (Figure 8.7)**


The Sonoma County Dam Inundation feature class dataset was obtained from the Sonoma County's enterprise GIS server on 09/12/2011. The Sonoma County Fire and Emergency Services Department are the stewards of the dataset residing on the GIS server.

The map illustrates the extent of water inundation caused by dam failure (whether by natural causes or manmade).

❖ Map carried forward from 2011 Hazard Mitigation Plan (no changes to supporting dataset)

## Wildland Fires

- **Wild Land Fire Threat (Figure 8.8)**

The Sonoma County Fire Responsibility Area feature class dataset was obtained from the California Department of Forestry and Fire Protection (CalFIRE) geospatial data gateway at [http://www.fire.ca.gov/fire\\_prevention/fhsz\\_maps\\_sonoma](http://www.fire.ca.gov/fire_prevention/fhsz_maps_sonoma) (version SRA15\_1, 07/01/2015). 

The fire protection responsibility areas (RA) dataset represents the legal fire protection obligation between the Federal (FRA), State (SRA) and Local (LRA) jurisdictions within Sonoma County. The fire protection responsibility areas are created, maintained and governed by the California Department of Forestry (CDF) and Fire Protection (CAL FIRE).

The California Department of Forestry (CDF) has a legal responsibility to provide fire protection on all State Responsibility Area (SRA) lands, which are defined based on land ownership, population density and land use. For example, CDF does not have responsibility for densely populated areas, agricultural lands, or lands administered by the federal government. To more efficiently provide protection over a more contiguous land base, CDF swaps protection areas with other providers, with the resulting lands being called CDF Direct Protection Area (DPA). SRA designations undergo a thorough 5 year review cycle, as well as annual updates for incorporations.

The Sonoma County Fire Hazard Severity Zone feature class dataset was obtained from the California Department of Forestry and Fire Protection (CalFIRE) geospatial data gateway at [http://www.fire.ca.gov/fire\\_prevention/fhsz\\_maps\\_sonoma](http://www.fire.ca.gov/fire_prevention/fhsz_maps_sonoma) (version c49fhszl06\_1, 07/2016). The severity zones are categorized by "Very High", "High", and "Moderate."

The Sonoma County Fire Station (06/2016) feature class datasets was obtained from the Sonoma County's enterprise GIS server. The dataset is kept current per Emergency Operation Center (EOC) activation.

The map illustrates the fire hazard severity zones within Sonoma County in relationship to local and state fire responsibility areas.

- **Historic Fires (Figure 8.9)**

The Sonoma County Historic Fire feature class dataset was obtained from the California Department of Forestry and Fire Protection (CalFIRE) geospatial data gateway at [http://frap.cdf.ca.gov/data/frapgisdata-sw-fireperimeters\\_download](http://frap.cdf.ca.gov/data/frapgisdata-sw-fireperimeters_download) (version Statewide Fire Perimeters 15\_1 FGDB, 06/09/2016).

The Sonoma County Fire Station (06/2016) feature class datasets was obtained from the Sonoma County's enterprise GIS server. The dataset is kept current per Emergency Operation Center (EOC) activation.

The map illustrates the chronology of historical fires within Sonoma County from 1939 to 2009.

- **Fire Districts and Responsibility Areas (Figure 8.10)**

The Sonoma County Fire Responsibility Area feature class dataset was obtained from the California Department of Forestry and Fire Protection (CalFIRE). Please refer to previously discussed Figure 8.8 data detail for further source information.

The Sonoma County Fire District (05/2016; Sea Ranch/Annapolis merged into North Sonoma Coast Fire Protection District) feature class datasets was obtained from the Sonoma County's enterprise GIS server. The dataset is kept current per Emergency Operation Center (EOC) activation.

The map illustrates the fire districts within Sonoma County in relationship to federal, local and state responsibility areas.

## Landslides

- **Landslide Hazard Areas (Figure 8.11)**

The Sonoma County Shaking Potential feature class dataset was obtained from the California Department of Conservation on 07/13/2011. The source of the dataset: Wills, C.J., Perez, F.G. & Gutierrez, C.I., "Susceptibility to Deep-Seated Landslides in California", California Geological Survey, Map Sheet 58 (2011). The "Map Sheet 58" PDF can be viewed at: <http://www.conservation.ca.gov/CGS/information/publications/ms/Documents/MS58.pdf>.

The dataset was from authored source, Ante Perez, as a zipped ArcGRID raster file. For map regeneration purposes, the ArcGRID raster file underwent a transformation called "Flattening Overlaid Images" (<http://mappingcenter.esri.com/index.cfm?effect=Flatten&fa=maps.craterLake>).

The raster's background layers were flattened and exported to JPEG format (400 DPI, Max JPEG Quality and turn on option to Write World File). The JPEG file was added and saved to the map document (.mxd).

The map illustrates the relative likelihood of deep landsliding based on regional estimates such as Sonoma County per rock strength and steepness of slopes. On the most basic level, weak rocks and steep slopes are more likely to generate landslides. The "Map Sheet 58" uses detailed information on the location of past landslides, the location and relative strength of rock units, and steepness of slope in a methodology developed by Wilson and Keefer (1985).

❖ Map carried forward from 2011 Hazard Mitigation Plan (no changes to supporting dataset)