

Appendix C. Methods and Sources Used for Hazard Assessment

This section describes the methods used to assess the hazards and risks in this Plan. Two separate consultant teams were involved in the analysis of hazards. The firm Natural Hazards Mitigation (NHM) developed the Hazard Assessment for earthquakes, wildfires and landslides. URS Group, Inc. developed the Hazard Assessment for floods. NHM made formatting and minor content changes to the work of URS Group, Inc. to make it consistent with the presentation of other hazards. The methods and sources used by each team are described separately in this appendix.

Earthquake, Wildfire and Landslide Analysis Methods:

Exposure and Vulnerability Assessment Methods

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

Hazard

Facilities were analyzed for their exposure to earthquake shaking, liquefaction, seismically-induced landslides, fault rupture, wildfires and landslides. Information about hazard zones was taken from the following sources:

- Shaking: California Geological Survey map, “Seismic Shaking Hazards in California”, based on the USGS/CGS Probabilistic Seismic Hazards Assessment (PSHA) Model, 2002 (revised April 2003). Exposure to violent shaking refers to location in areas estimated to experience shaking greater than 0.75g with a 10% probability in 50 years
- Liquefaction: USGS Open File 00-444, categories “High” and “Very High”
- Landslides (from all causes): USGS Open File 97-745, categories “Mostly” and “Many”
- Wildfires: CDF Fire Severity Map, categories “High” and “Very High”

County Emergency Response Buildings

Sonoma County General Services provided a dataset listing all important County owned and used buildings. This dataset included information about the insured value of buildings and their contents for most buildings. The dataset also provided information for some buildings on date of construction and material of construction. The parcel number for the location of each building was included in the dataset.

The value of buildings and their contents was assumed to equal the insured value for each building and its contents. Nearly all buildings were insured for flood risk; some were also insured for earthquake risk. Values used for flood insurance were applied for all hazards. Buildings that did not have insured values listed in the dataset were identified as having an unknown value.

A GIS layer identifying the parcels with County buildings was developed. This layer was superimposed on the hazard maps. Buildings were identified as potentially in a hazard zone when any portion of their parcel was located in a hazard zone. Some parcels are

large and, therefore, particular buildings may not be exposed to a hazard even though the hazard intersects with its parcel. Exposure to hazard may be over-represented in some cases.

Fire Stations

The locations of fire stations are identified in the County provided GIS layer “Export_Fire”, provided by the Sonoma County PRMD. This layer was superimposed on hazard maps to identify fire stations in hazard areas. Fire stations and their locations are listed in the text.

City and State Emergency Buildings

A complete source with the locations of state and city emergency response buildings in the County was not available. Some key facilities were identified by superimposing the following GIS layers on hazard:

- “Export_CUPA”: Items in the “FACIL_NAM” column were reviewed to identify critical facilities. CUPA refers to the Certified Use Program Agency.
- “Export_HAZUS”: Items in the “NAME” column were reviewed to identify critical facilities. This file is an inventory of sites with hazardous materials.
- “Export_LawStations”: Items in the “NAME” column were reviewed to identify critical facilities.

Relevant facilities are mentioned in the text. All of these GIS layers were provided by the Sonoma County PRMD.

Hospitals

The GIS layer “Export_Care_Facilities”, provided by the Sonoma County PRMD, was superimposed on hazard zones. The “Name” and “Address” columns were used to identify structures of concern. Additional data about hospitals was taken from the report Office of Statewide Health Planning and Development, *Summary of Hospital Seismic Performance Ratings*, April 2001. <http://www.oshpd.cahwnet.gov/SB1953/index.htm>.

Shelters

Analysis of shelters was limited to Veteran’s buildings. Veteran’s buildings were superimposed on hazard zones using the GIS file “Vet Halls”, provided by the Sonoma County PRMD. Values for the Veteran’s Halls and their contents were taken from the dataset of all County buildings prepared by the Sonoma County Department of General Services. See *County Emergency Response Buildings* section for more information.

Schools

Schools in the hazard zones were identified by superimposing three GIS layers on the hazard zones:

- “Export_Public_Schools”: the columns “School” and “District” were used to identify each school
- “Export_Private_Schools”: the column “Name” was used to identify each facility
- “Export_Private_Schools_Other”: the column “School_Nam” was used to identify each facility

These GIS files were provided by the Sonoma County PRMD. Additional web research was conducted to verify private schools were still in business. Schools were generally not named in the text, but the numbers and sometime the city of location were mentioned in the text.

County Roads

The GIS layer “Streets”, provided by the Sonoma County PRMD, was superimposed on hazard zones. Many streets intersected hazard zones. The column “STREET_NAM” was compared, along with printed maps of streets intersecting hazard zones, with maps of Sonoma County to identify the most important County maintained roads that have significant exposure to hazard zones. Important roads with significant exposure to hazards are listed in the text. Many County roads that intersect hazard zones are not listed in the text. Length of County owned roads in hazard zones was not calculated.

The GIS layer “Export_Bridges”, provided by the Sonoma County PRMD, was superimposed on hazard zones. Structures indicated in the column “STRUCTURE” as “BR” and “V/BR” were analyzed, which stand for bridge and viaduct/bridge, respectively, as indicated on metadata provided by the County. The column “YEARCONSTR” was reviewed for information about when bridges were constructed. No information was available for the value of bridges, and values were not estimated.

State and Federal Highways

The GIS layer “Highways”, provided by the Sonoma County PRMD, was superimposed on hazard zones. The results were examined visually to identify highways with significant exposure to hazards; results were listed in the text. Lengths of state and federal highways in hazard zones were not calculated.

Other Transportation Facilities

The exposure of Sonoma County airports was determined by superimposing the GIS layers “Airports” and “Airports Merged Points”, both provided by the Sonoma County PRMD, on hazard zones. No significant exposure was found.

The exposure of railroads was determined by superimposing the GIS layer “Railways”, provided by the Sonoma County PRMD, on hazard zones. The results were examined visually to identify areas with significant exposure. The findings were reported in the text.

No other transportation facilities were assessed.

SCWA Water and Wastewater Systems

The exposure of SCWA facilities to hazards was examined by superimposing the GIS layers “AllFacilitiesPoints” and “Transmission_Pipes”, both provided by the Sonoma County PRMD, on hazard zones. For “AllFacilitiesPoints”, the columns “Description” and “Facility” were reviewed to identify which types of facilities are located in hazard zones. For “Transmission_Pipes”, the results of the overlay were visually examined to identify areas with significant hazard exposure.

In select cases, information about the value of exposed SCWA facilities was available from the dataset provided by Sonoma County Department of General Services. See discussion of this dataset under *County Emergency Response Buildings*. This information was presented in the text or in table format. Other findings were described in the text.

Analyses of exposure and vulnerability of SCWA systems was limited because the systems are currently being assessed for their vulnerability to multiple hazards by another consultant team.

Other Utilities

Incomplete information was available about other utilities. The following GIS databases, provided by the Sonoma County PRMD, were superimposed on hazard zones and some utility sites were identified:

- “Export_CUPA”: Items in the “FACIL_NAM” column were reviewed to identify critical facilities. CUPA refers to the Certified Use Program Agency.
- “Export_HAZUS”: Items in the “NAME” column were reviewed to identify critical facilities. This file is an inventory of sites with hazardous materials.

Findings were described in the text.

Emergency Communications System

County owned communications towers were included in the dataset provided by the Sonoma County Department of General Services. These were included in the GIS layer developed by the consultant team. See *County Emergency Response Buildings* for more information about the dataset and the GIS layer created from it. Insured values of these towers were included. Hazard exposure was presented in tables.

Dams

The GIS layer “Export_Dam”, provided by the Sonoma County PRMD, was superimposed on hazard zones. The columns “DAMNAME”, “OWNER” and “CAPACITY” were examined to learn more about dams exposed to hazards. Findings were described in the text.

Hazardous Materials Sites

The following GIS databases, provided by the Sonoma County PRMD, were superimposed on hazard zones and some utility sites were identified:

- “Export_CUPA”: Items in the “FACIL_NAM” column were reviewed to identify critical facilities. CUPA refers to the Certified Use Program Agency.
- “Export_HAZUS”: Items in the “NAME” column were reviewed to identify critical facilities. This file is an inventory of sites with hazardous materials.

Findings were described in the text. Individual facilities with hazardous materials were not identified, but the number and types of facilities were reported.

County Buildings

The Sonoma County Department of General Services provided a dataset with information about County owned buildings, including insured values, parcel number, date of construction, and type of construction. A GIS layer was constructed from this information, and parcels with county buildings were superimposed on hazard zones. See *County Emergency Response Buildings* for more information.

124 Buildings were included in the exposure analyses. These buildings were identified by the Sonoma County General Services Department as Emergency Response Buildings or Critical Facilities. Other buildings were not analyzed, but are included in the GIS layer developed for this plan.

Findings are presented in discussion in text, and in table format as Appendix D.

People and Private Buildings

The population in hazard zones was calculated by superimposing census blocks on hazard zones. However, census blocks in the County range considerably in size and many of them partially overlap with hazard zones, suggesting that some but not all of the population of that block is at risk. Population estimates for the unincorporated areas were calculated using the census blocks listed in the following section, *Impacts and Loss Estimates Methods*. These census blocks approximate the unincorporated area.

Three analyses were conducted with GIS to provide a best estimate of the population living within hazard zones, as well as an absolute minimum and maximum living in these zones. The minimum possible population in each hazard zone was determined by identifying census blocks that are completely contained within hazard zones and summing their populations. The maximum possible population in each hazard zone was calculated by identifying census blocks that intersect with hazard zones and summing their population. The best estimate of the actual population in hazard zones was determined by identifying census blocks with their geographic center within a hazard zone and summing their population. Visual checks comparing the locations of buildings with hazard zones were made for each hazard to confirm that this was a reasonable estimate of population residing in hazard zones.

The findings for each hazard are listed below. Only the best estimates of population in hazard zones are reported in the main text of this plan.

Population in very strong or higher earthquake shaking risk

- Best estimate: 151,000 (entire unincorporated population)
- Minimum: 151,000
- Maximum: 151,000

Population in liquefaction risk

- Best estimate: 10,600
- Minimum: 1,600
- Maximum: 61,000

Population in landslide risk

- Best estimate: 19,200
- Minimum: 1,400
- Maximum: 58,500

Population in wildfire risk

- Best estimate: 33,900
- Minimum: 19,100
- Maximum: 45,300

The number of buildings located in each hazard zone was determined by superimposing the GIS layer "Export_Building_Footprint", provided by the Sonoma County PRMD, on hazard zones. The column "SHAPE_AREA" lists the square footage of buildings. Buildings greater than 1000 square feet were considered to be significant. The number of buildings greater than 1000 square feet were counted. The total square footage of buildings greater than 1000 square feet was summed. The replacement cost of buildings was assumed to be \$150 per square foot, to provide a ballpark estimate of the value of buildings exposed to hazards. Figures are presented as rough estimates only.

The Sonoma County Landmarks Commission provided a table listing historic buildings in the County, and identifying which structures are in fault and flood zones. Structures in fault zones were listed.

The Sonoma County PRMD provided tables listing unreinforced masonry structures, their use, and their status under state law. This information was summarized and presented.

Environmental Resources

Reports and publications from environmental reserves in the County were reviewed for relevant information.

Impact and Loss Estimates Methods

Earthquakes

Two scenarios were developed to provide impact assessments and loss estimates for earthquakes. These scenarios were developed using HAZUS software, created for and distributed by FEMA.

The scenario for the Roger's Creek fault was developed by conducting two HAZUS runs, one for the entire County and one for unincorporated areas of the County only. An earthquake of magnitude 7.0 was used. Likewise, two HAZUS runs were used to develop the scenario for the San Andreas fault, one for the entire County and one for the unincorporated areas. An earthquake of magnitude 7.5 was used. The selected scenario earthquakes are the mean magnitudes for the two faults as identified by the USGS Working Group on Earthquake Probabilities in their 2003 report, "Earthquake Probabilities in the San Francisco Bay Region: 2002–2031."

Both scenarios were calculated using HAZUS-MH default data for geotechnical conditions, buildings and infrastructure. HAZUS provides estimates of geologic impacts, damage to homes, damage to commercial buildings, damage to County owned buildings, casualties, shelter requirements, impacts on hospitals, post-earthquake fires, damage to roads, damage to utilities, and economic losses.

The unincorporated areas of the county were approximated in a HAZUS-MH study region by including all census tracts in the county with over 50% of the population residing in unincorporated areas. The Census tracts used to approximate the unincorporated areas of the County are listed below:

06097150100
06097150302
06097150303
06097150304
06097150500
06097151000
06097151100
06097151201
06097152701
06097152702
06097153200
06097153403
06097153404
06097153501
06097153502
06097153600
06097153703
06097153704
06097153705
06097153706
06097154000
06097154100
06097154301
06097154302

Wildfires

Exposure analyses, as described in the *Exposure and Vulnerability Assessment Methods* section, were conducted for the areas of two historical fires that occurred simultaneously: the Hanly and Nunn's Canyon Fires. The boundaries of these fires were included in the GIS layer "Inu_historical_fire_per" provided by the Sonoma County PRMD. The costs of damages was determined by applying a replacement value of \$150 per square foot to buildings (identified as described in the section *People and Private Buildings*). Potential damages to other infrastructure and assets were not estimated.

Damage figures from recent California wildfires were also presented to provide context.

Landslides

Damage figures from past landslides in the County were provided. A discussion of areas that could be impacted by landslides was included.

Flood Analysis Methods:

Population data were obtained from the U.S. Census conducted in 2000. Data were collected at the Census block group level for the entire planning area. The unincorporated Sonoma County population for 2000 was 113,711.

To support the asset inventory, URS collected the following data from the Sonoma County PRMD, Sonoma County Landmarks Commission, and FEMA BureauNet.

- County-owned and –used buildings (Appendix B, Table B-1).
- Critical facilities (not owned by the County), including hospitals, public and private schools, major SCWA facilities, communication utilities, and dams.
- Infrastructure information, including County-owned roads, State and Federal highways, railways, bridges, and airports.
- Data regarding privately-owned structures.
- Data regarding single-family repetitive loss properties, for which mitigation projects had not been undertaken.
- Data regarding historic buildings.

Average replacement values, as well as certain critical facility locations, were obtained through FEMA's nationwide risk assessment software, HAZUS, and the Sonoma County Auditor-Controller.

An exposure-level analysis was conducted to assess the risks of floods to assets in Sonoma County. For each physical asset located within a hazard area, exposure was calculated by assuming the worst-case scenario; that is, assuming that the asset would be completely destroyed and would have to be replaced. The aggregate exposure, in terms of replacement value, for each building or facility was then calculated. A similar analysis was used to evaluate the proportion of the population at risk. However, the analysis simply represents the number of people at risk; no attempt to estimate the number of injuries or deaths was prepared.

Using GIS, population in flood hazards zones was calculated by superimposing the Census block groups on the 100-year floodplain. Census block groups that fell completely within the boundary of the hazard area were determined to be vulnerable and were totaled by count. Census block groups that intersected with the 100-year floodplains were also considered to be at risk and therefore calculated.

The physical locations of the County-owned and -used buildings, critical facilities, bridges, airports, private buildings (with a square foot print of 1,000 feet or greater), single-family repetitive loss properties, and historic buildings were compared to the 100-year floodplain only. For the repetitive loss property analysis, an additional 50-foot buffer was placed around the 100-year floodplain to ensure that properties on or near the 100-year floodplain were included in the analysis. The exposure analysis for linear assets, such as highways and roads, was measured in miles.

Due to data limitations, the private building data provided could not be sorted by type (residential versus nonresidential). Therefore, in order to determine the approximate number of residential structures within the floodplain, these buildings were considered to be private buildings with a footprint between 1,000 square feet to 5,000 square feet. The exposure for these buildings was calculated using the 2004 average resale cost of \$495,000 for residential buildings in Sonoma County. Additionally, overlap may occur among private buildings, repetitive loss properties, and historic buildings located within the 100-year floodplain. Due to data limitations, the private building database could not be addressed-mapped with the repetitive loss property database and historic building list. Therefore, double counting of the private building vulnerability assessment with the repetitive loss property and historic building vulnerability assessment may occur.