Douglas County
Hazard Mitigation Plan

1694 County Rd
Minden, NV 89423

2013

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List of Acronyms

BLM	United States Bureau of Land Management
CCHHS	Carson City Health & Human Services
CC PW	Carson City Public Works
CIA	Central Intelligence Agency
CDC	Center for Disease Control
cfs	cubic feet per second
CFR	Code of Federal Regulations
City	Carson City
DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000
DOJ	Department of Justice
DOT	United States Department of Transportation
EHS	Extremely Hazardous Substance
EMPG	Emergency Management Planning Grant
EOC	Emergency Operation Center
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
FEMA	Federal Emergency Management Agency
FBI	Federal Bureau of Investigation
GIS	Geographic Information System
HAZUS-MH	(abbreviation for **HAZ**ards **U**nited **S**tates) is a geographic information system-based natural hazard loss estimation software package developed and freely distributed by the Federal Emergency Management Agency
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
InSAR	Interferometric Synthetic Aperture Radar
JAVMA	Journal of the Federal coordinator for Meterology
M	Magnitude
MMI	Modified Mercalli Intensity
mph	miles per hour
NDEM	Nevada Division of Emergency Management
NDEP	Nevada Division of Environmental Protection

NDF	Nevada Division of Forestry
NDOT	Nevada Department of Transportation
NERMP	Nevada Earthquake Risk Mitigation Plan
NFIP	National Flood Insurance Program
NBMG	Nevada Bureau of Mines & Geology
NPS	National Park Service
NRC	National Response Center
NWS	National Weather Service
OFCM	Office of the Federal Coordinator for Meteorology
PDM	Pre-Disaster Mitigation
POC	Point of Contact
Planning Task Force	Hazard Mitigation Planning Task Force
SERC	State Emergency Response Commission
SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SPWB	State Public Works Board
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
State	State of Nevada
SR	State Route
UBC	Uniform Building Code
UNR	University of Nevada Reno
URM	Unreinforced Masonry Buildings
URS	URS Corporation
USC	United States Code
USDA	US Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
WMD	Weapons of Mass Destruction

Across the United States, natural and human-caused disasters have led to increasing levels of death, injury, property damage, and interruption of business and government services. The toll on families and individuals can be immense and damaged businesses cannot contribute to the economy. The time, money and effort to respond to and recover from these emergencies or disasters divert public resources and attention from other important programs and problems. With two Federal declarations in the last ten years, and several significant wildland fires in 2012 and 2013, Douglas County, Nevada, recognizes the consequences of disasters and the need to reduce the impacts of natural hazards.

The elected and appointed officials of Douglas County also know that with careful selection, mitigation actions in the form of projects and programs can become long-term, cost effective means for reducing the impact of natural and human-caused hazards. Applying this knowledge, the Douglas County Hazard Mitigation Planning Task Force updated the *Douglas County, Nevada, Hazard Mitigation Plan*. With the support of various County officials, the State of Nevada, and the United State Department of Homeland Security/Federal Emergency Management Agency (FEMA), this plan is the result of several months of work to update a hazard mitigation plan that will guide Douglas County toward greater disaster resistance in full harmony with the character and needs of the community and region.

People and property in Douglas County are at risk from a variety of hazards that have the potential for causing widespread loss of life and damage to property, infrastructure, and the environment. The purpose of hazard mitigation is to implement actions that eliminate the risk from hazards, or reduce the severity of the effects of hazards on people and property. Mitigation is any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event. Mitigation encourages long-term reduction of hazard vulnerability. The goal of mitigation is to save lives and reduce property damage. Mitigation can reduce the enormous cost of disasters to property owners and all levels of government. In addition, mitigation can protect critical community facilities, reduce exposure to liability and minimize community disruption. Preparedness, response, and recovery measures support the concept of mitigation and may directly support identified mitigation actions.

The *Douglas County, Nevada Hazard Mitigation Plan* has been updated in compliance with Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act or the Act), 42 U.S.C. 5165, enacted under Sec. 104 the Disaster Mitigation Act of 2000 (DMA 2000), Public Law 106-390 of October 30, 2000. Since the first plan was adopted in 2007, 14 mitigation actions have been completed or are ongoing. 3 actions have been combined with other mitigation actions. This updated plan identifies on-going and new hazard mitigation actions intended to eliminate or reduce the effects of future disasters throughout the County.

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This section provides an overview of the Disaster Mitigation Act of 2000 (DMA 2000; Public Law 106-390), the adoption of the updated *Douglas County, Nevada, Hazard Mitigation Plan* (HMP) by the local governing body, and supporting documentation for the adoption.

1.1 DISASTER MITIGATION ACT OF 2000

The DMA 2000 was passed by Congress to emphasize the need for mitigation planning to reduce vulnerability to natural and human-caused hazards. The DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act; 42 United States Code [USC] 5121-5206 [2008]) by repealing the act's previous Mitigation Planning section (409) and replacing it with a new Mitigation Planning section (322). In addition, Section 322 provides the legal basis for the Federal Emergency Management Agency's (FEMA's) mitigation plan requirements for mitigation grant assistance.

To implement the DMA 2000 planning requirements, the Federal Emergency Management Agency (FEMA) published an Interim Final Rule in the *Federal Register* on February 26, 2002. This rule (44 Code of Federal Regulations [CFR] Part 201) established the mitigation planning requirements for states, tribes, and local communities. The planning requirements are described in detail in Section 2 and identified in their appropriate sections throughout the Plan.

1.2 ADOPTION BY THE LOCAL GOVERNING BODY AND SUPPORTING DOCUMENT

The requirements for the adoption of an HMP by the local governing body, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 REQUIREMENTS: PREREQUISITES

Adoption by the Local Governing Body

Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).

Element

- Has the local governing body adopted the plan?
- Is supporting documentation, such as a resolution, included?

Source: FEMA, March 2008.

Douglas County is not the sole jurisdiction represented in this HMP. There are numerous independent jurisdictions within Douglas County. Jurisdictions participating in the development of this HMP are listed on page 5 in Section 3. This HMP attempts to represent Douglas County as a whole including applicable political subdivisions within the Douglas County footprint. The Douglas County HMP meets the requirements of Section 409 of the Stafford Act, Section 322 of the DMA 2000 and the Flood Mitigation Assistance (FMA) program authorized by the National Flood Insurance Act of 1968, as amended, as required under 44 CFR §79.6(d)(1).

The local governing body (Board of County Commissioners) of Douglas County has adopted this HMP. The signed resolution is provided in Appendix A.

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2.1 PLAN PURPOSE AND AUTHORITY

The DMA 2000, also referred to as the 2000 Stafford Act amendments, was approved by Congress on October 10, 2000. On October 30, 2000, the President signed the bill into law, creating Public Law 106-390. The purposes of the DMA 2000 are to amend the Stafford Act, establish a national program for pre-disaster mitigation, and streamline administration of disaster relief.

The Douglas County HMP meets the requirements of the DMA 2000, which calls for all communities to prepare hazard mitigation plans. By preparing this HMP, the County is eligible to receive Federal mitigation funding after disasters and to apply for mitigation grants before disasters strike. This HMP starts an ongoing process to evaluate the risks different types of hazards pose to Douglas County, and to engage the County and the community in dialogue to identify the steps that are most important in reducing these risks. This constant focus on planning for disasters will make the County, including its residents, property, infrastructure, and the environment, much safer.

The local hazard mitigation planning requirements encourage agencies at all levels, local residents, businesses, and the non-profit sector to participate in the mitigation planning and implementation process. This broad public participation enables the development of mitigation actions that are supported by these various stakeholders and reflect the needs of the entire community.

States are required to coordinate with local governments in the formation of hazard mitigation strategies, and the local strategies combined with initiatives at the state level form the basis for the State Mitigation Plan. The information contained in HMPs helps states to identify technical assistance needs and prioritize project funding. Furthermore, as communities prepare their plans, states can continually improve the level of detail and comprehensiveness of statewide risk assessments.

For FEMA’s Hazard Mitigation Assistance (HMA), which includes a Pre-Disaster Mitigation (PDM) grant program, a Hazard Mitigation Grant Program (HMGP) and Flood Management Assistance (FMA), a local jurisdiction must have an approved HMP to be eligible for PDM and HMGP funding for a Presidentially declared disaster after November 1, 2004. Plans approved any time after November 1, 2004, will allow communities to be eligible to receive HMA project grants.

Adoption by the local governing body demonstrates the jurisdiction’s commitment to fulfilling the mitigation goals and objectives outlined in the HMP. Adoption legitimizes the updated HMP and authorizes responsible agencies to execute their responsibilities. The resolution adopting this HMP is included in Appendix A.

2.2 STAFFORD ACT GRANT PROGRAMS

The following grant programs require a State, tribe, or local entity to have a FEMA-approved State or Local Mitigation Plan.

Hazard Mitigation Grant Program (HMGP): HMGP provides grants to State, tribes, and local entities to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property as a result of natural disasters and to enable mitigation measures to be implemented during the immediate recovery from disaster. Projects must provide a long-term solution to a problem: for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. The program may provide a State or tribe with up to 20 percent of the total disaster grants awarded by FEMA. The cost-share for this grant is 75/25 percent (Federal/non-Federal).

Pre-Disaster Mitigation (PDM) Program: PDM provides funds to State, tribes, and local entities, including universities, for hazard-mitigation planning and the implementation of mitigation projects before a disaster event. PDM grants are awarded on a nationally competitive basis. Like HMGP funding, a PDM project's potential savings must be more than the cost of implementing the project. In addition, funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. Congress appropriates the total amount of PDM funding available on an annual basis. The cost-share for this grant is 75/25 percent (Federal/non-Federal).

Flood Management Assistance (FMA): The FMA program provides funds on an annual basis so that measures can be taken to reduce or eliminate risk of flood damage to buildings insured under the National Flood Insurance Program (NFIP). FMA provides up to 75% Federal funding for a mitigation activity grant and/or up to 90% Federal funding for a mitigation activity grant containing a repetitive loss strategy.

Repetitive Flood Claims (RFC): The RFC program provides funds on an annual basis to reduce the risk of flood damage to individual properties insured under the NFIP that have had one or more claim payments for flood damages. RFC provides up to 90% Federal funding for eligible projects in communities that qualify for the program.

Severe Repetitive Loss (SRL): The SRL program provides funds on an annual basis to reduce the risk of flood damage to residential structures insured under the NFIP that have had one or more claim payments for flood damages. SRL provides up to 100% Federal funding for eligible projects in communities that qualify for the program.

2.3 PLAN ORGANIZATION

The remainder of this HMP consists of the following sections:

- ***Section 3 - Community Description***

Section 3 provides a general history and background of the County and historical trends for population, demographic and economic conditions that have shaped the area. Trends in land use and development are also discussed.

- ***Section 4 - Planning Process***

Section 4 describes the planning process, identifies Planning Committee members, and the key stakeholders within the community and surrounding region. In addition, this section documents public outreach activities and the review and incorporation of relevant plans, reports, and other appropriate information.

- ***Section 5 - Risk Assessment***

Section 5 describes the process through which the Planning Committee identified and compiled relevant data on all potential natural hazards that threaten Douglas County and the immediately surrounding area. Information collected includes historical data on natural hazard events that have occurred in and around the County and how these events impacted residents and their property.

The descriptions of natural hazards that could affect Douglas County are based on historical occurrences and best available data from agencies such as FEMA, the U.S. Geological Survey (USGS), and the National Weather Service (NWS). Detailed hazard profiles include information on the frequency, magnitude, location, and impact of each hazard as well as probabilities for future hazard events.

- ***Section 6 – Vulnerability Analysis***

Section 6 identifies potentially vulnerable assets such as people, housing units, critical facilities, infrastructure and lifelines, hazardous materials facilities, and commercial facilities. This data was compiled by assessing the potential impacts from each hazard using GIS and FEMA's natural hazards loss estimation model, HAZUS-MH. The resulting information identifies the full range of hazards that Douglas County could face and potential social impacts, damages, and economic losses.

- ***Section 7 - Capability Assessment***

Although not required by the DMA 2000, Section 7 provides an overview of the County's resources in the following areas for addressing hazard mitigation activities:

Legal and regulatory resources

Administrative and technical: The staff, personnel, and department resources available to expedite the actions identified in the mitigation strategy

Fiscal: The financial resources to implement the mitigation strategy

- ***Section 8- Goals, Objectives & Actions - Mitigation Strategy***

As Section 8 describes, the Planning Committee developed a list of mitigation goals, objectives, and actions based upon the findings of the risk assessment and the capability assessment. Based upon these goals and objectives, the Planning Committee reviewed and prioritized a comprehensive range of appropriate mitigation actions to address the risks facing the community. Such measures include preventive actions, property protection techniques, natural resource protection strategies, structural projects, emergency services, and public information and awareness activities.

- ***Section 9 - Plan Maintenance Process***

Section 9 describes the Planning Committee's formal plan maintenance process to ensure that the HMP remains an active and applicable document. The process includes monitoring, evaluating, and updating the HMP; implementation through existing planning mechanisms; and continued public involvement.

- ***Section 10 - References***

Section 10 lists the reference materials used to prepare this HMP.

- ***Appendices***

The appendices include the Adoption Resolution, Planning Committee Meetings, and Public Involvement process.

This section describes the history, location, and geography of Douglas County as well as its government, demographic information, and current land use and development trends.

3.1 HISTORY, LOCATION, AND GEOGRAPHY

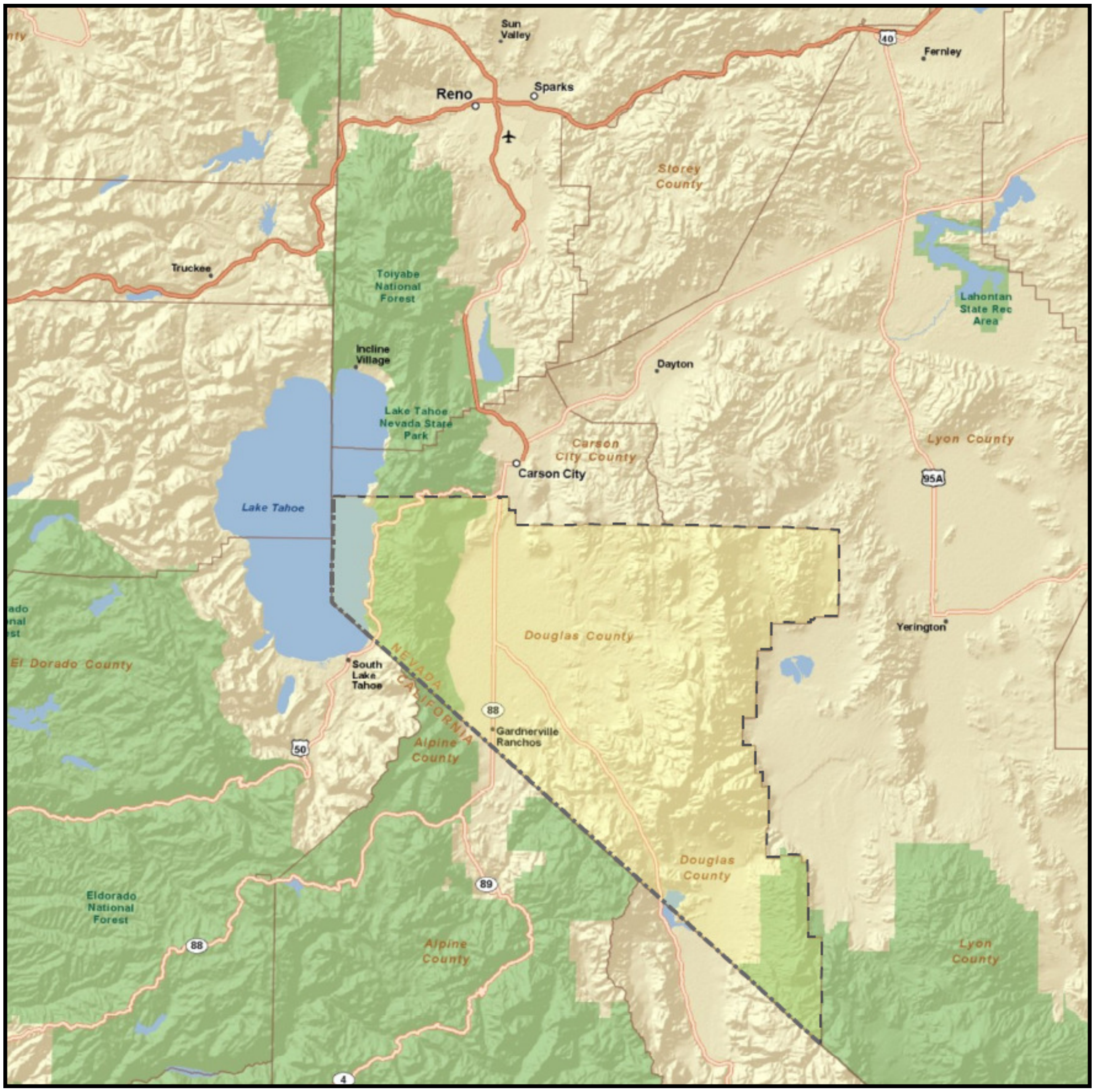
Trading posts were established in the area starting in the 1850s. Named for Stephen A. Douglas, famous for his 1858 Presidential campaign debates with Abraham Lincoln, Douglas County was established on November 25, 1861, becoming one of the first of nine counties created by the Nevada Territorial Legislature. The County was retained after the territory became the 36^{th} State in the Union on October 31, 1864 (the 150^{th} Anniversary of the State of Nevada will be in 2014). Many of the earliest communities in the County were developed as trading posts and centers of farming and ranching. Genoa, originally known as Mormon Station, is the oldest community in the County. The County seat was originally in Genoa but was subsequently moved to Minden in 1916.

Douglas County is located in Northern Nevada (see Figure 3-1) and contains a total area of 737.7 square miles, or 472,133 acres. The County is bordered by the Consolidated Municipality of Carson City ("Carson City"), the State Capital, to the north, Lyon County to the south and east, and the State of California to the west and southwest. Douglas County includes a portion of Lake Tahoe, Topaz Lake, as well as the Carson and Walker Rivers. The Carson Range of the Sierra Nevada Mountains borders the western portion of Douglas County while the eastern portion is bordered by the Pinenut Mountain Range.

Since statehood, the boundaries of Douglas County have only been realigned two times: between Douglas County and Ormsby County (now Carson City) in 1965, and between Douglas County and Lyon County in 1967.

Elevations within the County vary from a low of 4,625 feet on the valley floor to a high of 9,500 feet at East Peak. The proximity of the Carson Valley to the Sierra Nevada Mountains creates one of the most comfortable daily temperature ranges in the continental United States. Generally, the climate is arid, with warm summers, moderate winters, and cool evening temperatures year round. Because of the elevation, the cold air is dry; likewise, summer heat is also very dry. Annual rainfall averages 9.4 inches and snowfall averages 19.4 inches. The heaviest precipitation occurs during the months of December, January and March. Afternoon thunderstorms in July and August bring warm summer rains.

Figure 3-1



3.2 GOVERNMENT

Douglas County, while exhibiting a predominately rural flavor, is a rapidly growing area. However, it ranks as the third smallest county in Nevada geographically. There are two principle geographic and political areas, the East Fork Township and the Tahoe Township. Douglas County, to date, has no incorporated areas.

East Fork Township

The East Fork Township is the larger of the two areas. The majority of the population resides in the Carson Valley. The township includes; Minden (County seat), neighboring Gardnerville, Genoa and Gardnerville Ranchos. The main geographic features include the Carson Valley, the east and west forks of the Carson River, the east slope of the Carson Range (Sierra Nevada Mountains), the Pinenut Mountains, and Topaz Lake. There are numerous environmentally sensitive areas (e.g... wetlands, rivers, lakes, reservoirs, agricultural lands, etc.) located in this township. Land uses include undeveloped forest and rangelands, agricultural fields and pasture, and urban development of housing and commercial/industrial uses. The major transportation routes for this area are US Highway 395 and US Highway 88.

Tahoe Township

The Tahoe Township is the smaller of the two townships. The Tahoe Township is that area of Douglas County located within the Tahoe Basin and includes Stateline and smaller communities along U.S. Highway 50 from the California border to the Douglas/Carson County line. The Stateline area is made up of several large hotel resort casinos, residences, condominiums, apartments and a wide variety of businesses. The tourist population in the area could increase the size of the population base by as many as 100,000 during peak seasonal and holiday periods. The geography is dominated by Lake Tahoe and the surrounding slopes of the Sierra Nevada Mountains. The basin is heavy forest area with a very sensitive environmental system. The major transportation routes for this area are U.S. Highway 50 and Nevada State Route 207, Kingsbury Grade.

Towns, General Improvement Districts and Special Purpose Districts

There are three unincorporated towns within the East Fork Township: Gardnerville, Genoa, and Minden. The towns are governed by their own elected Town Advisory Boards and each town has a Town Manager, Town Engineer, as well as additional staff persons. The population of each town, based on the 2010 Census is 4,756 for Gardnerville, 233 for Genoa, and 3,067 for Minden.

In addition to the three unincorporated towns, there are several general improvement districts (GID) and special purpose districts that provide urban-type services to residents of Douglas County, including Gardnerville Ranchos, Indian Hills, Topaz Ranch Estates, Kingsbury GID, and others. Both the East Fork and Tahoe Townships have general improvement and special purpose districts within them.

County Government

County residents elect officials to provide community leadership and administration. Currently, the county operates under a commission-manager form of government. Douglas County government includes elected officials, departments, boards, commissions, and committees.

The Board of Commissioners is the governing, legislative body for Douglas County. The five members of the Board are elected at large, by district. Commissioners serve four-year, overlapping terms, and receive limited compensation for their service to the community. Each year, the Board selects one of its members to serve as Chairman and preside over public meetings.

The various departments, boards, commissions, and committees within Douglas County government provide a full range of services to residents. Services provided by the County include: airport; animal control; building safety; fire protection and paramedic services; general administrative services; law enforcement; parks and recreation; street construction and maintenance, including traffic signalization; Water and sewer services, and Welfare and social services.

Douglas County also has numerous special districts and three jurisdictions designated as "towns" under Nevada Revised Statutes. Those special districts and towns are listed below. These entities were all invited to participate in the process either through direct committee participation or through the solicitation of hazard potential within each jurisdiction.

Key Officials

Douglas County has a commission-manager form of government with a County Manager appointed by the five member Board of Commissioners. The County has 13 advisory committees including the seven member Planning Commission and the five member Water Conveyance Advisory Committee. Public safety services, including emergency management, are provided by the Douglas County Sheriff's Office (elected office), the East Fork Fire and Paramedic Districts, and the Tahoe Douglas Fire Protection District.

District 1 County Commissioner	County Manager	District Attorney
District 2 County Commissioner	Assessor	Environmental Health Director
District 3 County Commissioner	County Engineer	Finance Director/Risk Manager
District 4 County Commissioner	Clerk-Treasurer	Fire Chief/Emergency Manager
District 5 County Commissioner	Cooperative Extension Director	Judges
Recorder	Community Development Director	Sheriff

County Departments/Divisions

Assessor	911 Emergency Services	Public Administrator
Building and Safety	Juvenile Probation & Detention	Public Guardian
Clerk	Internal Audit	Senior Services
Community Development	Human Resources	Purchasing
Community Services	Justice Court	Recorder
DART Transportation	Animal Care & Services	China Springs/Aurora Pines
District Attorney	Library	Sheriff
District Courts	County Manager's Office	Social Services
District Health	Parks and Recreation	Treasurer
Engineering	Public Works	Economic Development
Finance/Comptroller	Information Technology	Technology Services
Geographic Information Systems	Community Health Nurse	Alternative Sentencing
UNR Cooperative Extension	Weed Control	

General Improvement Districts, Special Districts and Towns

East Fork Fire and Paramedic Districts

Tahoe Douglas Fire Protection District

East Fork Swimming Pool District

Town of Minden

Town of Genoa

Town of Gardnerville

Douglas County School District

Gardnerville Ranchos General Improvement District

Indian Hills General Improvement District

Topaz Ranch Estates General Improvement District

Gardnerville Town Water

Cave Rock General Improvement District

Lake Ridge General Improvement District

Marla Bay General Improvement District

Round Hill General Improvement District

Zephyr Cove General Improvement District

Zephyr Knolls General Improvement District

Minden-Gardnerville Sanitation District

Kingsbury General Improvement District

Logan Creek General Improvement District

Oliver Park General Improvement District

Sierra Estates General Improvement District

Topaz Ranch Estates General Improvement District

Zephyr Heights General Improvement District

Douglas County Sewer Improvement District

Washoe Tribe

There is one federally recognized community under the Washoe Tribe of Nevada and California that is located within the jurisdictional boundary covered by this Hazard Mitigation Plan. That is the Dresslerville Colony located five miles south of the Town of Gardnerville, Nevada. The Washoe Tribal headquarters is centrally located on Tribal Land within the Dresslerville Community and within a 20-mile radius of nearly all current Tribal lands.

The Tribe is organized under the provisions of the Indian Reorganization Act of June 18, 1934, exercising rights of home rule and responsibility for the general welfare of its membership. The Washoe Tribal Council, a 12-member body, serves as the local authority for purposes of authorizing any planning program for the Tribe's future.

Washoe Tribe has an approved Tribal Level Hazard Mitigation Plan dated August 4, 2005 and an update is in progress.

The ancestral homeland of the Washoe Tribe radiated from Lake Tahoe, a spiritual and cultural center in the central Sierra Nevada Mountain Range west of Douglas County, Carson City and southern portions of Washoe County. The area originally encompassed over 1.5 million acres, the traditional homelands stretched from the Central Sierra Nevada in California to the Great Basin in Nevada.

Today, through ongoing tribal efforts and federal collaborations, the Tribe has recovered approximately 4,920 acres and approximately 61,000 acres of individual trust allotments within the ancestral homelands. Washoe Tribal lands are unique in that they do not comprise a single reservation, but are fractionated into several discrete parcels, located in six different counties and two different states. While the Tribe has some forested lands in the Sierra Nevada, most current lands are located just within the boundaries of the Great Basin desert, in the Carson River Watershed.

The last Tribal census in 1993 determined the total tribal enrollment to be 1,596 (one-quarter or more blood quantum), with 1,380 Tribal members living on one of the four reservation communities. While not all of these Tribal members live within Douglas County, a significant number do. In addition, the Tribe maintains around 250 employees, most of whom work out of the administration buildings in the Dresslerville parcel. While many of these employees are not residents of Tribal lands, they are nonetheless exposed to the hazards therein.

3.3 DEMOGRAPHICS

Population

Since the 1960s, Douglas County has grown from a small predominantly agricultural community to a mid-size community comprised of both urban and rural areas. The population boom began in the 1960s with the greatest growth rate between 1970 and 1980. The population increased from 6,882 in 1970 to 19,421 in 1980. As of the 2010 Census, the population of Douglas County has reached 46,997. While the population for the County has increased every year, there continues to be a population decline for those communities that surround Lake Tahoe. As shown in Table 3-1, the population totals at Kingsbury, Stateline, and Zephyr Cove have decreased since 2000.

Table 3-1

Population Change in Douglas County

And

Douglas County Census Designated Places (CDP's), 2000 to 2010

Area	2000	2010	2000-2010 Change	Percentage Change
Douglas County	41,259	46,997	5,738	13.9%
CDP's in Carson Valley Regional Plan				
Minden CDP	2,836	3,001	165	2.88%
Gardnerville CDP	3,357	5,656	2,299	40.07%
Indian Hills CDP	4,407	5,627	1,220	21.26%
Johnson Lane CDP	4,837	6,490	1,653	28.81%
Gardnerville Ranchos CDP	11,054	11,312	258	4.50%
CDP's in Tahoe Regional Plan				
Kingsbury	2,624	2,152	(472)	-17.99%
Stateline CDP	1,215	842	(373)	-30.70%
Zephyr Cove/Roundhill CDP	1,649	1,324	(325)	-19.71%
CDP's in Topaz Lake Regional Plan				
Topaz Ranch Estates CDP	na	1,501		
Topaz Lake CDP	na	157		

Source: 2010 Census, CDP-Census Designated Place. In 2000, Topaz Ranch Estates and Topaz Lake CDP's did not exist. CDP's do not have the same geographies as the Douglas County Community Plans.

Table 3-2 shows the median age of the population in Nevada counties. From 1990 to 2010 the median age of Douglas County residents increased by 11.2 years, from 36.2 to 47.4 years. Douglas County has the fifth highest median age in Nevada after Esmeralda, Storey, Nye and Mineral Counties. The median age in Carson City and Washoe County for 2010 is 41.7 and 37.0, respectively.

Table 3-2

Median Age by County in the State of Nevada: 1990, 2000 and 2010

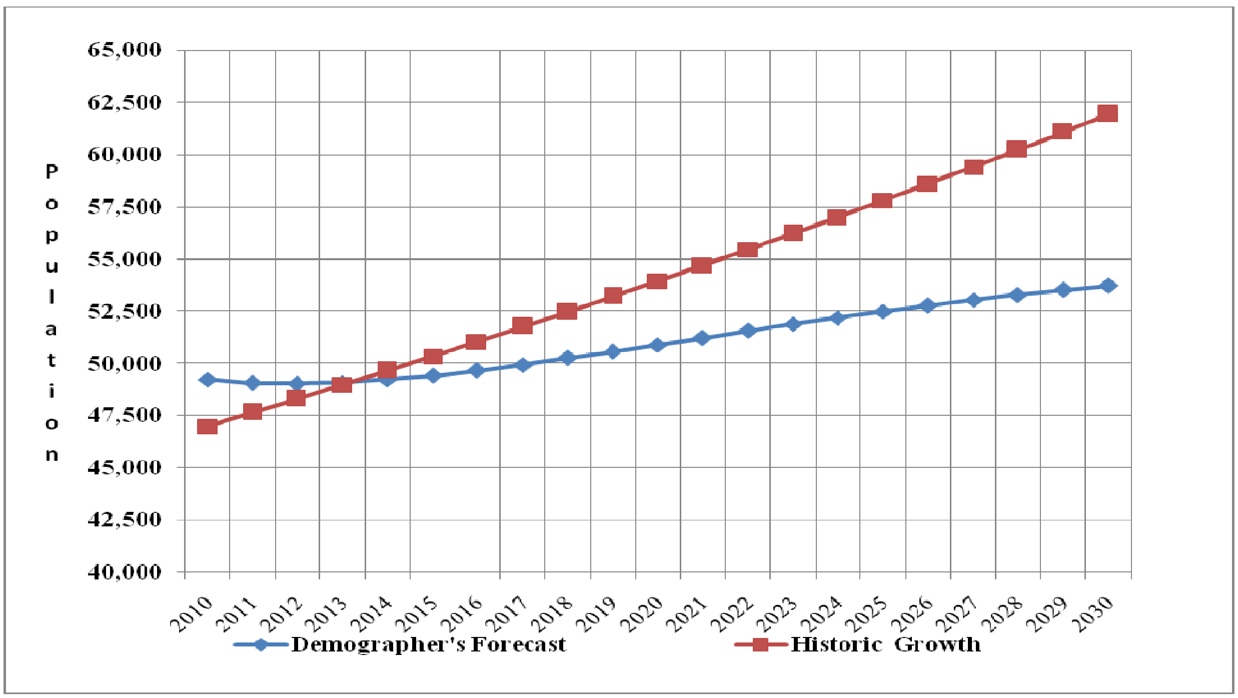
	1990	2000	2010
County/Area	**Years of age**	**Years of age**	**Years of age**
Carson City	36.6	38.7	41.7
Churchill	33.0	34.7	39.0
Clark	33.1	34.4	35.5
Douglas	36.2	41.7	47.4
Elko	29.4	31.2	33.4
Esmeralda	35.8	45.1	52.9
Eureka	33.3	38.3	42.4
Humboldt	30.6	33.4	36.2
Lander	28.7	34.1	37.1
Lincoln	33.4	38.8	39.9
Lyon	36.4	38.2	40.9
Mineral	33.9	42.9	49.2
Nye	36.5	42.9	48.4
Pershing	31.7	34.4	41.0
Storey	37.6	44.5	50.5
Washoe	33.6	35.6	37.0
White Pine	33.8	37.7	40.8
State Of Nevada	33.3	35.0	36.3
U.S.	32.9	35.3	37.2

Source: U.S. Department of Commerce. "Census 2000 and 2010 Redistricting Data (PL-94-171) Summary File, Table PL1 and 1990 Census." Bureau of Census: Washington D.C. 2010, 2000 and 1990.

As part of the 2011 update of the Douglas County Master Plan, population forecasts were prepared for 2030 based on the latest estimate from the State of Nevada Demographer as well as the County's average annual growth rate. The historic growth rate for the County is based on the annual average increase of 1.39 percent which represents the Douglas County's growth rate from 2000 to 2010. Using this growth rate, the Douglas County population is projected to be 61,940 by 2030. The August 31, 2011 projections from the State Demographer showed Douglas County reaching a total population of 53,724 by 2030. Figure 3-2 shows population projections for 2010 to 2030 based on the historic growth rate for Douglas County as well as the August 2011 State Demographer's forecast.

Figure 3-2

Comparison of Douglas County Population Projections, 2010-2030



Housing

According to the Douglas County Assessor (*September 4, 2012 Housing Count*), there are now 24,287 housing units in Douglas County. The housing stock is still largely dominated by single-family detached units (73.2 percent), followed by single-family attached units (12.7 percent). The median sales price for all single-family detached homes sold during 2012 was $215,500 with an average size of 2,044 square feet. When broken out by Township, the median sales price for homes sold in the East Fork Township portion of Douglas County during 2012 was $169,950 while the comparable figure for the Tahoe Township was $474,900.

Figure 3-3 shows trends of building permits and values by decade beginning in 1990. This figure also indicates a temporary slowing in building, property value and by inference population increase trends. These trends are expected to reverse as the economy improves.

Figure 3-3
Douglas County Building Permits and Values by Decade

	SFD PERMITS	SFD VALUATION	DUPLEX PERMITS	DUPLEX VALUATION	COM'L PERMITS	COML VALUATION	MFR PERMITS	MFR VALUATION	MANR PERMITS	TOTAL PERMITS ISSUED	TOTAL VALUATION
1990	544	67,289,814	Unknown	Unknown	30	19,487,679	2	331,136	99	1,656	114,771,027
1991	410	52,187,387	Unknown	Unknown	23	6,191,943	11	1,869,092	49	1,793	82,538,121
1992	498	66,232,264	Unknown	Unknown	30	15,856,645	5	10,578,892	18	1,722	108,441,845
1993	504	70,355,496	Unknown	Unknown	23	10,445,098	9	1,993,272	21	1,941	118,089,384
1994	626	91,643,022	Unknown	Unknown	39	25,076,588	13	2,968,122	16	2,025	131,239,746
1995	423	68,255,674	12	Unknown	32	11,639,111	0	0	9	1,663	108,349,142
1996	448	66,572,915	1	Unknown	39	21,040,095	0	0	28	1,781	112,440,309
1997	436	64,240,674	2	Unknown	36	20,088,904	0	0	22	1,740	111,634,844
1998	435	74,375,143	1	Unknown	44	40,854,631	1	418,054	26	1,637	147,272,370
1999	485	77,676,237	0	Unknown	34	26,073,755	0	0	32	1,853	136,976,060
TOTAL	**4809**	**698,828,626**	**16**		**330**	**196,754,449**	**41**	**18,158,568**	**320**	**17,811**	**1,171,752,848**
2000	542	91,417,846	0	0	30	21,606,243	4(64)	4,908,366	29	1,777	145,545,605
2001	560	94,664,266	4(8)	534,660	33	31,076,470	9	2,415,393	40	1,755	169,689,570
2002	672	113,110,261	2(4)	291,281	25	13,126,791	0	0	37	2,009	155,740,219
2003	517	101,516,848	2(4)	333,160	34	21,344,322	24(104)	6,015,393	27	2,058	166,478,317
2004	505	106,637,015	2(4)	497,843	44	16,679,829	10(50)	1,907,420	19	2,106	155,847,417
2005	537	118,022,693	1(2)	625,344	42	17,403,322	16(74)	4,096,230	11	2,150	176,320,837
2006	418	104,896,384	1(2)	250,297	39	23,308,488	0	0	4	1,509	166,014,015
2007	145	50,814,964	0	0	16	7,732,733	5(77)	19,445,650	2	1,323	125,045,467
2008	48	22,377,950	0	0	19	17,453,391	3(20)	967,363	1	1,335	74,309,287
2009	43	17,204,657	0	0	8	2,904,777	0	0	3	988	49,962,889
TOTAL	**3,987**	**820,662,884**	**12(24)**	**2,532,585**	**290**	**172,636,366**	**62(389)**	**39,755,815**	**173**	**17,010**	**1,384,953,623**
2010	35	16,207,102	0	0	8	3,434,208	2(21)	3,401,936	1	1,076	48,552,895
2011	35	11,106,794	0	0	8	2,142,620	0	0	1	1,132	44,246,751
2012	49	16,042,805	0	0	10	6,564,732	0	0	0	1,103	43,396,050
			(-) Units				(-) Units				
	SFD=	**Single Family Dwelling**									
	COM'L=	**New Commercial Building**									
	MFR=	**Multi-Family Res-**									
	MANR= Manufactured Homes										

For Fiscal Year July 1, 2012 - June 30, 2013, there were 75 permits for new Single Family Dwellings, including 3 at Lake Tahoe. In addition, the permit for the new Parkway Vista affordable senior housing in Gardnerville (30 units) was issued in April. The total value of all single family dwelling permits for the fiscal year 2012-2013 was $25,556, 873, an increase of 118 % from Fiscal Year 2011-2012, which was $11,722,927. During Fiscal year 2011-2012, there were 38 permits for new Single Family Dwellings.

3.4 Land Use and Development Trends

Douglas County is one of 17 counties in the State of Nevada and is the third smallest county in the State after Storey County and Carson City. The County includes 711.4 square miles of land area and 26.3 square miles of water, as shown in Table 3-3 below.

Table 3-3

Douglas County Total Area

	Acres	Square Miles
Land Area	455,291.0	711.4
Water Area	16,842.5	26.3
Total Area	472,133.5	737.7

Similar to the pattern of land ownership for the entire State of Nevada, a significant portion of the County is in public lands as shown in Table 3-4 below. There are 305,825 acres, or 64.8 percent of the total County area, that is public land. The largest category of public land is under the Bureau of Land Management (BLM) with 161,830 acres, followed by the Bureau of Indian Affairs (BIA) with 59,275 acres.

Table 3-4
Public Land Ownership in Douglas County, by Federal and State Agencies

Public Entity	Acres	Percentage of Total County Area (Total = 472,133 acres)
Bureau of Land Management	161,830	34.2
Bureau of Indian Affairs	59,275	12.6
US Forest Service	83,080	17.6
State of Nevada	1,641	.3
Total Acreage	305,826	64.8

In addition to public lands, there are 3,455 acres in Douglas County which belong to the Washoe Tribe of Nevada and California. The Washoe Tribal Lands include the Tribal Trust Lands of 3,455 acres as well as the BIA Allotments, which total 59,275 acres, for a total of 62,730 acres.

Table 3-5 provides information on the future land use designations of all properties within Douglas County, based on the County's 2011 Master Plan. Future land use information is provided by parcels as well as by acreage.

The single family residential and single family estates future land uses contain the highest percentage of parcels in Douglas County at 28 percent and 21.6 percent, respectively. The future land use with the highest number of acres, however, is Forest Range at 75.2 percent of the total land acreage in Douglas County. The Forest and Range land use category includes federal lands under the control of the BLM, the US Forest Service, and the BIA.

Table 3-5

Douglas County Master Plan Land Area in Douglas County, by Future Land Use*

Future Land Use Category	Total Parcels	%	Total Acres	%
Recreation	41	.2	481.4	.2
Forest and Range	1,962	7.2	338,651.2	75.2
Agriculture	983	3.6	38,498.2	8.5
Washoe Tribal Lands	20	.1	3,456.4	.7
Rural Residential	1,831	6.7	19,848.5	4.4
Single Family Estates	5,868	21.6	9,500.9	2.1
Single Family Residential	7,620	28.0	2,742.4	.6
Multi-Family Residential	1,503	5.5	469.2	.1
Commercial	714	2.6	1,487.5	.3
Industrial	390	1.4	1,990.2	.4
Community Facilities	273	1.0	5,866.6	1.3
Receiving Areas	1,170	4.3	5,918.8	1.3
Tahoe Regional Plan Parcels	4,834	17.8	21,514.4	4.8
Total	27,209	100.0	450,425.7	100.0

*Does not include Water Bodies or Right-of-Way. Percentages may not total 100% due to rounding.

Table 3-6 provides information on the current zoning districts or zoning categories within Douglas County, by parcel and by acreage. The low density residential category, which includes .5 acre, 1 acre, and 2 acre zoning districts, has the highest percentage of parcels at 28.8 percent. The average parcel size is 1.5 acres. The Forest Range – 40 acre Zoning District covers 215,005 acres in the County with an average parcel size of 1,004.7 acres. The Agriculture-19 acre zoning district includes 1,057 parcels for a total acreage of 39,178.

Table 3-6

Land Area in Douglas County, by Zoning District*

Zoning Category or Zoning District	Parcels	%	Acreage	%	Average Parcel Size
Forest Range- 19 acre Zoning District	1,809	6.6	125,773	28.1	69.5 Acres
Forest Range – 40 acre Zoning District	214	7.9	215,005	48.1	1,004.7 Acres
Agriculture-19 acre Zoning District	1,057	3.9	39,178	8.8	37.07 Acres
Rural Residential Category (RA-5, RA-10 Zoning Districts)	1,729	6.3	20,190	4.5	11.7 Acres
Low Density Residential Category (SFR 1, SFR 2, SFR 1/2)	7,853	28.8	12,046	2.7	1.5 Acres
Medium Density Residential Category (SFR-12,000, SFR-8,000 Zoning Districts)	6,703	24.6	2,395	.5	.4 Acres
High Density Residential (MFR) Zoning District	1,590	5.8	577	2.7	.4 Acres
Commercial Category (NC, OC, GC, MUC, TC Zoning Districts)	784	2.9	2,376	5.3	3.0 Acres
Industrial Category (LI, SC, GI Zoning Districts)	391	1.4	1,990	.4	5.1 Acres
Community Facility Category (Airport, Public Facility Zoning Districts)	280	1.0	5,896	1.3	21.1 Acres
Tahoe Regional Plan Parcels	4,834	17.7	21,514.4	4.8	4.5 Acres
Total	27,244	100%	446,940	100%	

* Does not include Water Bodies or Right-of-Way. There are no parcels zoned as SFR-T 3,000-SFR-T 8,000

Population Density

The population density for each of the Community Plans within the Carson Valley portion of Douglas County is depicted in Table 3-7. The Airport Community Plan has the lowest density at 12 persons per square mile. The highest population density is in the Minden/Gardnerville Community Plan at 1,362 persons per square mile. The Gardnerville Ranchos Community Plan has the highest population at 11,065 persons. The overall density for the entire Carson Valley Regional Plan is 220 persons per square mile. The population density for all of Douglas County is 64 persons per square mile and ranges from 14 persons per square mile in the Airport Community Plan to 1,061 persons per square mile in the Gardnerville Ranchos Community Plan.

Table 3-7

Population Density, by Community Plan

Community Plan	Total Acreage	Square Miles	2010 Population	Population Density (Persons/Sq. Mile)
Agriculture	33,272	51.98	733	14 persons/sq. mile
Airport	4,678	7.31	85	12 persons/sq. mile
East Valley	9,922	15.50	1,524	98 persons/sq. mile
Fish Springs	12,197	19.06	685	36 persons/sq. mile
Foothill	6,679	10.44	1,337	128 persons/sq. mile
Gardnerville Ranchos	6,673	10.43	11,065	1,061 persons/sq. mile
Genoa	6,363	9.94	935	94 persons/sq. mile
Indian Hills/Jacks Valley	5,056	7.90	5,406	684 persons/sq. mile
Johnson Lane	17,984	28.10	6,496	231 persons/sq. mile
Minden/Gardnerville	4,052	6.33	8,619	1,362 persons/sq. mile
Ruhenstroth	5,092	7.96	1,650	207 persons/sq. mile
Total	111,968	174.95	38,535	220 persons/sq.mile

This section provides an overview of the planning process; identifies Planning Committee members, and key stakeholders; documents public outreach efforts; and summarizes the review and incorporation of existing plans, studies, and reports used in the development of this HMP. Additional information regarding the Planning Committee and public outreach efforts is provided in Appendices C and D. Section four updates are listed in Table 4-1.

The requirements for the planning process, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Planning Process

Documentation of the Planning Process
Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

- An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
- An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and nonprofit interests to be involved in the planning process; and
- Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Element

- Does the new or updated plan provide a narrative description of the process followed to prepare the plan?
- Does the new or updated plan indicate who was involved in the planning process? (For example, who led the development at the staff level and were there any external contributors such as contractors? Who participated on the plan Committee, provided information, reviewed drafts, etc.?)
- Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)
- Does the new or updated plan indicate that an opportunity was given for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?
- Does the updated plan document how the planning team reviewed and analyzed each section of the plan?
- Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?
- Does the updated plan indicate for each section whether or not it was revised as part of the update process?

Source: FEMA, March 2008.

4.1 OVERVIEW OF PLANNING PROCESS

The first step in the planning update process was to establish a Planning Committee composed of existing Douglas County agencies. Tod Carlini, District Fire Chief and Douglas County Emergency Management Director, served as the primary Point of Contact (POC) for Douglas County and the public. Chief Carlini also functioned as project leader for the update process.

Each section of the previous HMP was reviewed for content and the committee revised every section of the plan. The plan was also re-drafted into a new outline as all NV State plans are requested to be in this new outline.

During the 5 years since the previous plan was adopted there was no plan maintenance performed. There was discussion on mitigation actions taken and planning regarding wildfire during the update of the Community Wildfire Protection Plan. However, other than wildfire, all information on mitigation action accomplishments and new public input was derived during the planning process. There has been a change in Emergency Management leadership within Douglas County. Emergency Management services are contracted to the East Fork Fire and Paramedic Districts through an interlocal agreement. The following table provides the new section format and provides details on the update.

Table 4-1

Plan Outline and Update Effort

Plan Section	Update Effort	What Changed
Section 1 – Official Record of Adoption	Minor Revisions	The process for plan adoption remains the same but the update provides a discussion of the current process.
Section 2- Background	Moderate Revisions	This section was revised in content and format, expanded to include Flood Management Assistance, repetitive flood and severe repetitive flood descriptions.
Section 3 – Community Description	Moderate Revisions	This section was updated to include new land use map, listing of key officials, special districts and towns, and the Washoe Tribe. Demographics were updated and projections added. The land use and population density portions were expanded to include land use and development trends to address new requirements.
Section 4 – Planning Process	Major Revisions	This section was updated to reflect details of the current plan's planning process. Current public and stakeholders outreach efforts are described.
Section 5 – Hazard Analysis	Major Revisions	Avalanche and landslide were deleted as hazards by the committee after scoring hazards. Drought, epidemic, volcano and seiche (tsunami) were added. The committee rated the hazards according to low, moderate or high planning significance. The individual hazard sections were reformatted to the new outline and then provided to the committee member with expertise to update history and revise as needed. New Hazus information was used for the earthquake hazard and new FIRM maps were used for flood hazard.
Section 6 – Vulnerability Analysis	New	This section was included in the Risk Analysis section of the last plan. New analysis of population, residential, non-residential and critical facilities based on mapping efforts tied to hazards was included. Identified URMs were included. Future development was included. This new section was added to meet requirements and help with the mitigation strategy section. The team used it to prioritize projects.
Section 7 – Capability Assessment	Minor Revisions	This section was reviewed and new information included in the new outline format. A local mitigation capability assessment was included and a section on NFIP was included to address requirements.
Section 8 – Mitigation Strategy	Major Revisions	The goals and actions were reviewed and progress was included, actions deleted, and actions added. The prioritization process was expanded to include the STAPLE+E process to better evaluate and prioritize actions.
Section 9 – Plan Maintenance	Major Revisions	The planning leads determined the maintenance process needed to be improved. Planning forms were included in Appendix F to help with the maintenance process.
Section 10 – Reference	New	This section was revised for plan update references.

Once the Planning Committee was formed, the following five-step planning process took place during the 11-month period from July 2012 to October 2013.

Organize resources: The Planning Committee identified resources, including Douglas County staff, agencies, and local community members, which could provide technical expertise and historical information needed in the development of the HMP.

Assess risks: The Planning Committee identified the hazards specific to Douglas County, and developed the risk assessment for the thirteen identified hazards. The Planning Committee reviewed the risk assessment, including the vulnerability analysis, prior to and during the development of the mitigation strategy.

Assess capabilities: The Planning Committee reviewed current administrative and technical, legal and regulatory, and fiscal capabilities to determine whether existing provisions and requirements adequately address relevant hazards.

Develop a mitigation strategy: After reviewing the risks posed by each hazard, the Planning Committee worked to develop a comprehensive range of potential mitigation goals, objectives, and actions. Subsequently, the Planning Committee identified and prioritized the actions to be implemented.

Monitor progress: The Planning Committee developed an implementation process to ensure the success of an ongoing program to minimize hazard impacts to Douglas County.

4.2 HAZARD MITIGATION PLANNING COMMITTEE

4.2.1 Formation of the Planning Committee

As previously noted, the planning process began in July 2012. Tod Carlini, District Fire Chief and Emergency Manager for Douglas County, formed the advisory body, known as the Planning Committee, utilizing staff from relevant Douglas County, special districts, general improvement district and other agencies, the State of Nevada, and community organizations. The Planning Committee members are listed in Table 4-2. The Planning Committee meetings are described in section 4.2.2, along with a summary of each meeting in appendix C. Please see appendix E for each meeting's agenda and sign-in sheet.

Table 4-2

Douglas County Hazard Mitigation Planning Committee & Participating Agencies

Name	Department	Participation
Chair: Tod Carlini	Emergency Management & Fire Department	Chair of the Committee, chaired meetings, provided evaluation and information on the following sections; earthquake, severe storm, vulnerability analysis, risk assessment, mitigation strategies, plan maintenance, provided public outreach. Attended meetings, reviewed drafts and provided input.
Elizabeth Ashby	State Hazard Mitigation Officer	Provided information on tools, guidance and plan outline.
Karen Johnson	State Hazard Mitigation Specialist	Provided information on tools, guidance and plan outline.
Erik Nilssen	Douglas County Engineer	Provided information on flood hazard and management, drainage and public utilities. Attended meetings, reviewed drafts and provided input.
Candace Stowell	Community Development	Provided information on planning, zoning and community description. Attended meetings, reviewed drafts and provided input.
Bob Spellberg	Gardnerville Ranchos GID	Provided information on public utilities and critical infrastructure. Attended meetings, reviewed drafts and provided input.
Steve Eisele	East Fork Fire	Provided information on wildfire and structure count. Attended meetings, reviewed drafts and provided input.
Greg Hill	Town of Minden	Provided information on public utilities and critical infrastructure. Attended meetings, reviewed drafts and provided input.
Josh Poulson	Town of Gardnerville	Provided information on flood management and drainage. Attended meetings, reviewed drafts and provided input.
Tom Dallaire	Town of Gardnerville	Provided information on flood management and drainage. Attended meetings, reviewed drafts and provided input.
Eric Schmidt	Douglas County GIS	Provided mapping and data management. Attended meetings, provided input.
Nate Leising	County Citizen/Agriculture	Attended meetings, reviewed drafts and provided input on agricultural interests.

John Pickett	Tahoe-Douglas Forestry	Provided information on wildland fire. Attended meetings, reviewed drafts and provided input.
Mark Novak	Tahoe-Douglas Fire District	Provided information on wildland fire. Attended meetings, reviewed drafts and provided input.
Mike Vollmer	Tahoe Regional Planning Agency	Attended meetings, reviewed drafts and provided input.
Gary Cullen	Douglas County School District	Provided information on critical infrastructure for the district.
Craig DePolo	Bureau of Mines and Geology	Provided information on Earthquakes Attended meetings
Doug Sonnemann	Douglas County Assessor	Provided information on structure count and values.

4.2.2 Planning Committee Meetings & Monthly Progress

- ***September 2012***

During the kick-off meeting at Douglas County Emergency Operations Center, the Committee discussed the objectives of the DMA 2000, the hazard mitigation planning process, the public outreach process, and the steps involved in updating the HMP and achieving the County's goals. The planning process was discussed, including the purpose of the plan and the previous plans tasks, goals and objectives and new goals and objectives were considered. The 12 potential hazards from the original HMP were reviewed and modifications to the hazards list were discussed. A hazard identification table was completed for the update. The exercise identified the specific hazards that the Planning Committee wanted to address in the HMP. A Hazard Profiling Worksheet was then completed by the Planning Committee, which used group averaging to prioritize the hazards into high, medium and low categories. See Appendix E for agenda, list of attendees and handouts.

- ***October 2012***

Briefed the Planning Committee on progress made to date. A review of the completed Hazard Profiling worksheets took place, along with confirmation of hazard ranking. Sub-committee groups for the highest ranking hazards were established and given assignments. Progress report dates were also established. See Appendix E for agenda, list of attendees and meeting handouts.

- ***February 2013***

Presentations of work performed thus far on the top five identified hazards were given by each sub-committee leader. Discussion of lower raking hazards took place, along with future actions on those hazards. Project identification and priority were briefly discussed as well. The committee ended the meeting by reviewing the plan update schedule and discussing future meetings and procedural matters. See Appendix E for agenda, a list of attendees and meeting handouts.

- ***July 11, 2013***

A brief review of the rough draft HMP document took place, along with the review of the identified goals and actions. STAPLE+E worksheets were distributed and explained for prioritization of the identified goals and action items. Each member was asked to complete the STAPLE+E forms and submit them back for scoring. The upcoming HMP public presentations were discussed, along with the recently revised HMP update timeline. See Appendix E for agenda, a list of attendees and meeting handouts.

- ***July 25, 2013***

Another review of the rough draft HMP document took place. Results of the STAPLE+E worksheet were thoroughly reviewed and discussed. Some goals and actions were re-prioritized based on importance. See Appendix E for agenda, a list of attendees and meeting handouts.

4.2.3 Plans, Studies, Reports and Technical Information

Tod Carlini, the Chair of the Committee, felt that the information available was of high quality.

4.3 Public Involvement

The public and stakeholder input in the previous plan was limited. For the purposes of this plan, public notice was provided in local publications regarding the process and public presentations and input sessions were held to review draft documents and consider public comment. Two public presentations were offered in July. These presentations were held in two geographic locations of the county, Minden and Round Hill (Lake Tahoe). These meetings were promoted through press releases.

Press Release & Public Awareness

A press release was posted on the Douglas County Emergency Management website and published in the local newspaper, The Record-Courier. The press release can be found in Appendix D of this document. In August of 2013, the final draft of the HMP was made available on the Douglas County Emergency Management website and was published via mail and e-mail to the entire Planning Committee and Local Emergency Planning Committee.

Douglas County Emergency Management mailed letters (see Appendix D) regarding the update of the HMP to the following entities:

Neighboring Communities

Counties of Carson, Lyon, Storey, Alpine (California) and Eldorado (California)

Letters to Stakeholders

Minden-Tahoe Airport

Washoe Tribe of Nevada

Town of Genoa

Town of Gardnerville

Town of Minden

Gardnerville Town Water

East Fork Swim District

Round Hill General Improvement District

Gardnerville Ranchos General Improvement District

Indian Hills General Improvement District

Topaz Ranch Estates General Improvement District

Cave Rock General Improvement District

Lake Ridge General Improvement District

Marla Bay General Improvement District

Zephyr Cove General Improvement District

Zephyr Knolls General Improvement District

Kingsbury General Improvement District

Logan Creek General Improvement District

Oliver Park General Improvement District

Sierra Estates General Improvement District

Zephyr Heights General Improvement District

State of Nevada Department of Emergency Management

State of Nevada Department of Water Resources

Nevada Department of Transportation

Tahoe Regional Planning Agency

4.4 INCORPORATION OF EXISTING PLANS AND OTHER RELEVANT INFORMATION

During the planning process, the Planning Committee reviewed and incorporated information from existing plans, studies, reports, and technical reports into the HMP. A synopsis of the sources used follows.

Douglas County Building Code* **(International Building Code 2006):** These regulations concern zoning districts, variances, and general development standards for structures other than residential structures within Douglas County.

Douglas County Building Code* **(International Residential Code 2006):** These regulations concern zoning districts, variances, and general development standards for residential structures within Douglas County

Douglas County Fire Code* **(International Fire Code 2006)*:*** This document includes a wildland/urban interface section that delineates regulations for building and maintaining homes in wildland fire prone areas.

Douglas County Master Plan **(Douglas County Community Development 2011):** Though the plan does not specifically identify hazard mitigation, the plan incorporates hazard mitigation into several elements like zoning.

Douglas County Open Space and Agricultural Lands Preservation Implementation Plan: This plan guides the creation of open space through the use of public land and public resources within the county boundaries.

Douglas County Code Title 20 Zoning Ordinance of Douglas County: This land use zoning ordinance encourages, guides, and provides orderly planned use of land and water resources and future growth and development.

FEMA Flood Insurance Study for Douglas County, Nevada (FEMAS 1999, 2000, 2005, 2009): This study outlined the principal flood problems and floodplains within the county. Douglas County is currently contesting this study.

Carson Water Subconservency District (CWSD), Carson River Watershed Regional Floodplain Management Plan, 2008: This plan provides strategies for floodplain management that can be applied regionally as well as locally.

Community Wildfire Protection Plan **(August 2009):** This document includes findings and recommendations for mitigating the threat to property from wildland fires.

Emergency Operations Plan*:* This document is the main reference source for managing disasters and large scale emergencies in Douglas County. The plan has several annexes that apply to the HMP including Firefighting (including wildland fire fighting), Health and Medical (including epidemic), Recovery, Public Works and Engineering, Utilities, Human Services, Hazard Mitigation, and Hazardous Materials.

Carson River Geographic Response Plan*:* This is a regional plan covering five counties in two states. The plan was developed to protect the health, safety, environment, and property (both public and private) from the effects of hazardous materials incidents in or near the Carson River.

State of Nevada Multi-Hazard Mitigation Plan*:* This plan, prepared by NDEM, was used to ensure that the Counties HMP was consistent with the State's Plan.

Washoe Tribe of NV & CA Hazard Mitigation Plan 2005

The following FEMA guides were also consulted for general information on the HMP process:

How-To Guide #1: Getting Started: Building Support For Mitigation Planning **(FEMA 2002)**

How-To Guide #2: Understanding Your Risks – Identifying Hazards and Estimating Loss Potential **(FEMA 2001)**

How-To Guide #3: Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies **(FEMA 2003)**

How-To Guide #4: Bringing the Plan to Life: Implementing the Hazard Mitigation Plan **(FEMA 2003)**

Local Multi-Hazard Mitigation Planning Guidance (FEMA 2008)

A complete list of the sources consulted is provided in Section 10, Reference.

*Update to the 2006 Douglas County codes are in process.

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Even though a particular hazard may not have occurred in recent history in the study area, all significant natural and human-caused hazards that may potentially affect the study area are included in the screening process. The planning committee agreed that hazards that are unlikely to occur, or for which the risk of damage is accepted as being very low, are eliminated from consideration.

All identified hazards will be profiled by describing hazards in terms of their nature, history, magnitude, frequency, location, and probability. Hazards are identified through the collection of historical and anecdotal information, review of existing plans and studies, and preparation of hazard maps of the study area. Hazard maps are used to determine the geographic extent of the hazards and define the approximate boundaries of the areas at risk.

5.1 HAZARD IDENTIFICATION AND SCREENING

The requirements for hazard identification, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Risk Assessment – Overall

Identifying Hazards

§201.6(c)(2)(i): [The risk assessment shall include a] description of the type of all natural hazards that can affect the jurisdiction.

Element

- Does the new or updated plan include a description of all the types of all natural hazards that affect the jurisdiction?

Source: FEMA, March 2008.

The risk assessment process is the identification and screening of hazards, as shown in Table 5-1. The Planning Committee identified 12 possible hazards that could affect Douglas County. The Planning Committee evaluated and screened the comprehensive list of potential hazards based on a range of factors, including prior knowledge or perception of the relative risk presented by each hazard, the ability to mitigate the hazard, and the known or expected availability of information on the hazard (see Table 5-1).

Seiche (tsunami), epidemic, volcano, infestation and expansive soils are all newly identified potential hazards that were considered during this update of the HMP. Severe wind, hail/thunderstorm, tornado and extreme heat were combined with severe weather.

Table 5-1
Identification and Screening of Hazards

Hazard Type	Should It Be Profiled?	If Yes is this a New Hazard?	Explanation
Avalanche	No		Douglas County is located in area prone to frequent or significant snowfall. No historical record of avalanche or damage.
Drought	Yes	No	Federal statewide drought declarations were issued in 2002, 2004, 2012 and 2013.
Earthquake	Yes	No	Several active fault zones pass through the County.
Epidemic	Yes	Yes	This hazard was addressed in the State Multi-Hazard Mitigation Plan.
Expansive Soils	No		No significant historic events have occurred in the County.
Flood	Yes	No	Flash floods and other flood events occur regularly during rainstorms.
Infestations	No		No significant historic events have occurred in the County.
Land Subsidence	No		No significant historic events have occurred in the County.
Severe Weather	Yes	No	Douglas County is susceptible to severe storms. Previous events have occurred including winter storms, thunderstorms and high winds.
Seiche (Tsunami)	Yes	Yes	No recent historic events have occurred, however the Tahoe Basin is at risk.
Volcano	Yes	Yes	No recent historic events have occurred in the County. However, there have been some indicators of volcanic activity in neighboring areas.
Wildland Fire	Yes	No	The terrain, vegetation, and weather conditions in the region are favorable for the ignition and rapid spread of wildland fires.

Assigning Vulnerability Ratings

During a Committee meeting the members were tasked to prioritize the hazards by their total impact on the community. An exercise requiring the committee to complete a hazard profiling worksheet (see appendix E, page 6) which tabulated their ratings of each hazard was accomplished. The exercise formula took into account the historical occurrence of each respective hazard, the potential area of impact when the disaster does occur, and the magnitude. Please see Table 5-2 for scoring criteria.

It is important to note that hazards of the same magnitude and the same frequency can occur in similar sized areas; however, the overall impact to the areas would be different because of population densities and property values in the areas impacted.

Table 5-2

Vulnerability Ratings Rubric

		Magnitude	Duration	Economic	Area Affected
Lowest	1	Insured Loss	1-3 Days	Community	Community
	2	Local	4-7 Days	City / Town	City / Town
	3	State	8-14 Days	County	County
	4	Federal Emergency	15-20 Days	State	State
Highest	5	Federal Disaster	20 + Days	Federal	Federal

		Frequency	Degree of Vulnerability	State & Community Priorities
Lowest	1	10+ years	1-5% damaged	Advisory
	2	6-9 years	6-10%	Considered further Plan
	3	1-5 years	11-25%	Prompt Action
	4	2-12 months	26-35%	Immediate Action
Highest	5	0-30 days	36-50%	Utmost immediacy

A value of 1-5 was given to each category (i.e. magnitude, duration etc.) by each committee member. The members' totals for each hazard were tallied. The following table provides the results of the exercise.

Table 5-3

Hazards Rating

	Hazard	**Total**
High	Flood	349
	Wildland Fire	343
	Earthquake	335
	Drought	275
	Severe Weather	265
Low	Epidemic	211
	Volcano	191
	Seiche (tsunami)	184
Very Low	Infestation	149
	Land Subsidence	146
	Avalanche	142
	Expansive Soils	113

Upon obtaining total scores for each hazard, the team utilized the scores to analyze and prioritize the hazards to focus upon during the profiling, vulnerability assessment and mitigation planning.

The Planning Committee determined that five hazards pose the highest threat to Douglas County: floods, wildland fire, earthquake, drought and severe weather. No hazards fell into the moderate hazard category, and epidemic, volcano and seiche (tsunami) were considered low hazards. Infestation, land subsidence, avalanche and expansive soils were considered very low threat and excluded through the screening process. The very low threat hazards were considered to pose little threat to life and property in Douglas County due to the low likelihood of occurrence or the low probability that life and property would be significantly affected. Should the risk from these hazards increase in the future, the HMP can be updated to incorporate a vulnerability analyses for these hazards.

5.2 HAZARD PROFILES

The requirements for hazard profile, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Risk Assessment – Profiling Hazards

Profiling Hazards

Requirement §201.6(c)(2)(i): [The risk assessment **shall** include a] description of the location and extent of all natural hazards that can affect the jurisdiction. The plan **shall** include information on previous occurrences of hazard events and on the probability of future hazard events.

Element

- Does the risk assessment identify the **location** (i.e., geographic area affected) of each natural hazard addressed in the plan?
- Does the risk assessment identify the **extent** (i.e., magnitude or severity) of each hazard addressed in the plan?
- Does the plan provide information on **previous occurrences** of each hazard addressed in the plan?
- Does the plan include the **probability of future events** (i.e., chance of occurrence) for each hazard addressed in the plan?

Source: FEMA, March 2008.

The specific hazards selected by the Planning Committee for profiling have been examined in a methodical manner based on the following factors:

- Nature
- History
- Location of future events
- Extent of future events
- Probability of future events

The hazards profiled for Douglas County and presented in this section are in alphabetical order. The order of presentation does not signify the level of importance or risk. Committee members considered expert in the specific hazard were tasked to review the previous HM Plan and make modifications to each profile. Revisions were made to update the historical information and new information was incorporated, for example new FIRM maps were used in the Flood profile. HAZUS runs from 2009 were used in the Earthquake profile as the newer runs are not reliable due to FEMA's changes in the updated software.

The full reports for Earthquake, Flood and Wildland Fire were abbreviated to accommodate the requirements of this section. The full reports are contained in Appendix B.

5.2.1 Drought

Planning Significance – High

5.2.1.1 Nature

Drought is a temporary but recurrent feature of climate that occurs virtually everywhere, including in regions that normally receive little rainfall. Characteristics of drought can vary significantly from one region to another and, partly due to differences in impact, there are scores of definitions. Drought is often described simply as a period of deficient precipitation, usually lasting a season or more, resulting in extensive damage to agricultural crops with consequential economic losses. Water shortages can result for some activities, groups, or environmental sectors.

The onset and end of a drought are difficult to determine, and in contrast with quick and intense natural hazards such as tornadoes, the impact of drought is more of a slower “creeping hazard” and may be spread over a larger geographic area. The impact of a particular drought depends on numerous factors including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation.

The negative effects of drought increase with duration. Lower than normal reservoir or river levels can impact recreational opportunities, fire suppression activities, and animal habitat. Patterns of human consumption can also be altered. Non-irrigated croplands are most susceptible to precipitation shortage. Rangeland and irrigated agricultural crops may not respond to moisture shortage as rapidly, however yield during periods of drought can be substantially lower. During periods of severe drought, lower moisture in plant and forest fuels create an increased potential for devastating wildfires. An increase in insect infestation can be a particularly damaging impact from severe drought conditions.

The U.S. Drought Monitor product utilizes several indices along with data retrieved from various organizations and personnel directly involved in the field to create a graphical assessment of drought conditions. The five drought intensities or classifications offered by the authors of this product are: D0 Abnormally Dry, D1 Moderate Drought, D2 Severe Drought, D3 Extreme Drought and D4 Exceptional Drought. The National Weather Service in Reno will issue Drought Information Statements and brief water resource partners during periods of drought.

5.2.1.2 History

Increased wildfire risk, water shortages and an anomalous insect infestation have all been attributed to recent droughts. Douglas County has experienced 6 drought periods of Drought Monitor classification D1 or higher since 2000, including the current drought. Maximum intensity of these droughts ranged from severe (D2) to extreme (D3) and averaged just over one year in duration. The longest drought in the period of record was from January 2007 to June 2009 – 28 months. The last two droughts have been the longest and most extreme since 2000. There is no regular pattern to drought occurrences in the county, though there have been long periods without drought, most notably the wet years of 2005-2006. It should be noted the ongoing drought starting in 2012 has resulted in a USDA Drought Disaster Area Declaration for much of Nevada, including Douglas County.

Table 5-4

Recent drought periods extracted from data supplied by the U.S. Drought Monitor

Drought Period	Duration of Drought	Maximum Intensity
3 April 2001 - 8 Jan 2002	9 months	Extreme (D3)
28 May 2002 - 12 Nov 2002	5 months	Severe (D2)
11 Feb 2003 - 30 Dec 2003	10 months	Severe (D2)
27 Apr 2004 - 11 Jan 2005	8 months	Severe (D2)
23 Jan 2007 - 9 Jun 2009	28 months	Extreme (D3)
3 Jan 2012 - ongoing	19 months	Extreme (D3)

5.2.1.3 Location, Extent, and Probability of Future Events

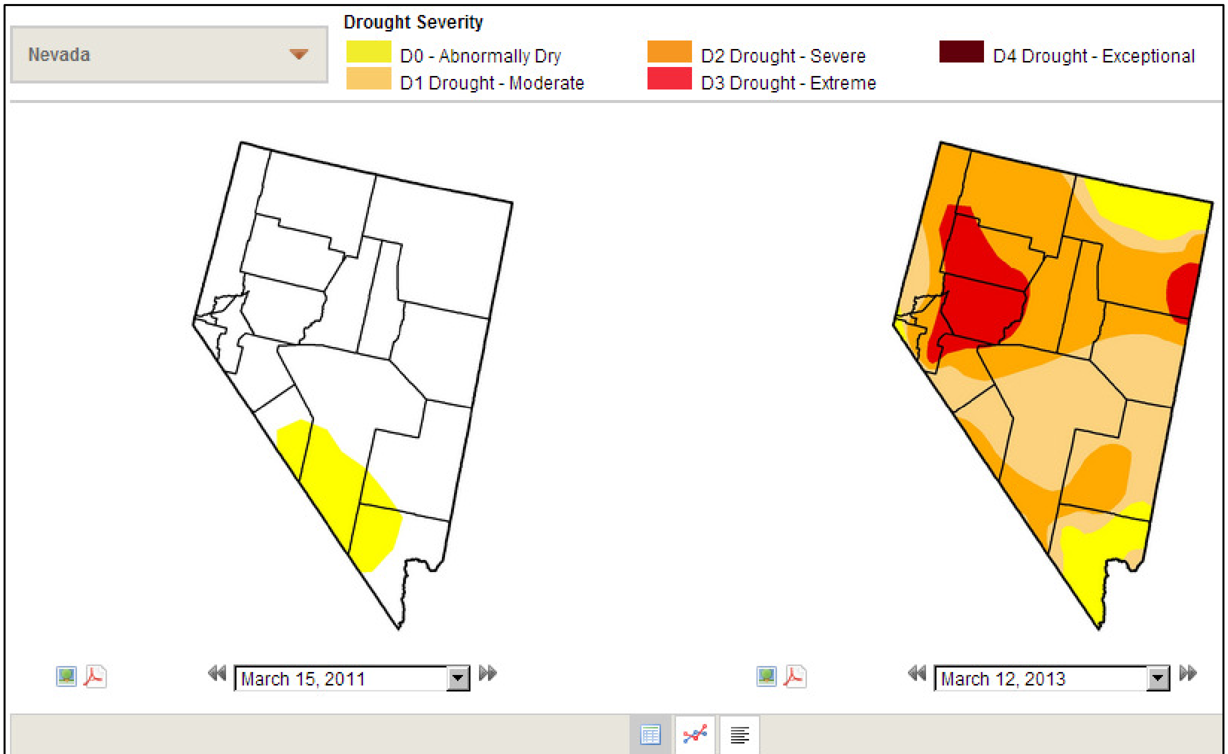
Droughts are a naturally-occurring cyclical part of the climate and Douglas County is highly susceptible to periods of dry conditions and drought. Based on recent cycles, Douglas County can expect highly varying degrees and durations of drought to occur. The recently released Southwest Climate Assessment report indicated that drought severity has increased across the Southwest U.S., including Nevada, and that the trend is likely to continue. There have been extreme of severe drought in six of the last ten years. Future probability has been 60% for the last ten years, that probability is expected to continue for the next five years.

Though agricultural wells do irrigate considerable cropland, agricultural irrigation in Douglas County is predominantly from surface water. There is comparatively little upstream storage of surface water other than the winter snowpack itself. Therefore, irrigated agricultural land in Douglas County is very susceptible to precipitation shortage.

Surface water also recharges groundwater that is necessary for agricultural irrigation wells. Similarly, very little domestic (human) water in Douglas County does not come from wells recharged by surface water.

Figure 5-1

Comparison of the U.S. Drought Monitor maps of Nevada for a year without drought (left, 2011) to a year with widespread drought (right, 2013).



Week	Nothing	D0-D4	D1-D4	D2-D4	D3-D4	D4
March 15, 2011	89.83	10.17	0.00	0.00	0.00	0.00
March 12, 2013	0.00	100.00	88.87	55.49	12.22	0.00

Climate change may be expected to lead to more frequent, longer duration and more extreme drought conditions in the future. Nevada's desert climate characterized by hot summers and low humidity may become more extreme. In addition higher snow levels would lead to lower mountain snowpack and less spring and summer runoff, lessening water availability for farmland, ranchland and natural vegetation.

5.2.2 Earthquake

Planning Significance - High

5.2.2.1 Nature

An earthquake is a sudden motion or trembling caused by a release of strain accumulated within or along the edge of the earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning and, after just a few seconds, can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion, or the vibration or shaking of the ground during an earthquake.

The severity of ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. Ground motion causes waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves. There are two kinds of seismic waves. P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back-and-forth oscillation along the direction of travel (vertical motion). S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side to side (horizontal motion). There are also two kinds of surface waves: Raleigh waves and Love waves. These waves travel more slowly and typically are significantly less damaging than seismic waves.

In addition to ground motion, several secondary hazards can occur from earthquakes, such as surface faulting. Surface faulting is the differential movement of two sides of a fault at the earth's surface. Displacement along faults, both in terms of length and width, varies but can be significant (e.g., up to 20 feet), as can the length of the surface rupture (e.g., up to 200 miles). Surface faulting can cause severe damage to linear structures including railways, highways, pipelines, and tunnels.

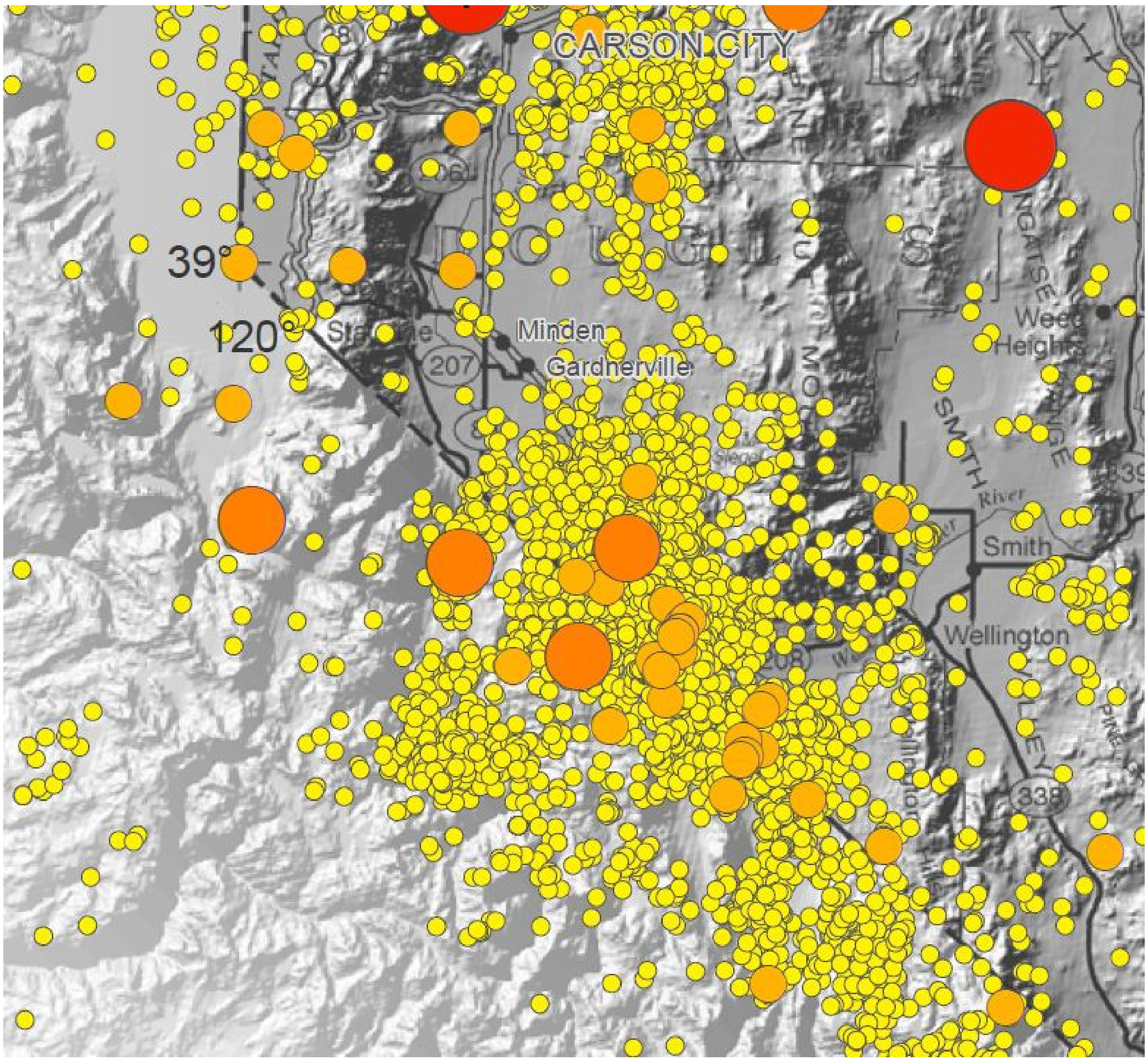
Earthquake-related ground failure due to liquefaction is another secondary hazard. Liquefaction occurs when seismic waves pass through saturated granular soil, distorting its granular structure and causing some of the empty spaces between granules to collapse. Porewater pressure may also increase sufficiently to cause the soil to behave like a fluid for a brief period and cause deformations. Liquefaction causes lateral spreads (horizontal movements of commonly 10 to 15 feet, but up to 100 feet), flow failures (massive flows of soil, typically hundreds of feet, but up to 12 miles), and loss of bearing strength (soil deformations causing structures to settle or tip). Liquefaction can cause severe damage to property.

The effects of earthquakes are described by a scale called the Modified Mercalli Intensity. The lower part of this scale is related to human perception of an earthquake, the middle part is based on earthquake damage, and the upper part is related to ground effects from an earthquake. The scale is described in Appendix B, page B-52. The Richter Magnitude Scale, another method of measuring earthquakes, is a mathematical basis that expresses the effects of an event in magnitude (M).

5.2.2.2 History

Nevada is ranked third in the states having the highest number of large earthquakes. Douglas County is earthquake country. Earthquakes have strongly shaken Douglas County in 1887, 1932, 1933, and 1994 (table 5-5) and over 3,700 earthquakes were recorded in the county between 1970 and 2010 (fig. 5-2).

Figure 5-2



Earthquakes recorded in Douglas County from the 1840s to 2010. Yellow dots are earthquakes with magnitudes less than M4, smaller orange dots are earthquakes with magnitudes 4 to 4.9, larger orange dots are earthquakes with magnitudes between 5 and 5.9. The cut-off red dot near the top is the questioned location of the magnitude ~6.5 Carson City earthquake and the red dot in the upper right of the figure is the 1933 magnitude 6 Wabuska earthquake. Over 3,700 earthquakes have been recorded in Douglas County. From dePolo and dePolo (2012).

Table 5-5

Major Historical Earthquakes That Have Strongly Shaken Douglas County

Date	Magnitude	Nearest Community	Effects
June 3, 1887	6.5	Carson City	Building damage, liquefaction
Dec. 20, 1932	7.1	Gabbs	Surface rupture, chimney damage
June 25, 1933	6.0	Wabuska	Building and chimney damage
Sept. 12, 1994	5.8	Gardnerville	Chimney damage, foundation cracking

1887 Carson City Earthquake

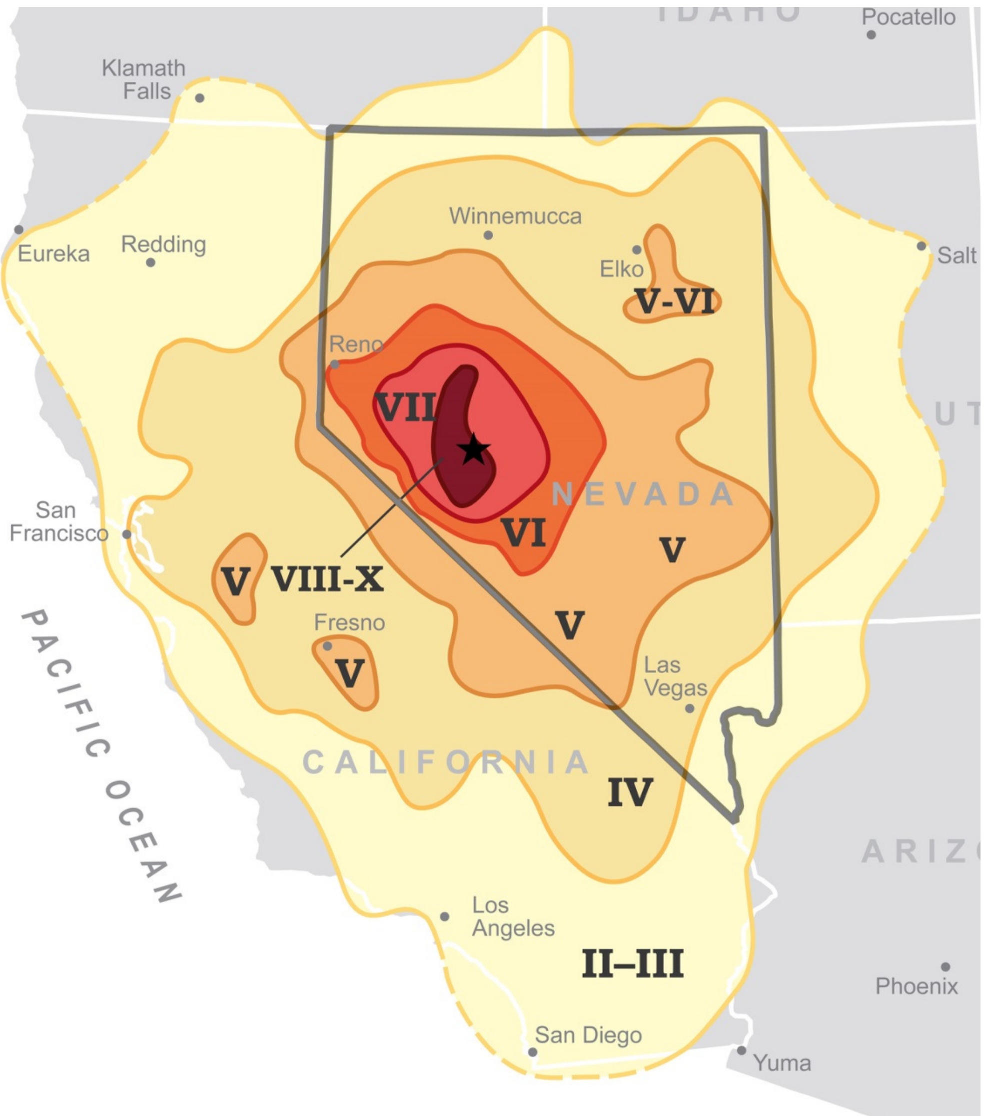
The June 3, 1887 Carson City magnitude 6.5 earthquake was one of the most violent earthquakes in western Nevada's history. The event occurred at 2:40 in the morning. Buildings were severely damaged in Carson City and Genoa, some so bad that they likely had to be partially torn down and rebuilt. The earthquake, which was preceded by a heavy rumbling sound, was strong enough to throw some people to the ground in Carson City and caused general hysteria in Carson City, Genoa, and Virginia City, where people ran out of buildings wearing only their sleeping garments (The Nevada Tribune, 6/3/1887).

1932 Cedar Mountain and 1933 Wabuska Earthquakes

In the 1930s several earthquakes shook Nevada, including the 1932 magnitude 7.1 Cedar Mountain and the 1933 magnitude 6 Wabuska earthquakes, which were both strongly felt in Douglas County. The December 20, 1932 Cedar Mountain earthquake initiated just north of Gabbs, Nevada and ruptured to the south, into Monte Cristo Valley (Gianella and Callaghan, 1934; Bell and others, 1999). The earthquake occurred at 10:10 p.m. PST and was felt from Los Angeles to Salt Lake City and throughout Nevada (fig. 5-3). This earthquake was located in a remote part of Nevada, but nevertheless had severe effects on local towns. Some miner's cabins near the earthquake collapsed (Gianella and Callaghan, 1934). Damage in the town of Luning, where china was thrown across rooms and chimneys and walls collapsed, was considered to be Modified Mercalli Intensity IX (U.S. Coast and Geodetic Survey, 1968). There were some injuries in Mina; a man suffered a skull fracture when he fell from operating a small mining train (Nevada State Journal 12/26/1932) and two children were injured when an adobe house collapsed (Reno Evening Gazette 12/21/1932). Chimneys fell as far away as Fallon and Reese River Valley (Reno Evening Gazette 12/21/1932 and 12/22/1932).

The earthquake produced scattered ground breaks over about 75 km (46 mi), with the most pronounced and continuous surface rupture near the southern end, where as much as 2 m (6.6 ft) of right-lateral offset occurred along one fault trace.

Figure 5-3



Modified Mercalli Intensity Map of the moment magnitude 7.1 1932 Cedar Mountain Earthquake. For description of intensity levels please see Appendix B, page B-52. Modified from Stover and Coffman (1993).

In Douglas County, the shaking from the 1932 earthquake was characterized as Modified Mercalli Intensity V at Minden, Gardnerville, and Zephyr Cove (U.S. Coast and Geodetic Survey, 1968), which would be strong enough to be felt by all and awaken sleeping people, but was not strong enough to cause widespread damage, shy of some isolated cases of cracks in walls. As an interesting side note, earthquake lights in the direction of the earthquake area were reported by residents in Carson Valley (Gardnerville Record-Courier, 2/1/1933). Prospectors closer to the earthquake reported lightning near the peak of Pilot Mountain (Reno Evening Gazette, 2/2/1933), indicating an electrostatic discharge may have occurred in the earthquake area and been the source of lights observed in Carson Valley.

The 1933 Wabuska earthquake occurred on June 25, at 12:45 p.m. PST on a Sunday afternoon. It was a magnitude 6 event that strongly shook western Nevada and caused damage over 60 km (37 mi) from the epicenter. The earthquake caused some severe damage in Yerington and Wabuska and liquefaction in Mason Valley. In Yerington, the rear wall of the three-story brick Courthouse was cracked and separated from the building by 5 cm (2 in), plaster was cracked throughout the building, and the window in the county clerk's office was broken (The Mason Valley News 6/30/1933; Reno Gazette Journal 6/27/1933). The Mason Valley News reports that "at the Parker ranch cracks running from an inch to three inches traversed the property. For some time water shot from the openings and floated the land for a distance of 200 feet." This is evidence of liquefaction occurring during this event.

In Carson Valley people scrambled from stores and homes (Garnerville Record-Courier 6/30/1933) "The duration of the quake was not as long as the one in December [1932 Cedar Mountain earthquake] but was more violent while it lasted" (Gardnerville Record-Courier 6/30/1933). The Gardnerville Record-Courier notes that "A few residents of Gardnerville report that when they started to hasten from their homes the floors rocked so violently they could not keep on their feet." At Minden, damage was reported at Modified Mercalli Intensity VI, with cracked plaster and small objects overturned (Neumann, 1935).

1994 Double Spring Flat earthquake

The M 5.8 September 12, 1994 Double Spring Flat earthquake was felt throughout Douglas County and western Nevada, and from Sacramento to Elko (Ichinose and others, 1998; Ramelli and others, 2003). The earthquake occurred about 15 km (9.3 mi) south of Gardnerville, in a remote location in the southern Pine Nut Mountains. Damage was limited from the earthquake, consisting of a damaged chimney in Minden, a cracked foundation in Double Spring Flat, and minor damage from objects knocked off of shelves (Ramelli and others, 2003). Although the earthquake was distinctly felt throughout Douglas County, there were fortunately no injuries.

The 1994 earthquake was a normal-left-oblique event that occurred along a northeast-striking fault that crossed the north-central part of the Double Spring Flat fault zone (Ichinose and others, 1998). Triggered slip and microseismicity occurred along the Double Spring Flat fault zone following the earthquake and created cracks along several faults within 4 km (2.5 mi) of the epicentral area (Ramelli and others, 2003; Amelung and Bell, 2003). Additionally there were ground cracks along some regional faults, including a 1.5 km (0.9 mi) long zone of cracks along a fault in western Fish Spring Flat and ground cracking to the east in Smith Valley (Ramelli and others, 2003).

5.2.2.3 Location, Extent, and Probability of Future Events

The location of damage from an earthquake would impact all of Douglas County. Eight major late Quaternary faults were identified in Douglas County (figure 5-4). These are the largest earthquake hazards there are in the county.

Figure 5-4

Schematic map of the eight largest faults in Douglas County

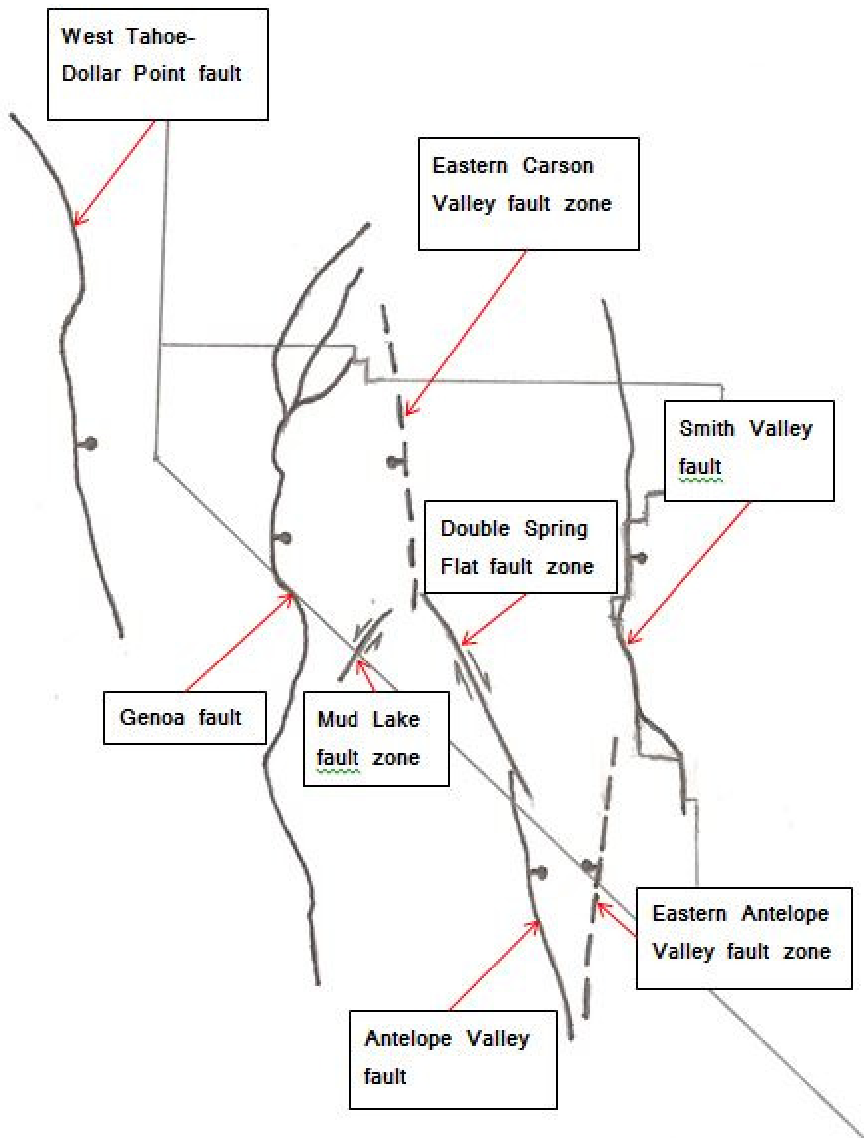


Table 5-6

Major Late Quaternary Faults in Douglas County

Normal Dip-Slip Faults
Genoa fault (GF)
Eastern Carson Valley fault zone (ECVFZ)
Smith Valley fault (SVF)
Antelope Valley fault (AVF)
Eastern Antelope Valley fault zone (EAVFZ)
West Tahoe-Dollar Point fault* (WTDPF)

*The West Tahoe fault intersects the surface in California, but dips to the west and is a threat to South Lake Tahoe.

Possible Strike-Slip Faults
Double Spring Flat fault zone (right-lateral) (DSSFZ)
Eastern Carson Valley fault zone (right-lateral oblique)
Mud Lake fault zone (left-lateral) (MLFZ)
Eastern Antelope Valley fault zone (right-lateral oblique)

The normal faults listed above are two general types, large east-side-down range-bounding faults and smaller, generally west-side-down distributed fault zones. The large normal faults are all northerly striking and the relative down-dropping of their eastern sides created Carson, Antelope, Tahoe, and Smith Valleys. These faults appear to have large earthquakes that offset the ground vertically by 1 to 5 m (3 to 16 ft). The smaller, west-side-down normal faults are more of an enigma. They are antithetic to the larger range-bounding normal faults and are on the opposite side of the basin created by the larger faults. The west-side-down faults appear to have a role in the breakup of the hanging wall of the range-bounding faults and based on rupture patterns may also accommodate right-lateral strike-slip motion.

Two of the eight faults identified likely accommodate dominantly strike-slip movement, the Double Spring Flat and the Mud Lake fault zones. These faults are limited in their length and thus, their earthquake potential. They appear to have apparent secondary tectonic roles, connecting normal faults to one another. It is likely that other strike-slip faults exist in the county but have not been mapped.

The estimated maximum magnitude earthquakes for the major faults in Douglas County range from magnitude 6.5 to 7.2. These major earthquakes usually occur every few thousand years to tens of thousands of years along any individual fault. The high earthquake hazard in Douglas County is the result of these larger faults and hundreds of other smaller faults. For earthquake preparedness, risk mitigation, emergency and recovery planning purposes, understanding the largest earthquakes that can occur in the county are the most important.

There are also several major faults that surround Douglas County and earthquakes along these faults can also cause damage in the county. The major faults that immediately surround the county are tabulated (Table 5-7), but they are not discussed or modeled. The potential effects from earthquakes on these faults are covered by the modeling of the major faults within Douglas County.

Table 5-7

Major Late Quaternary Faults Near Douglas County

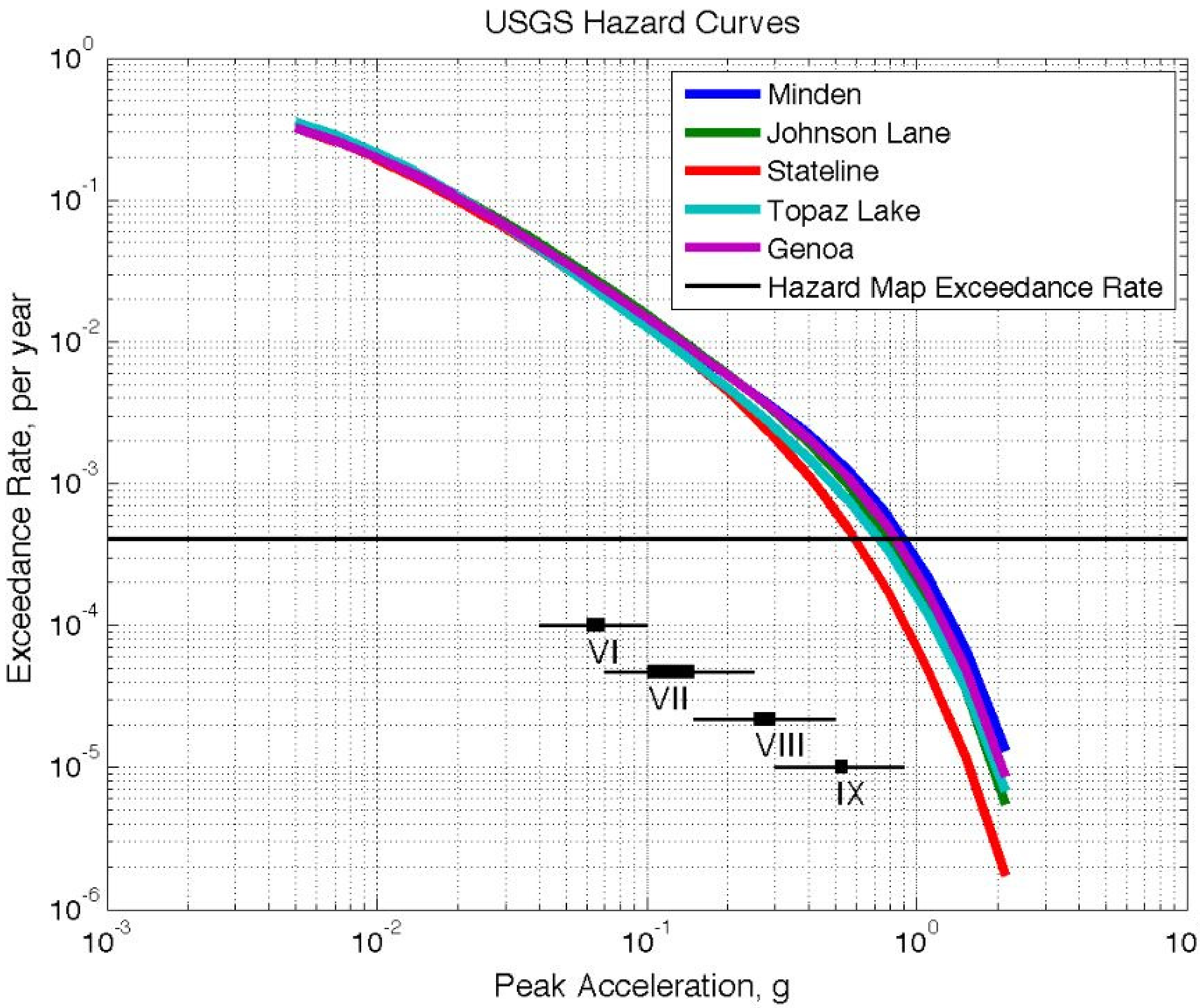
Normal Dip-Slip Faults
North Tahoe fault
Incline Village fault
Waterhouse Peak fault
Slinkard Valley fault
Northern Carson Range fault zone faults
Singatzse Range fault zone
Pine Nut Mountains fault zone

Possible Strike-Slip Faults
Wabuska lineament (left-lateral)

An approach for examining the potential damage to communities by earthquakes is to generate hazard curves for the communities, using a web application provided by the U.S. Geological Survey. This application calculates the occurrence rate of the level of ground motion occurring at a location, based on the National Seismic Hazard Map (http://geohazards.usgs.gov/hazardtool/application.php). Dr. John Anderson of the Nevada Seismological Laboratory kindly made figure 5-5 using this application for several Douglas County communities. The similarity of the curves indicates that these give a general probability for the county and communities. Communities not listed should use the curve for the community closest to them. Included on this figure are potential Modified Mercalli Intensity values based on those given in Bolt (1999). Thus, the occurrence rate for when the level of ground motion, in acceleration, for a particular intensity can be approximated for a given community curve. Similar to instrumentally recorded earthquakes, the occurrence rates for a given magntidue can be converted to probabilities of occurrence for a given timeframe.

An example will help understand figure 5-5. The blue line is the earthquake hazard curve for Minden. The graph is occurrence rate versus ground acceleration, here expressed as a percent of gravity, or “g”. The larger the ground acceleration is the stronger the ground motion from an earthquake. Stronger ground motion is less frequent than weaker ground motion and the curve describes this relationship using occurrence rate, or events per year; in this case the number of times per year a level of acceleration occurs. If the occurrence rate is inverted (1 divided by the occurrence rate), the result is a once-in-so-many-years expression of the ground motion. Intensity VI is a level of ground motion that begins to crack walls. The central part of intensity VI ground motion begins at an acceleration of 0.06 g. The curve for Minden indicates a peak ground acceleration of 0.06 g occurs with an occurrence rate of 0.05 events per year, or once in 20 years on average. Thus, we learn how frequently Minden has ground motion from earthquakes that can crack walls - once every 20 years on average. The last such event occurred in 1994, which just happens to be about 19 years ago. The graph indicates that on average intensity VII ground motion occurs in Minden once every 77 years, intensity VIII ground motion occurs once every 233 years, and intensity IX ground motion occurs once every 588 years. Note that these statistics are based on average communities. Communities that work towards being earthquake resilient can experience higher levels of ground motion with less damage than estimated here. In other words, seismic risk mitigation can affect these estimates.

Figure 5-5



U.S. Geological Survey earthquake hazard curves for five Douglas County communities. Also shown are ranges of ground motion that can be associated with Modified Mercalli Intensity; these values are from Bolt (1999). This figure was prepared by Dr. John A. Anderson of the Nevada Seismological Laboratory.

Table 5-8

Probabilities of Modified Mercalli Intensity Levels Occurring in Douglas County Communities Based on the U.S. Geological Survey Hazard Curves

Earthquake Intensity	50-Year Probability	100-Year Probability
VI	68-78%	90-95%
VII	39-48%	63-73%
VIII	11-19%	21-35%
IX	2-8%	5-16%

Discussion

Within a 50-year timeframe, Douglas County has a 99% chance of having a magnitude 5 or larger earthquake, about a 50% to 60% chance of having a magnitude 6 or larger earthquake, and a 10% to 20% chance of having a magnitude 7 or larger earthquake. In terms of damage, over a 50-year timeframe there is a 39% to 48% chance of having ground motion levels that would correspond to Modified Mercalli Intensity VII, or strong enough to damage and topple chimneys. Thus, there is a substantial probability of a potentially damaging earthquake in Douglas County.

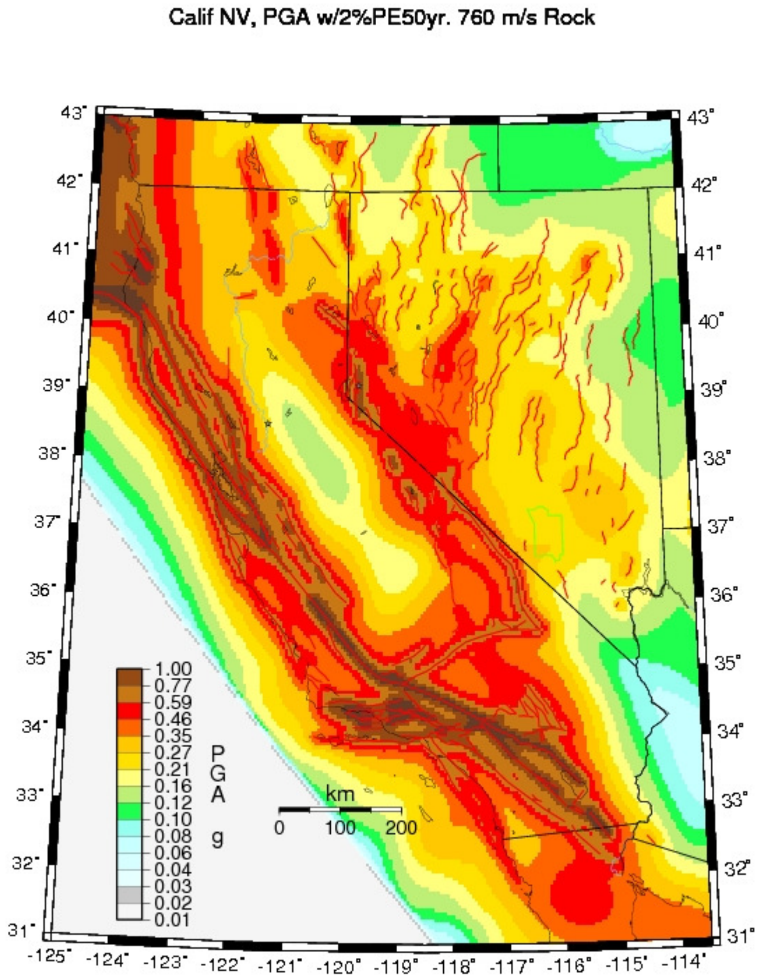
The values given in Table 5-8 can also be used to estimate the chance that and emergency response to a damaging earthquake or a major recovery effort will be required in Douglas County. Assuming that an emergency response would be mounted for an earthquake that causes intensity VII or higher damage and that a major recovery effort for a community will be required with intensity VIII or higher damage, the probabilities of these operations can be estimated. Using the probabilities in Table 5-8 and the assumptions stated, the chances for mounting an emergency response to an earthquake in Douglas County are 39% to 48% and the chances that a major recovery effort will be needed for an earthquake-damaged community are 11% to 19%.

Earthquake Strong Ground Motion Hazard

Shaking of the ground is the most damaging and widespread effect from earthquakes. Estimating the potential earthquake ground motion at a site is an involved process because several factors affect this motion including the size of an earthquake, its distance, whether there is rock or soft sediments, and the size and shape of sedimentary basin. Thus, seismologists and engineers need to have information on a number of parameters to make site-specific characterizations of potential earthquake ground motion.

Peak ground accelerations in percent of gravity (g) for bedrock are shown in figure 5-6 give a relative sense of the strong ground motion potential in Douglas County. The map is from the National Seismic Hazard Map project (http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/) and are used as earthquake ground motion input for the International Building Code. The graph presented in figure 5-5 also portrays these peak ground accelerations for several communities in Douglas County and has a black horizontal line indicating the 2% probability of exceedance in 50 years (a once in a 2,500 year event) used in the International Building Code and figure 5-6.

Figure 5-6



Peak ground acceleration map from the 2008 National Seismic Hazard Map for Nevada and California. These values have a 2% chance of being exceeded within 50 years. The highest peak ground acceleration values in the state are estimated for Douglas County.

The 2008 National Seismic Hazard Map indicates that some of the highest ground motion levels in the state can occur in Douglas County. The specific ground motions from the next earthquake cannot be precisely predicted because of the many variables involved that influence ground motion, but the peak ground accelerations indicated by figure 5-6 range from ~0.5 g to ~0.9 g, with a 2% chance of being exceeded in 50 years. Such ground motions, if sustained for a short period of time, can cause damage commensurate with Modified Mercalli Intensity IX, or levels where significant damage occurs in buildings that lack earthquake resistance in their design and construction.

Peak ground velocity estimates, another measure of ground motion, are 49 cm/s to 140 cm/s, with a 2% chance of being exceeded in 50 years (2008 National Seismic Hazard Map). Ground motion values tend to mean more to engineers that have to design buildings to withstand them than the general public.

Earthquake Surface Rupture Hazard

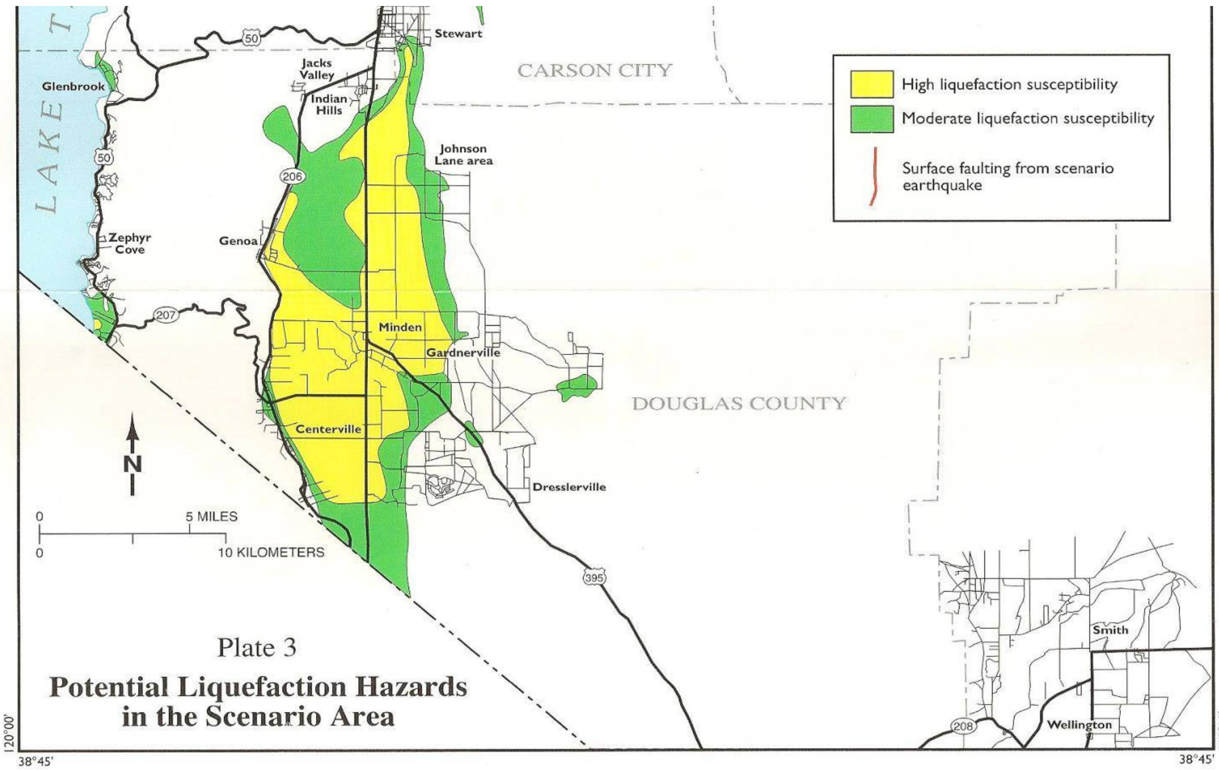
When earthquakes reach magnitude 6.5 ±0.3, the rupture tends to offset the ground surface (dePolo, 1994). These offsets are known as earthquake surface or ground rupture. In Douglas County, evidence for surface rupture hazard includes paleo-earthquake ground ruptures and offset landforms that were created by repeated offset of the ground surface along a fault. Historical surface fractures were formed aseismically in 1980 along a fault on the west side of Fish Spring Flat (Bell and Helm, 1998) and on the same fault trace, fracturing was triggered by the 1994 Double Spring Flat earthquake (Ramelli and others, 2003).

The potential for ground surface rupture is along and immediately adjacent to the mapped traces of late Quaternary faults (faults that have moved in the last 130,000 years). This timeframe is longer than in places like western California, mostly because faults within this timeframe have had major earthquakes in the Basin and Range Province (dePolo and Slemmons, 1998). The 1887 magnitude 7.4 Sonoran, Mexico earthquake, the largest historical normal dip-slip earthquake in the province, occurred along a fault that hadn’t moved in 100,000 years (Bull and Pearthree, 1988).

In Douglas County there are many late Quaternary fault traces and many fault traces with unknown activity. Some faults are relatively simple ruptures, such as sections of the Genoa fault, and others are broad and include many fault traces, such as the Eastern Carson Valley fault zone. Surface rupture hazard partly depends on the complexity fault traces, so the multi-trace Eastern Carson Valley fault zone poses a high surface rupture hazard.

Figure 5-7

Earthquake-Induced Liquefaction Hazard



The southern part of the liquefaction map from the Western Nevada Planning Scenario (dePolo and others, 1996). This generalized map shows potential areas of liquefaction in northern Douglas County.

Liquefaction hazards exist in Carson Valley, along the shores of South Lake Tahoe, in northern Antelope Valley, and in several small basins. Liquefaction occurs in places where groundwater is shallow and sediments, classically fine sands, are young and unconsolidated. When these types of saturated sediments are shaken strongly for a period of time, they can consolidate and expel the water from pore spaces. When pore pressure increases rapidly and cannot be dissipated, a phenomenon known as liquefaction occurs. During liquefaction, the soil column can behave as a liquid. When this happens, a sand-water mixture can squirt out of the ground, the land surface can flow downhill or sideways, and the ground may no longer be able to support the weight of buildings. Buildings on liquefied ground can sink and break up. Other effects of liquefaction are the violent oscillations that are potentially damaging to buildings and infrastructure.

A preliminary representation of liquefaction was constructed for the 1996 Planning Scenario for a Western Nevada Earthquake (dePolo and others, 1996; shown in figure 5-7). This map was made with the information available at the time. It is generalized and does not include southern Douglas County. For planning and appropriate land use purposes a more detailed, county-wide liquefaction analysis is necessary. Updated detailed geologic mapping and groundwater information can be utilized for a more detailed map. The 1996 liquefaction map illustrates the hazard.

There were reports of liquefaction in Carson Valley during the June 6, 1887 Carson City earthquake. The Nevada Tribune reported that, “In the corral, walking across either way, the ground seems as though all was hollow underneath, and by driving a pole down two or three feet, water flows immediately to the surface, and wherever a fissure is seen, black sand several inches deep has been thrown up,” on the Boyd Property. This is a fairly precise description of liquefaction.

5.2.3 EPIDEMIC

Planning Significance - Low

5.2.3.1 Nature

A disease is a pathological (unhealthy or ill) condition of a living organism or part of the organism that is characterized by an identifiable group of symptoms or signs. Disease can affect any living organism, including people, animals, and plants. Disease can both directly (via infection) and indirectly (via secondary impacts) harm these living things. Some infections can cause disease in both people and animals. The major concern here is an epidemic, a disease that affects an unexpected number of people or sentinel animals at one time. (Note: an epidemic can result from even one case of illness if that illness is unheard of in the affected population, i.e., smallpox.)

Of great concern for human health are infectious diseases caused by the entry and growth of microorganisms in man. Most, but not all, infectious diseases are communicable. They can be spread by coming into direct contact with someone infected with the disease, someone in a carrier state who is not sick at the time, or another living organism that carries the pathogen. Disease-producing organisms can also be spread by indirect contact with something a contagious person or other carrier has touched and contaminated, like a tissue, doorknob, or another medium (e.g., water, air, food).

According to the Centers for Disease Control and Prevention (CDC), during the first half of the twentieth century, optimism grew as steady progress was made against infectious diseases in humans via improved water quality and sanitation, antibiotics, and inoculations (October 1998). The incidences and severity of infectious diseases such as tuberculosis, typhoid fever, smallpox, polio, whooping cough, and diphtheria were all significantly reduced during this period. This optimism proved premature, however, for a variety of reasons, including the following: antibiotics began to lose their effectiveness against infectious disease (e.g., Staphylococcus aureus); new strains of influenza emerged in China and spread rapidly around the globe; sexually transmitted diseases resurged; new diseases were identified in the U.S. and elsewhere (e.g., Legionnaires's disease, Lyme disease, toxic shock syndrome, and Ebola hemorrhagic fever); acquired immunodeficiency syndrome (AIDS) appeared; and tuberculosis (including multidrug-resistant strains) reemerged (CDC, October 1998).

In a 1992 report titled *Emerging Infections: Microbial Threats to Health in the United States*, the Institute of Medicine (IOM) identified the growing links between U.S. and international health, and concluded that emerging infections are a major and growing threat to U.S. health. An emerging infectious disease is one that has newly appeared in a population or that has been known for some time, but is rapidly increasing in incidence or geographical range. Emerging infectious diseases are a product of modern demographic and environmental conditions, such as global travel, globalization and centralized processing of the food supply, population growth and increased urbanization.

In response to the threat of emerging infectious diseases, the CDC launched a national effort to protect the US public in a plan titled *Addressing Emerging Infectious Disease Threats*. Based on the CDC's plan, major improvements to the US health system have been implemented, including improvements in surveillance, applied research, public health infrastructure, and prevention of emerging infectious diseases (CDC, October 1998).

Despite these improvements, infectious diseases are the leading cause of death in humans worldwide and the third leading cause of death in humans in the U.S. (American Society for Microbiology, June 21, 1999). A recent follow-up report from the Institute of Medicine titled *Microbial Threats to Health: Emergence, Detection, and Response*, notes that the impact of infectious diseases on the U.S. has only grown in the last ten years and that public health and medical communities remain inadequately prepared. Further improvements are necessary to prevent, detect, and control emerging, as well as resurging, microbial threats to health. The dangers posed by infectious diseases are compounded by other important trends: the continuing increase in antimicrobial resistance; the diminished capacity of the U.S. to recognize and respond to microbial threats; and the intentional use of biological agents to do harm (Institute of Medicine, 2003).

The CDC has established a national list of over 50 nationally reportable diseases. A reportable disease is one that, by law, must be reported by health providers to report to federal, state or local public health officials. Reportable diseases are those of public interest by reason of their communicability, severity, or frequency. The long list includes such diseases as the following: AIDS; anthrax; botulism; cholera; diphtheria; encephalitis; gonorrhea; Hantavirus pulmonary syndrome; hepatitis (A, B, C); HIV (pediatric); Legionellosis; Lyme disease; malaria; measles; mumps; plague; polio (paralytic); rabies (animal and human); Rocky Mountain spotted fever; rubella (also congenital); Salmonellosis; SARS; Streptococcal disease (Group A); Streptococcal toxic-shock syndrome; *Streptococcus pneumoniae* (drug resistant); syphilis (also congenital); tetanus; Toxic-shock syndrome; Trichinosis, tuberculosis, Typhoid fever; and Yellow fever (Centers for Disease Control and Prevention, May 2, 2003).

Many other hazards, such as floods, earthquakes or droughts, may create conditions that significantly increase the frequency and severity of diseases. These hazards can affect basic services (e.g., water supply and quality, wastewater disposal, electricity), the availability and quality of food, and the public and agricultural health system capacities. As a result, concentrated areas of diseases may result and, if not mitigated right away, potentially leading to large losses of life and damage to the economic value of the area's goods and services.

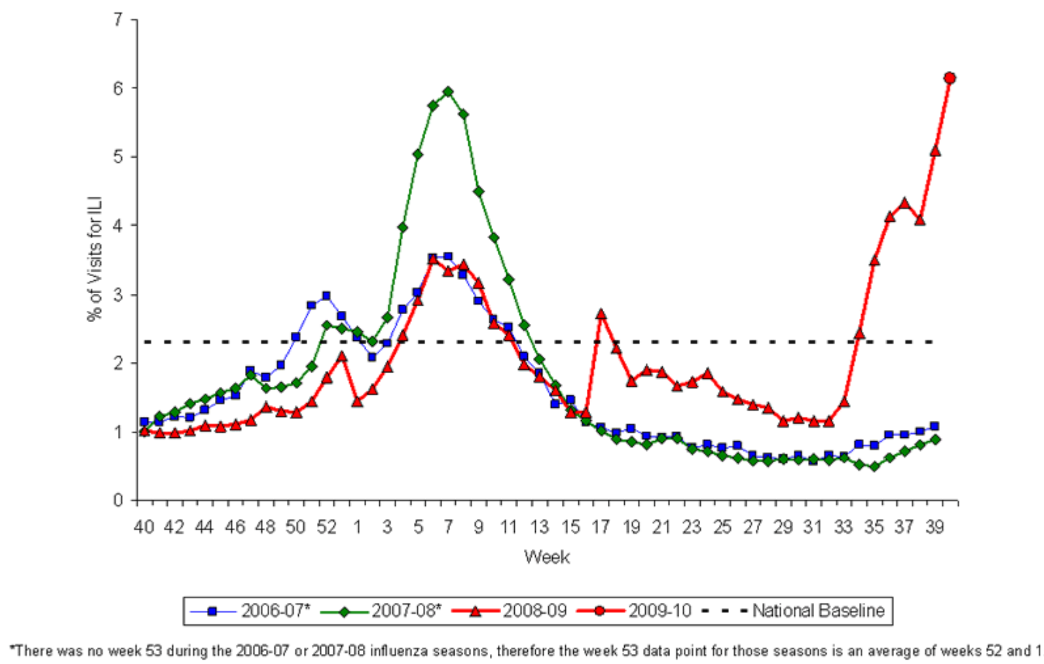
5.2.3.2 History

The influenza pandemic of 1918 and 1919, known as the Spanish Flu, had the highest mortality rate in recent history for an infectious disease. More than 20 million persons were killed worldwide, some 500,000 of which were in the U.S. alone (Centers for Disease Control and Prevention, October 1998). More recent incidences of major infectious diseases affecting people in the U.S. include the following:

H1N1, an influenza strain that was first recognized in Mexico and entered the US in Southern California in April 2009. H1N1 was recognized as a worldwide pandemic by the World Health Organization in May 2009. The CDC graph below illustrates the number of office visits due to the flu and demonstrates how easily the US medical system can be overwhelmed by a pandemic.

Figure 5-8

Percentage of Visits for Influenza-like Illness (ILI)



Source: U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), National Summary 2008-2009 and Previous Two Seasons (Posted October 16, 2009, 7:30 PM ET, for Week Ending October 10, 2009)

H1N1 varies from other influenzas in that it doesn't seem to affect populations born after 1950 due to that group's immunity to a similar strain. The CDC has taken an aggressive approach to this highly contagious strain and is in the process of inoculating the US public through vaccinations. Although H1N1 has a less than 1% mortality rate due to the high contagion rate this could lead to a significantly higher than normal number of deaths for the 2009-2010 flu season. (Centers for Disease Control and Prevention, October 2009)

West Nile Virus (WNV), a seasonal infection transmitted by mosquitoes, caused an epidemic which grew from an initial U.S. outbreak of 62 disease cases in 1999 to 4,156 reported cases, including 284 deaths, in 2002. However due to communities' aggressive approach to mosquito control the number of cases dropped to 1356 with 44 deaths in 2008 (Centers for

Disease Control and Prevention, October 2009). According to the Nevada State Department of Health and Human Services, there were 16 human cases of West Nile Virus in Nevada in 2012.

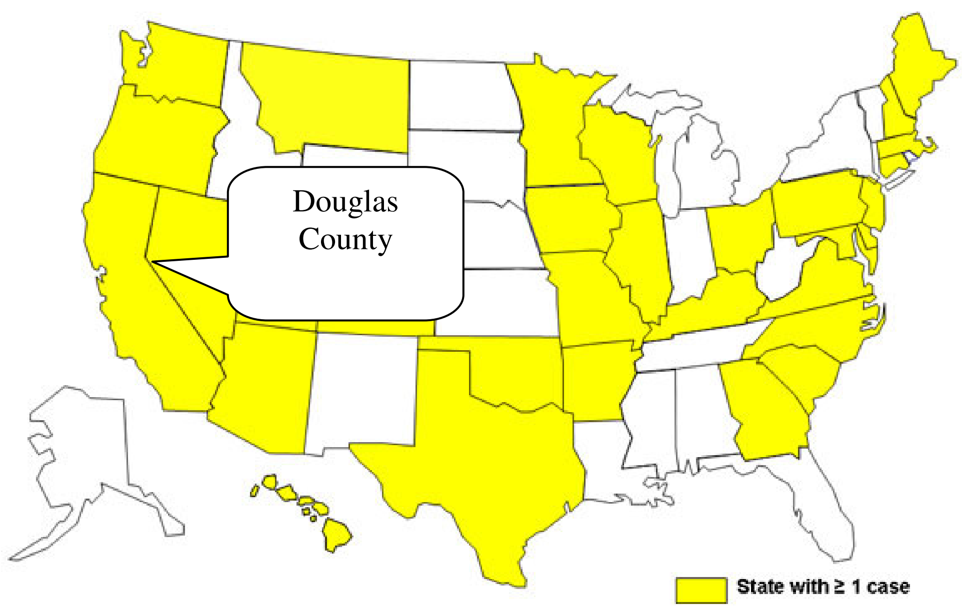
Severe acute respiratory syndrome (SARS), which is estimated to have killed 774 and infected 8,098 worldwide. In the U.S., there were 175 suspected cases and 8 confirmed cases all who traveled to other parts of the world, although no reported deaths (Centers for Disease Control and Prevention, October 2009).

Norovirus - CDC estimates that 23 million cases of acute gastroenteritis are due to norovirus infection, and it is now thought that at least 50% of all foodborne outbreaks of gastroenteritis can be attributed to noroviruses (Centers for Disease Control and Prevention, October 2009).

Escherichia coli (abbreviated as *E. coli*) are a large and diverse group of bacteria. Although most strains of *E. coli* are harmless, others can make you sick. Some kinds of *E. coli* can cause diarrhea, while others cause urinary tract infections, respiratory illness and pneumonia, and other illnesses. Experts think that there may be about 70,000 infections with *E. coli* O157 each year in the United States. (Centers for Disease Control and Prevention, October 2009).

Figure 5-9

States Where Persons Infected with the Outbreak Strain of E. coli O157:H7, Live United States, by State March 1, 2009 to June 22, 2009



Source: Centers for Disease Control; http://www.cdc.gov/ecoli/

Table 5-9

Historic Occurrences of Epidemics Registered in Nevada

Date	Details
February 1992	Cholera outbreak confirmed. At least 26 passengers from Aerolineas Argentinas Flight 386 that brought a cholera outbreak to Los Angeles traveled on to Las Vegas, where 10 showed symptoms of the disease. Cholera or cholera-like symptoms developed in 67 passengers of Flight 386.
Spring 2000	Five cases of the measles confirmed. Outbreak identified and confirmed. Clark County Health District (CCHD) Office of Epidemiology (OOE) worked with the Immunization Clinic and the media to alert the community about the prevention of the spread of the disease.
Summer 2004	West Nile Virus was first detected in Nevada, and has been reported in all counties.
October 2004	Norovirus confirmed at a major public accommodation facility on the Strip.
April 2009	H1N1 virus confirmed by the WHO as a worldwide epidemic.

5.2.3.3 Extent and Probability of Future Events

The probability and magnitude of disease occurrence, particularly an epidemic, is difficult to evaluate due to the wide variation in disease characteristics, such as rate of spread, morbidity and mortality, detection and response time, and the availability of vaccines and other forms of prevention. A review of the historical record (see above) indicates that disease related disasters do occur in humans with some regularity and varying degrees of severity. There is growing concern, however, about emerging infectious diseases as well as the possibility of a bioterrorism attack.

Epidemics constitute a significant risk to the population of Nevada, particularly as it relates to the frequency in which the Douglas County population travels and the proximity of Las Vegas and Reno's tourist population. Of highest concern is in the Reno area, in various entertainment venues, and Reno/Tahoe International Airport. The transient nature of the Washoe County population, coupled with dense population gatherings increase the potential for an epidemic as well as for its spread into neighboring counties such as Carson City and Douglas County.

On a lesser scale than Reno or Las Vegas, the Stateline (South Lake Tahoe casino corridor) area of Douglas County presents a more local world-class entertainment and tourist destination for visitors. The dense population gathering of local residents and visitors from large metropolitan areas of California, as well as from around the world, present a more localized increase of potential for an epidemic.

5.2.3.4 Location

An epidemic in Douglas County would affect a regional response requiring coordination among Carson Valley Medical Center, Minden Medical Center, County, neighboring counties, state and federal agencies. Segments of the population at highest risk for contracting an illness from a foreign pathogen are the very young, the elderly, or individuals who currently experience respiratory or immune deficiencies. These segments of the population are present within Douglas County.

5.2.3.5 Warning Time

Due to the wide variation in disease characteristics, the warning time for a disease disaster can vary from no time to months, depending upon the nature of the disease. No warning time may be available due to an extremely contagious disease with a short incubation period, particularly if combined with a terrorist attack in a crowded environment. However, there are agencies in place that have capabilities to prevent, detect, and respond to these types of diseases, such as Douglas County Community Health Nurse (DCCHN) , the Centers for Disease Control (CDC), and the Nevada State Health Division (NSHD). This provides a positive, balancing influence to the overall outcome of a disease disaster event.

The DCCHN conducts surveillance of communicable disease occurrences in Douglas County. They also implement control measures and develop reports as mandated by Nevada Revised Statutes (NRS), as well as receive and investigate complaints from the public regarding possible foodborne illness.

5.2.4 Floods

Planning Significance - High

5.2.4.1 Nature

Flooding is the accumulation of water where there usually is none or the overflow of excess water from a stream, river, lake, reservoir, or coastal body of water onto adjacent floodplains. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected.

Nationwide, floods result in more deaths than any other natural hazard. Physical damage from floods includes the following:

- Inundation of structures, causing water damage to structural elements and contents.
- Erosion or scouring of stream banks, roadway embankments, foundations, footings for bridge piers, and other features.
- Destruction of crops, erosion of topsoil, and deposition of debris and sediment on croplands.
- Release of sewage and hazardous or toxic materials as wastewater treatment plants are inundated, storage tanks are damaged, and pipelines are severed.
- Impact damage to structures, roads, bridges, culverts, and other features from high-velocity flow and from debris carried by floodwaters. Such debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping or backwater effects.

Floods also cause economic losses through closure of businesses and government facilities; disrupt communications; disrupt the provision of utilities such as water and sewer service; result in excessive expenditures for emergency response; and generally disrupt the normal function of a community.

Nevada is the driest state in the Union, with an average annual precipitation of only about nine and one half inches, although there are areas in Douglas County that average above forty inches (CWSD). Douglas County is unique in the fact that many different types of flooding occur within its boundaries. The major flood types that may occur in Douglas County include:

1) Alluvial Flooding (Zone AO FIRM Maps): Alluvial fans occur mainly in dry mountainous regions, are deposits of rock and soil that have eroded from mountainsides and accumulated on valley floors in a fan-shaped pattern. The deposits are narrow and steep at the head of the fan, broadening as they spread out onto the valley floor. Channels along fans are not well defined and flow paths are unpredictable. As rain runs off steep valley walls, it gains velocity, carrying large boulders and other debris. When the debris fills the runoff channels of the fan, floodwaters spill out, spreading laterally and cutting new channels. The process is

then repeated, resulting in shifting channels and combined erosion and flooding problems over a large area (Wright 2008).

2) Ponding (Zone AO and AH FIRM Maps): Ponding occurs when water has no available outlet. Ponding floodwaters are typified by low or no velocities and a depth. In areas where rivers exceed floodwater storage capacity excess water will begin to pond. Ponding is common in the Carson Valley adjacent to the Carson River and away from the Carson and Pinenut Mountain Ranges.

3) Riverine Flooding (Zone A and AE FIRM Maps): Stream channels are adjusted to carry the normal discharge of water from upstream and from tributaries. Most of the time, the water level remains within the confines of the stream banks, but periodically the flow of water is beyond the capacity of the channel to hold, and the water spills over the banks causing (riverine) flooding (Easterbrook 1999). Riverine flooding is more devastating to a community than alluvial flooding or ponding. Riverine flooding can inundate hundreds of square miles and the floodwaters could take several weeks to recede. In addition, riverine flooding may cause disruptions in utility services and may close large portions of the local transportation network. Douglas County is affected by riverine flooding under the following three scenarios:

   (1) Flash floods caused by summer thunderstorms;

   (2) Floods caused by rapid snowmelt; and

   (3) Floods caused by frontal rains and frontal rains on snow or frozen grounds.

Flash floods result from intense rainfall in localized areas during thunderstorms, usually during the months of June to November. These floods, while intense, tend to be localized because the storms usually cover a small area. Washes along the eastern boundary of Douglas County abutting the Pinenut Mountains and Gardnerville Ranchos are the area most likely to be affected by summer flash flooding. Floods from rapid snowmelt tend to occur between March and June, and can cover a large area but tend to flood areas close to the main river channel. Floods resulting from rain on snow or frozen ground tend to occur between November and April and have caused some of the greatest regional historical floods.

Flash Flooding, Johnson Lane Wash July, 2005

In Douglas County, the primary cause of riverine flooding is winter rainstorms saturating and melting the Sierra snowpack at elevations between 4,500 and 8,000 feet or higher. Though most winter storms bring snow to elevations above 6,000 feet, a pattern of warm storms (known as the Pineapple Express or Pineapple Connection because they come from the warm Pacific Islands) occasionally dumps rain at higher elevations. Winter floods can occur any time between November and April in successive years, or not occur at all for many years.

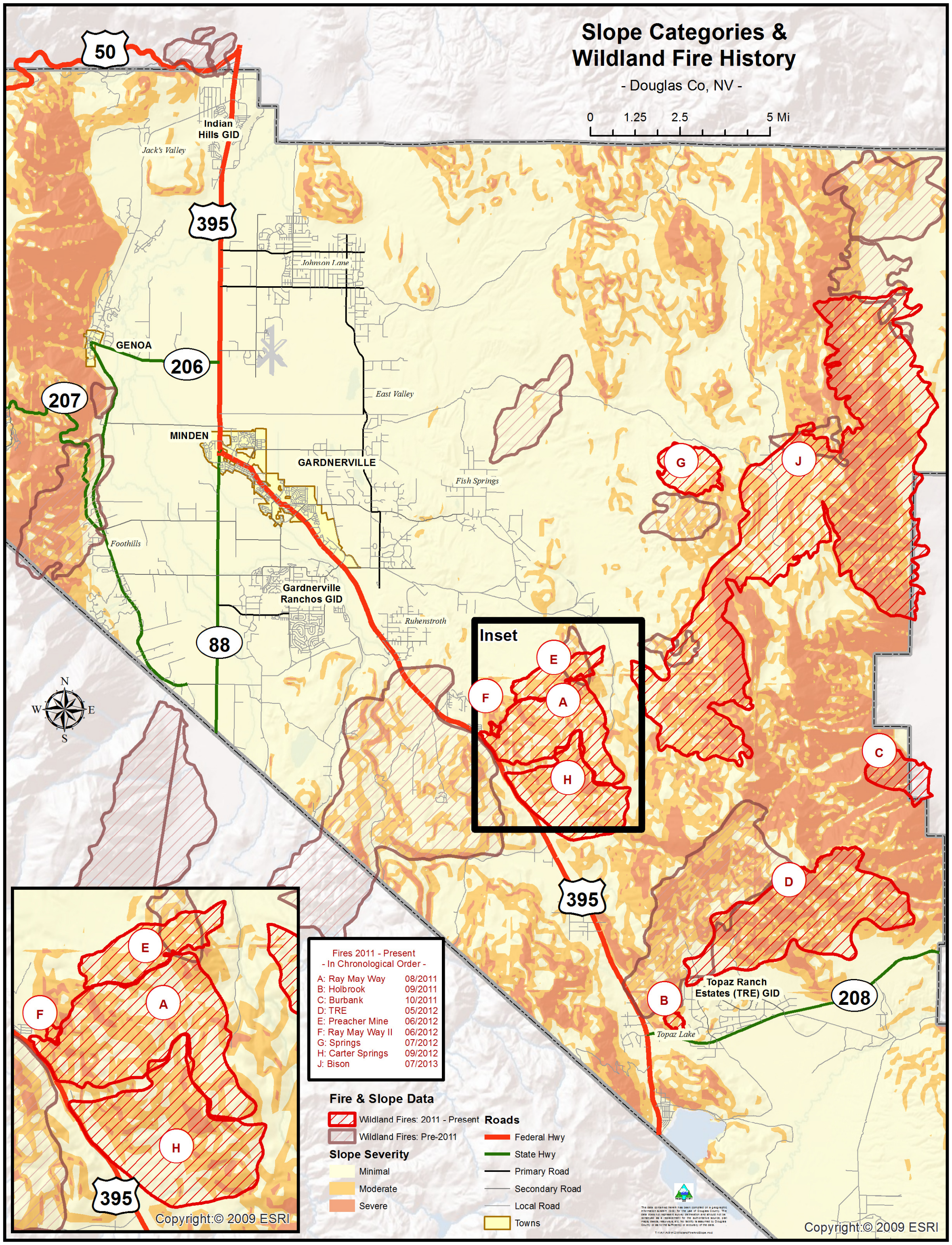
River Flooding, 1997 New Year's Flood, East Side of Gardnerville Ranchos
Photo by Marilyn Newton

5.2.4.2 Effects of Wildland Fires on Floods

Wildfire is a disturbance that can change the characteristics of a watershed such that the subsequent hydrologic response to normal precipitation is often a sudden and dramatic increase in water discharge. Wildfires alter the live and dead vegetation in a watershed by: (1) decreasing the canopy interception, which increases the percentage of rainfall available for runoff; (2) decreasing the water normally lost as evapotranspiration, which increases the base flow; (3) consuming ground cover, litter, duff, and debris, which increases runoff velocities and reduces interception and storage (Moody and Martin 2001).

Significant wildland fires, such as experienced during the 2011, 2012 and 2013 fire seasons, may affect the root systems of vegetation and trees. The soils (ground) in the burned area can become unstable and subject to movement (earth flows) which can cause damage to structures and road ways that are in its path. The most recent evidence of this occurrence was during a storm event near the Ray May Way wildland fire (2012) where severe damage to root systems of trees and vegetation allowed for wet saturated unstable ground to move downhill blocking Highway 395. The Wildland fire and slope map on the following page (Figure 5-10) shows recent fires in Douglas County. The map also identifies the slopes in these areas and the concern of deforestation on these slopes.

Figure 5-10
Recent Fires in Douglas County



5.2.4.3 History

The Carson River begins in multiple large watersheds in the Sierra Nevada in California south of Lake Tahoe, and consists of two forks, the West Fork Carson River and the East Fork Carson River. These Tributaries flow northward into Nevada before joining to form the main-stem Carson River in mid-Carson Valley. The west Fork Carson River enters Nevada west of Mud Lake and several miles west of U.S. 395. It continues in a northerly to northwesterly direction along the western side of Carson Valley and is joined by several small streams from the Carson Range to the west and joins the East Fork. The East Fork enters Nevada approximately 5 miles east and south of the West Fork in a deep, narrow canyon incised into volcanic bedrock. It flows northerly and enters the southern end of Carson Valley a few miles east of the West Fork. The East Fork then turns northwestward, flows to the west of the towns of Minden and Gardnerville, and joins the West Fork southeast of Genoa, near the western side of the valley (See The Primary Flood Zones Map (Figure 5-11) for 2010 floodplain boundaries in Douglas County).

From near Genoa, the main-stem Carson River flows northeasterly through the northern part of Carson Valley, crosses under U.S. 395 at Cradlebaugh Bridge, and exits the valley at its northeast corner. The river then flows northerly along a deep, bedrock canyon near Empire, just south of U.S. 50. After exiting the deep but short bedrock canyon a little west of Dayton, the Carson River continues in a northeasterly direction for several miles, traversing the broad, alluvial Carson Plains before entering a relatively confined bedrock-bounded channel in the northern end of the Pine Nut Mountains at the east end of the Carson Plains. As it enters the northern Pine Nut Mountains, the river turns nearly due west and flows a total distance of about 12 air miles before exiting the mountains at Fort Churchill. Downstream, the Carson River passes under Weeks Bridge on U.S. 95 Alt, and enters Lahontan Reservoir a few more miles to the east. Downstream from Lahontan Reservoir, the river flows northeastward to its terminus at Carson Sink. The Carson River Basin in Nevada and California encompasses about 3,966 square miles, of which about 3,360 square miles are in Nevada (CWSD).

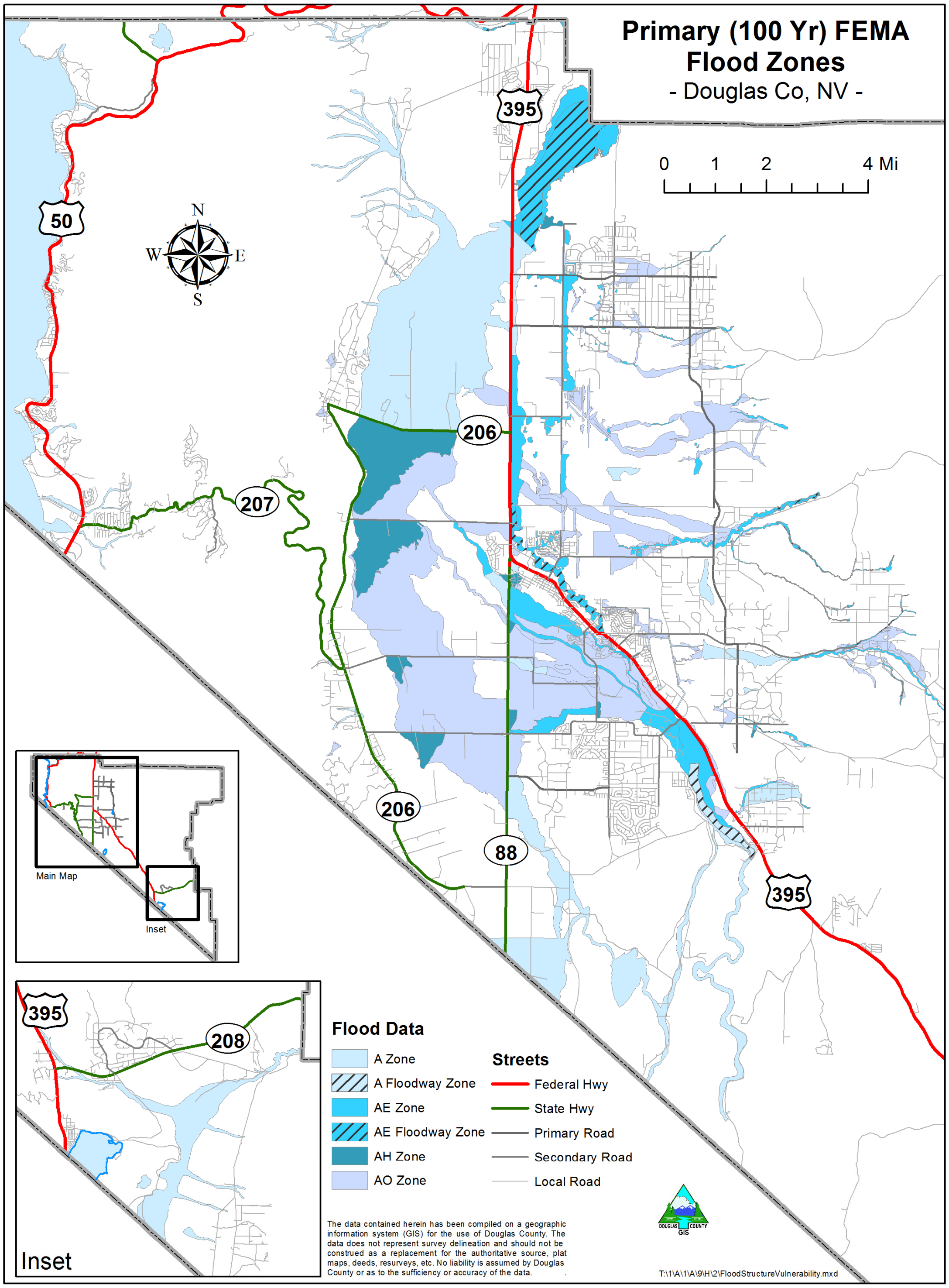
Douglas County entered into the National Flood Insurance Program on January 4, 1975 under the Emergency Program and then on March 28, 1980 under the regular program. The first Flood Insurance Rate Maps (FIRMs) for Douglas County were dated March 28, 1980. The most recent FIRMs are dated January 20, 2010. The County is covered by 37 published FIRM panels. According to the State of Nevada Community Assistance Visit (CAV) findings from February 2012, there are currently 1,077 flood insurance policies in Douglas County totaling $287,798,100 in coverage. There have been 117 losses in Douglas County totaling $2,943,995 in paid losses.

The FIRMs that are effective in Douglas County are the 2008 editions which have been found to be inaccurate. September 17, 2009, Douglas County filed suit against FEMA in U.S. District Court alleging that FEMA’s data and analyses were scientifically or technically incorrect, which is the sole statutory basis of an appeal. County officials were notified by the Scientific Resolution Panel on July 18, 2012 that based on the submitted scientific and technical information by Douglas County and FEMA, the panel has determined that FEMA’s data does not satisfy National Flood Insurance Program mapping standards defined in FEMA’s Guidelines and Specifications for Flood Hazard Mapping Partners and must be revisited. FEMA has subsequently stated that although the 2008 FIRMS are known to contain errors they are the “best available information” and the County still regulates to these maps. This has placed thousands of residences into floodplains where flood hazards do not actually exist. One of the major priorities for the County is to restudy and remap the flood hazards in the areas where the maps are known to be incorrect. There are other areas of the County where flood risk has not been studied or the studies are old and need to be redone.

The Carson River Water Subconservancy District is actively mapping and studying the entire Carson River Watershed. There are many “approximate floodplains” (Zone A) along the Carson River. This study will eliminate many of the approximate floodplain locations and provide more accurate floodplain elevations for the County to use for regulations.

Figure 5-11

Primary Flood Zones



Risk Mapping, Assessment, and Planning (MAP)

FEMA has recently developed a new program called Risk MAP. The goal of this program is to work closely with communities to better understand local flood risk, mitigation efforts, and spark watershed –wide discussions on flood awareness. Historically, FEMA has dealt with flood mapping and issues on a county-by-county basis. The Risk MAP process allows FEMA to focus on flood issues on a watershed- wide basis, with local input.

Risk MAP Charter

In 2012, Carson Water Subconservancy District (CWSD), FEMA, State of Nevada, Alpine County, Douglas County, Carson City, Lyon County, Churchill County, and other federal agencies became signatories to the Risk MAP Charter (Charter) for the Carson River Watershed. The Charter represents a good-faith effort by all parties to share data, communicate findings, and plan mitigation activities to protect communities within the watershed from flood risks. The Charter does not legally bind nor preclude communities from participating in FEMA's National Flood Insurance Rate Map (FIRM) appeal process. The Charter does:

- Detail the long-term flood hazard mapping vision for the watershed
- Describe the desired mapping, assessment, planning information, and planning products
- Describe the assistance that CWSD and FEMA will provide
- Summarize local flooding concerns and indicates areas where floodplain changes are expected
- Describe the roles and responsibilities of the CWSD, FEMA, and other signatory partners

Table 5-10

Historical Floods in Douglas County

	Flooding Location	Comments	Estimated Losses
December 1852	Carson Valley	Two days of heavy snowfall followed by four days of warm rain. Little damage occurred because settlements were located away from the low areas. It is likely flooding occurred along other western Nevada rivers at this time.	No Figures available
December 1861 January 1862	Carson and Truckee River Basins	Two days of heavy snow before Christmas, followed by extreme cold temperatures freezing the snow. From Christmas Day until December 27, a warm rain fell. It was reported that Carson Valley became a lake. At that time, most of the settlements were located out of the valley along the eastern slope of the Sierra Nevada, so little damage was reported.	No Figures available
December 1867 January 1868	Carson and Truckee River Basins	On December 20, an unseasonably warm rainstorm fell on snow accumulations in the Sierra Nevada. This storm became more intense on December 24 and ended on Christmas Day. After a period of clear weather, a second intense rainstorm began on December 30 and continued through January 2, 1868. The Carson Valley again became a lake. This flooding exceeded the 1861 flood crest. All bridges in the Carson Valley crossing the East Fork and West Fork Carson River as well as the main-stem, were swept away, including William Cradelbaugh's toll bridge, the first bridge over the Carson River in Carson Valley.	No Figures available

	Flooding Location	Comments	Estimated Losses
March 1907	Walker, Carson and Truckee River Basins	A series of snow storms began on March 16, turning to rain and continuing until March 20. The Truckee River severely damaged the Electric Light Bridge. In Carson Valley, all of the bridges of the East Fork and West Fork Carson River as well as the main-stem Carson River were either destroyed or seriously damaged. Among the bridges destroyed on the Carson River were the Cradlebaugh bridges on the Gardnerville-Carson city Road (U.S 395, and the McTarnahan bridge on the toll-road on the south end of Prison Hill.	No Figures available
March 1928	Walker, Carson and Truckee River Basins	A snowstorm began March 23 and soon turned to a rainstorm below the 8,000-foot elevation. On March 26 temperatures dropped. In the Carson Valley, both forks of the Carson River and the main-stem Carson River overflowed their banks, but little damage was caused.	No Figures available

	Flooding Location	Comments	Estimated Losses
December 1937	Carson and Truckee River Basins	Rain began on the evening of December 9, and continued until the afternoon of December 11, melting most of the snow pack at the higher elevations. After a short break, the rain restarted and continued until December 13. On the East Fork Carson River, the Douglas Power (Ruhenstroth) Dam was severely damaged. Flooding began in the south end of Carson Valley on December 10. In the Gardnerville area, the flood crested at 10.300 cfs late in the afternoon of December 11 at the USGS stream gage on the East Fork Carson River near Gardnerville. On the West Fork Carson River, parts SR 37 present day SR 88, were flooded to the depth of 14 inches. On the Carson River, Cradlebaugh Bridge was under about 18 inches of water, and the main highway between Carson City and Gardnerville was closed and not reopened until December 13.	No Figures available
November December 1950	Walker, Carson and Truckee River Basins.	A sequence of rapid moving storms and unseasonably high temperatures melted most of the early snow pack in the Sierra. During a period from November 13 to December 8, total precipitation ranged from about 5 inches at the foot of the Sierra Nevada in Nevada to about 30 inches at the crest in California. On the East Fork Carson River near Gardnerville, the flood crested on November 21, at 12,100 cfs. At the north end of Carson Valley, the peak discharge near Carson City was 15,500 cfs on November 22.	The estimate of damages in the three river basins was $4.4 Million ($27.6 million in 1997 dollars) (U.S. Geological Survey, 1954).

	Flooding Location	Comments	Estimated Losses
December 1955	Truckee, Carson and Walker River Basins	During December 21 to 24, an intense storm of unseasonably high temperatures melted part of the snow pack in the Northern Sierra Nevada. Precipitation at the headwaters of the principal river basins averaged from 10 to 13 inches. On the East Fork of the Carson River near Gardnerville, the flood crested at 17,600 cfs on December 23. On the West Fork Carson River at Woodfords, California, the flood crested on December 23 at 4,810 cfs. In the Carson Valley, over 16,000 acres were flooded (about the same acreage flooded in New Year's flood 1997) and many families were forced to move out when their homes were isolated and flooded. The largest structure destroyed in Carson Valley was Lutheran Bridge, which collapsed. At the north end of Carson Valley, the flood crested near Carson City on December 24 at 30,000 cfs, setting a record that stood until the New Year's flood 1997.	The estimate of damages in the three river basins was $3,992,000 ($22,327,000 in 1997 dollars) (U.S. Geological Survey 1963b). One life was lost.
January February 1963	Truckee, Walker and Carson River Basins	As late as January 27, western Nevada was having one of its worst winter droughts. An intense storm of unseasonably high temperatures started late January 28 and continued through February 1. Precipitation varied from 5 to more than 13 inches. The freezing level was above 8,000 feet during most of the storm and as high as 11,000 feet at times. On February 1, the flood crested at 13,360 cfs on the East Fork Carson River near Gardnerville, and at 4,890 cfs on the West Fork Carson river at Woodfords (USGS Survey, 1966 a).	Damage in the three river basins was estimated at $3,248,000 ($15,130,000 in 1997 in dollars) (U.S. Geological Survey 1966a).

	Flooding Location	Comments	Estimated Losses
December 1964	Truckee and Carson River Basins	This flood resulted from a storm of unseasonably high temperature and rain melting part of the snow pack. During December 21-23, warm air mass raised temperatures, increased wind velocities and caused torrential rains, as much as 16 inches in the mountain areas. This flood was similar to the December 1955 flood. On December 23, the East Fork Carson river near Gardnerville crested at 8,230 cfs and the West Fork Carson River at Woodfords crested at 3,100 cfs. In Carson Valley, 13,500 acres of pasture, hay and grain were flooded. The flood crested on the Carson River near Carson City on Christmas Day at 8,740 cfs (USGS Survey 1971).	The estimate of damages in these two river basins was $2,236,000 ($10,111,000 in 1997 dollars) (U.S. Geological Survey, 1966b).
February 1986	Truckee and Carson River Basins	A light rain began February 12 becoming heavy on February 15, diminishing on February 18. On February 19, the East Fork Carson River near Gardnerville crested at 7,380 cfs, and the West Fork Carson River at Woodfords crested at 551 cfs (Pupacko and others, 1988). Flooding in Carson Valley caused the closing of Cradlebaugh Bridge on U.S. 395 over the Carson River on February 17.	Damage resulting from this flood was estimated at $12,700,000 ($17,760,000 in 1997 dollars) (Donna Garcia, U.S. Army Corps of Engineers, verbal commun., 1997).
December 1996 January 1997	Walker, Carson and Truckee River Basins	This flood resulted from several moderate to heavy snowstorms during December 1996, followed by three subtropical, heavy rainstorms from the Pacific. The third storm melted most of the snow pack in the Sierra Nevada below 7,000 feet and produced heavy rainfall up to 10,000 feet.	Estimated initial damage (Interagency Hazard mitigation Team for FEMA-1153-DR-NV) $21,310,567.
August 2012	Preacher/Ray May Fire area watersheds	This flash flood resulted from thunderstorm rain on wildfire footprints. The debris covered and closed U.S. Highway 395.	Estimated initial damage : $92,000.00 (Nevada Department of Transportation).

5.2.4.4 Location, Extent and Probability of Future Events

Based on historical events, flooding is a high probability in Douglas County. According to the FIRMs maps, there is a 1% chance of a 100-year flood each year.

Flooding, whether localized or basin-wide, is a common phenomenon in the Carson River Basin and occurs with some regularity over the historic period of record. There is no reason to assume this will change now or in the future. Earlier snowmelt or less overall snow accumulation (in favor of more rain at higher elevations) may occur in response to climate change. However, both localized and regional-scale flooding will continue to be of concern to communities living on or near flood-prone areas. From the USGS website http://nevada.usgs.gov/crfld/floodhistory.cfm#

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies often use historical records, such as stream flow gages, to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed as a percentage for the chance of a flood of a specific extent occurring in any given year.

Factors contributing to the frequency and severity of flooding include the following:

- Rainfall intensity and duration
- Antecedent moisture conditions
- Watershed conditions, including steepness of terrain, soil types, amount and type of vegetation, and density of development
- The existence of attenuating features in the watershed, including natural features such as swamps and lakes and human-built features such as dams
- The existence of flood control features, such as levees and flood control channels
- Velocity of flow
- Availability of sediment for transport, and the erodibility of the bed and banks of the watercourse

These factors are evaluated using (1) a hydrologic analysis to determine the probability that a discharge of a certain size will occur, and (2) a hydraulic analysis to determine the characteristics and depth of the flood that results from that discharge.

Climate change may be expected to lead to more frequent extreme weather conditions in the future. Nevada's desert climate characterized by hot summers and low humidity may become more extreme. The potential for experiencing wet and dry weather extremes from year-to-year is also increased.

The following table (Table 5-11) from the Carson River Watershed's Regional Floodplain Management Plan shows that the Carson River is able to transport flows up to around 10,000 cfs before transportation is affected and first responders would need to mobilize.

Table 5-11

Level (ft)	Approximate cfs	Potential Flood Impacts
19.0	38000	Incredible flood with damage previously unknown from Carson Valley to Fort Churchill including Empire and Dayton areas. USGS estimated 100 yr flood...
17.0	29600	Record flooding. All towns cut off...bridges and roads destroyed.
16.0	25800	Near record flooding with massive destruction throughout reach. Most towns isolated with transportation nearly impossible.
15.0	22200	Major flood disaster with widespread destruction throughout reach from Genoa to Weeks. Transportation extremely difficult.
13.5	17400	Flood disaster throughout reach. Transportation very difficult. Large number of structures affected and infrastructure damage (roads, bridges, power, water).
12.0	13300	Extensive flooding with major damage. Most roads in valley areas flooded making transportation difficult. Massive erosion with large agricultural losses and cattle drownings.
11.0	10900	Major flooding. Many roads and highways flooded. Transportation becoming difficult...US Hwy 395 closes. Massive bank erosion with the ability to wash away buildings...cars...roads. River channel begins to move around laterally.
10.5	9800	Moderate flooding through reach. Damage to roads, bridges, crops, .irrigation systems and buildings in lower areas. Transportation begins to be affected.
10.0	8800	Flood stage. Minor to moderate lowland flooding with several homes having flood problems in Genoa, Carson Valley, Stewart, and Dayton. Minor to moderate damage to agriculture.
9.5	7800	Minor flood impacts in lower portions of reach.
9.0	6900	Minor lowland flooding through reach in lower flood prone areas.
8.5	6000	Minimal lowland flooding through reach.
8.0	5200	Monitoring stage. Flood threat and localized overbank flows begin in lowest areas.

Source: NOAA National Weather Service, Advanced Hydrologic Prediction Service: Reno: Carson River near Carson City

5.2.5 Seiche (tsunami)

Planning Significance – Low

5.2.5.1 Nature

US Army Corps of Engineers defines Seiche as:

A standing wave oscillation of an enclosed waterbody that continues, pendulum fashion, after the cessation of the originating force, which may have been either seismic or atmospheric.

An oscillation of a fluid body in response to a disturbing force having the same frequency as the natural frequency of the fluid system. Tides are not considered to be seiches induced primarily by the periodic forces caused by the Sun and Moon.

Seiches (also known as tsunamis) can be generated when land tilts or drops as a result of fault rupture or other seismic activity. Computer modeling, by a group at the University of Nevada at Reno that is working with a Japanese tsunami expert, showed ruptures along Tahoe faults could lift or drop the bottom of the lake and possibly generate a tsunami. The tsunami in turn could trigger seiche waves within seconds that could crisscross the lake, and reach heights of 30 feet or more and persist for hours.

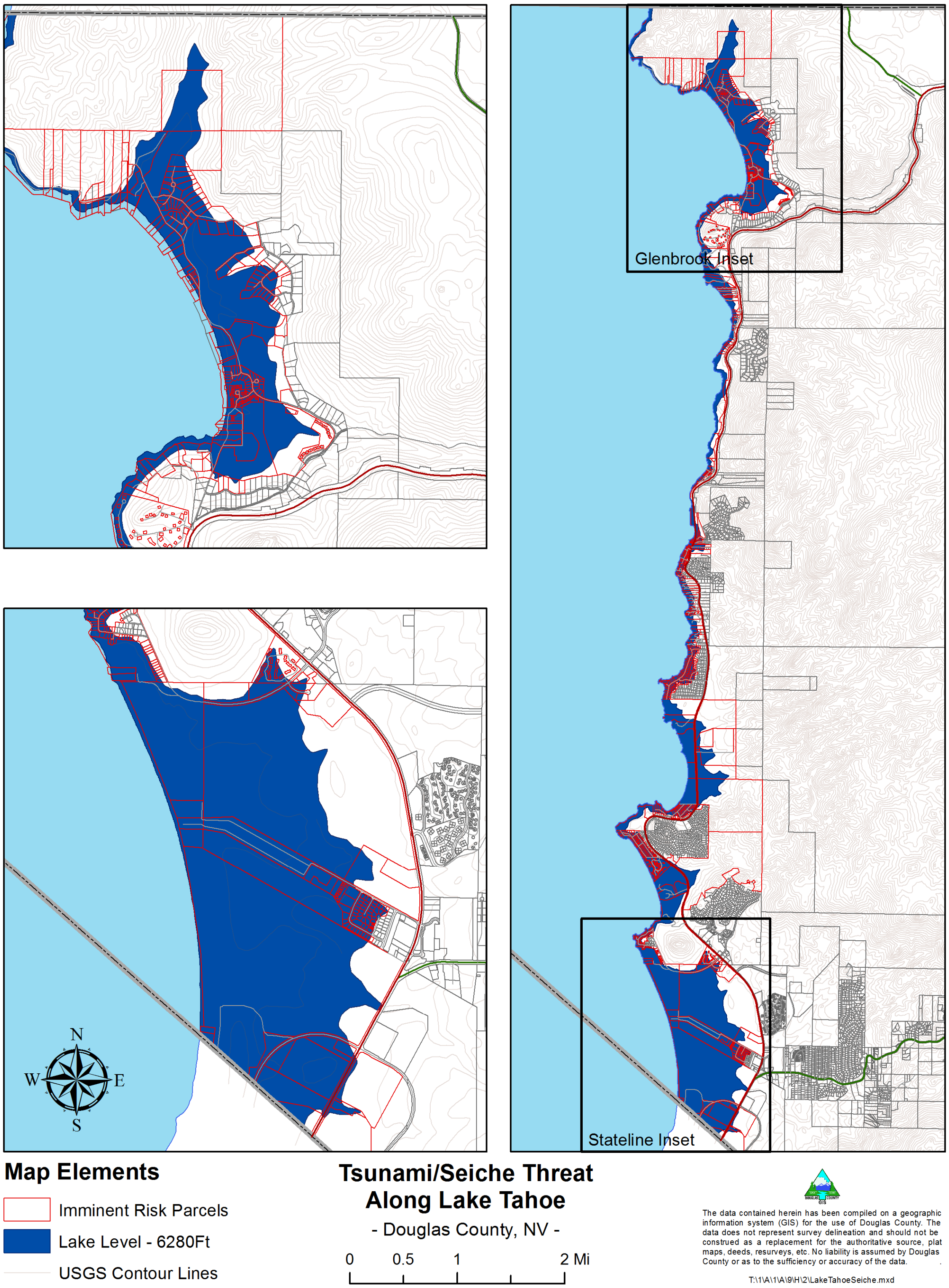
5.2.5.2 History

There have been no occurrences of major seiche activity at Lake Tahoe in recent years. University of California at Davis' Tahoe Environmental Research Center geologists have found landslide deposits that extend for ten miles along the bottom of the lake adjacent to the McKinney Bay shore from Sunnyside through Tahoma. This landslide was triggered by an earthquake along the West Shore Fault. Scientists have also found evidence indicating a tsunami and seiche with 30 foot high waves resulted from the landslide. This tsunami and numerous reverberating seiche left nearly everything along the entire Tahoe shore destroyed. This event occurred thousands of years ago.

5.2.5.3 Location Extent, and Probability of Future Events

Douglas County northern boundary resides in the central eastern side of Lake Tahoe. The southern county boundary resides at the southeastern corner of the lake at the California/Nevada stateline. Figure 5-12 illustrates the potential height of a possible tsunami and resulting seiche activity.

Figure 5-12


Glenbrook Inset
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Map Elements
Imminent Risk Parcels
Lake Level - 6280Ft
USGS Contour Lines
Tsunami/Seiche Threat
Along Lake Tahoe
- Douglas County, NV -
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DOUGLAS COUNTY
GIS
The data contained herein has been compiled on a geographic information system (GIS) for the use of Douglas County. The data does not represent survey delineation and should not be construed as a replacement for the authoritative source, plat maps, deeds, resurveys, etc. No liability is assumed by Douglas County or as to the sufficiency or accuracy of the data.
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Douglas County's boundary along the lake includes privately owned, government and commercial structures of substantial value. The highway and some major utilities are at a high enough elevations or protected so that they would not be affected by a 30 foot wave. However, some water, sewer and other major utilities are within the hazard area. Many of these utilities are owned by local general improvement districts. The possibility of a tsunami and resulting seiche with magnitude and significant severity of impacts is considered low in Douglas County. Based on the frequency of seiche occurrences in Lake Tahoe, the probability of future seiche-influenced flooding events is very low with less than .01 percent chance of occurrence in a given year based on scientific data from UNR and U.C. Davis.

5.2.6 Severe Weather

Planning Significance - High

5.2.6.1 Nature

While a considerable percentage of days in the region are characterized by tranquil weather – a number of high-impact severe weather types can occur. The following starts with impacts from summer thunderstorms, transitioning into snow, and wind from winter storms. Douglas County faces additional weather hazards (e.g. dense fog, dust storms, rare weak tornadoes) but the following are the most prominent with the highest economic and societal tolls.

Thunderstorms - Hail

Nature: Hail forms on condensation nuclei such as dust or ice crystals, when supercooled water freezes on contact. In clouds containing large numbers of supercooled water droplets, these ice nuclei grow quickly at the expense of the liquid droplets. The hail grows increasingly larger. Once a hailstone becomes too heavy to be supported by the storm's updraft it falls out of the cloud. Hail is most common in mid-latitudes during spring and early summer where surface temperatures are warm enough to promote the instability associated with strong thunderstorms, but the upper atmosphere is still cool enough to support ice. Hailstones are usually from the size of a pea to the size of a golf ball. The National Weather Service in Reno issues Severe Thunderstorm Warnings for thunderstorms capable of producing high winds (above 58 mph) and/or large hail (above 1 inch diameter).

History: Large hail is relatively rare in Nevada. The NOAA National Climatic Data Center has records of 4 large hail events in Douglas County since 2000. These events have recorded hail from 0.75 inches to 1 inch. There have not been any deaths or injuries associated with these recorded hail events or any reportable damages.

Location, Extent, and Probability of Future Events: Douglas County is susceptible to hail events although it is infrequent. As noted above, the area is susceptible to hail the size of up to 1 inch. Based on previous occurrences, the county can expect a large hail event to occur on the order of every 2 to 4 years.

Thunderstorms - High Winds & Lightning

Nature: Thunderstorms are formed from a combination of moisture, rapidly rising warm air, and a force capable of lifting air, such as warm and cold fronts or a mountain. Thunderstorms may occur alone, in clusters, or in lines. As a result, it is possible for several thunderstorms to affect one location in the course of a few hours. A thunderstorm can produce lightning, thunder, and rainfall and may also lead to the formation of tornados, hail, downbursts, and microbursts of wind. Focusing on the wind threat from thunderstorms - downbursts are strong, straight-line winds created by falling rain and sinking rain that may reach speeds of 125 mph. Microbursts are more concentrated than downbursts, with speeds reaching up to 150 mph. Both downbursts and microbursts typically last 5 to 7 minutes. The National Weather Service in Reno issues Severe Thunderstorm Warnings for thunderstorms capable of producing high winds (above 58 mph) and/or large hail (above 1 inch diameter).

History: Strong winds from thunderstorms are fairly common in Nevada, producing wind gusts above 40 mph. With that being said there are only 2 thunderstorm high wind reports in Douglas County since 2000 with gusts 55-65 mph. There have not been any deaths or injuries associated with these recorded wind events or any reportable damages. There have been 5 instances of lightning resulting in damage to structures since 2000, though no fatalities. Lightning is a common factor in new wildfire starts in Nevada, though no specific information is available for Douglas County. Often thunderstorms are the most common over high terrain and other remote areas of Nevada - leading to minimal actual reports of severe weather and lightning.

Location, Extent, and Probability of Future Events: Thunderstorms in Douglas County tend to favor the high terrain, including the Pine Nut Mountains and Carson Range. Thunderstorm activity which would produce high winds and/or significant lightning generally occurs from June through August. During this timeframe it is not unusual to experience thunderstorm activity on a daily basis. In an average year 3-6 severe thunderstorm warnings for high winds are issued for portions of Douglas County. Severe thunderstorm warnings are not issued solely for significant amounts of lightning, though the National Weather Service will issue Red Flag Warnings for fire partners when widespread dry thunderstorms are expected.

Winter Storms – Heavy Snow

It is important to note that county-level storm data are not available for this phenomenon, therefore this analysis uses NWS forecast zone data. Forecast zones are geographic areas of similar weather features NWS groups together to produce forecasts. Douglas County is within two NWS forecast zones, one that covers the immediate lee of the Sierra or "Sierra Front" and the other covering the Lake Tahoe basin part of the county. For reference, a map of those zones is provided at the end of the severe weather section.

Nature: Winter snow storms are often large areas of low pressure originating from the Gulf of Alaska and then moving into the western United States. As the moist air masses push across the Sierra Nevada and other Great Basin mountains, the air masses cool and the water condenses as snow. Wind in combination with the snow can cause reduced visibilities and deep snowdrifts. In addition, heavy snow can cause avalanches in areas along steep terrain. In some instances, freezing rain occurs, when very cold inland arctic air becomes trapped under warm moist air. The National Weather Service in Reno issues winter storm watches/warnings/advisories for heavy snow, and provides briefings to Emergency Managers when winter storms are forecast.

History: Since 2000 there have been 33 days where heavy snow has impacted the lower elevation areas of Douglas County, with 81 days in portions of the county within the Lake Tahoe basin. On these days, snow amounts of greater than 6-12 inches occurred, along with other winter storm hazards such as high winds, low visibility, and cold temperatures. Western portions of Douglas

County, including Stateline, Minden, and Gardnerville are also susceptible to lake effect snows producing localized very heavy snowfall roughly once every 1-2 years. FEMA Federal Disaster Declarations have been issued in the wake of several widespread winter storm events impacting Douglas County, including February 2005 and January 2008.

Location, Extent, and Probability of Future Events: It is not uncommon for Douglas County's populated areas to experience snow with accumulations of 1-3 inches per winter storm, which can cause travel inconveniences but little in the way of long lasting impacts. Storms like this normally happen 3-6 times each winter season. Larger storms, producing 6 inches or more in the lower elevations of the County, happen on average once or twice each winter season. Snowfall in these events can exceed 1-2 feet in the higher terrain of the Carson Range, impacting critical transportation passes along Highway 50 and the Kingsbury Grade. Every few years, particularly strong storms can produce high winds along with heavy snow creating life threatening blizzard conditions.

Winter Storms – High Winds

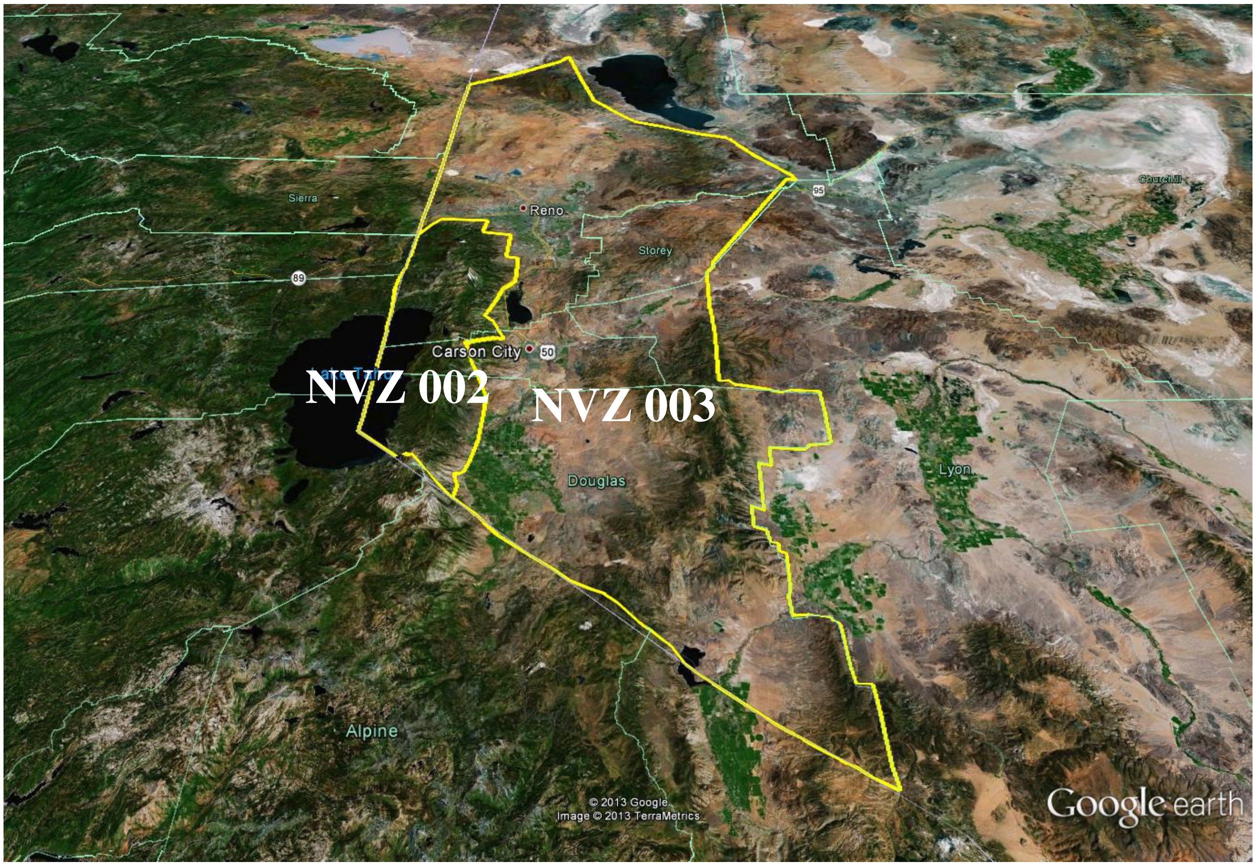
It is important to note that county-level storm data are not available for this phenomenon, therefore this analysis uses NWS forecast zone data. Forecast zones are geographic areas of similar weather features NWS groups together to produce forecasts. Douglas County is within two NWS forecast zones, one that covers the immediate lee of the Sierra or "Sierra Front" and the other covering the Lake Tahoe basin part of the county. For reference, a map of those zones is provided at the end of the severe weather section.

Nature: The same winter storms described previously also produce periods of widespread high winds in the Sierra Nevada and Great Basin. These winds of 40-60 mph typically precede the snow portion of a winter storm by a day or so – and are the most common from late fall through spring. Strong winds are the direct result of large differences in atmospheric pressure from the storm itself and the surrounding environment. Winds can be further enhanced in localized areas in the immediate lee of mountain ranges in what is called a downslope wind storm. Wind gusts in these situations can exceed 80 mph, reaching nearly 100 mph in the most extreme "once-in-a-decade" events. The National Weather Service in Reno issues high wind watches/warnings/advisories, and provides briefings to Emergency Managers when high winds threaten.

History: Since 2000 there have been 59 days where high winds have impacted Douglas County's lower elevation areas, with 7 days in portions of the county in the Lake Tahoe basin. These wind events have been associated with damage to buildings, knocking over trees and power lines, and overturning large vehicles.

Location, Extent, and Probability of Future Events: High wind events are not uncommon in Douglas County, especially along the Highway 395 corridor including Minden and Gardnerville. Downslope wind storms impact these areas several times each year with wind gusts above 70 mph, producing significant societal impacts ranging from power outages to structural damage. For locations near Lake Tahoe, strong winds often accompany winter storms a number of times each year with winds topping 50 to 60 mph.

Figure 5-13



Map of NWS Reno forecast zones covering Douglas County (yellow lines) with county outlines (light green). NVZ 003covers the lower elevations and the Pine Nut Range part of the county, while NVZ 002 covers the Lake Tahoe Basin portion.

Climate change may be expected to lead to more frequent extreme weather conditions in the future. Nevada's desert climate characterized by hot summers and low humidity may become more extreme. The potential for experiencing wet and dry weather extremes from year-to-year is also increased.

5.2.7 Volcanic Activity

Planning Significance - Low

5.2.7.1 Nature

A volcano is an opening, or rupture, in a planet's surface or crust, which allows hot, molten rock, ash and gases to escape from below the surface. Volcanic activity involving the extrusion of rock tends to form mountains or features like mountains over a period of time.

Volcanoes are generally found where tectonic plates pull apart or come together. By contrast, volcanoes are usually not created where two tectonic plates slide past one another. Volcanoes can also form where there is stretching and thinning of the earth's crust (called "non-hotspot intra plate volcanism"), such as in the Rio Grande Rift in North America.

5.2.7.2 History

There is a history of ancient volcanic action in State of Nevada; however, the risk is not considered significant within the State's geographic area. Volcanic activity surrounding the State of Nevada could potentially cause some ash fall over portions of the State. However this is predicted to cause little or no damage or significant disruptions. There is no immediate indication of renewed volcanic activity in State of Nevada. (U.S. Geological Survey)

5.2.7.3 Location, Extent, and Probability of Future Events

Any volcanic activity that produces ash would impact Douglas County's water for a short period of time. The probability is very low of an event occurring. The following Forum Report was made available to the Hazard Mitigation Plan Update Committee on volcanic hazard risks in Nevada from the Nevada Bureau of Mines and Geology.

Volcanic Hazards

Jon Price, State Geologist and Larry Garside, Research Geologist, Nevada Bureau of Mines and Geology. 6/04/02

"The most likely volcanic hazard for Nevada is an eruption from the Mono Craters area near Lee Vining and Mono Lake in Eastern California. Small eruptions from the volcanoes have sent ash into Nevada as recently as about 260 years ago. Other volcanoes that could deposit ash in Nevada include Mount Lassen, Mount Shasta and the Long Valley Caldera in California and volcanoes in the Cascade Mountains in Oregon.

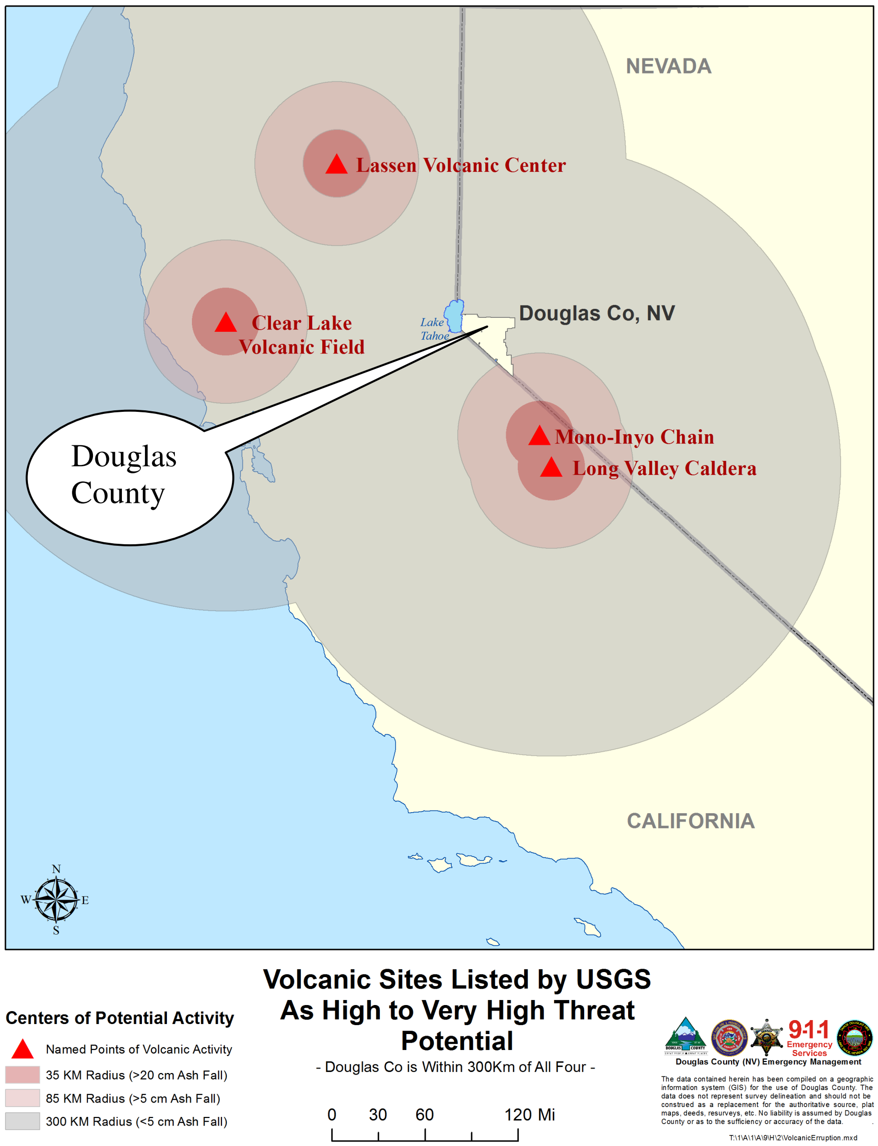
The biggest threat for Nevada from eruptions in California and Oregon is damage to flying aircraft. Ash from eruptions in California or Oregon is not likely to cause long-term problems in Nevada, because the ash deposits are likely to be thin, typically only a few inches thick at most.

A massive eruption from the Long Valley Caldera near Mammoth Lakes, California over 700,000 years ago devastated a considerable area in Owens Valley when thick, hot flows of ash were deposited as far south as Bishop. Air-fall ash from these eruptions did collect as thick piles of ash in parts of Nevada, and some of the ash may have been hot enough or thick enough to devastate the landscape locally. Scientists would expect to see strong indications from seismographs before another eruption of this magnitude. The U.S. Geological Survey continues to monitor the area around Mammoth Lakes, and will issue warnings prior to any subsurface changes that could precede a major eruption.

Please see the volcanic ash dispersal map Figure 5-14.

Figure 5-14

Volcanic Ash Dispersal Map



Source: USGS Volcano hazards program; C.D. Miller, J. Johnson; http://lvo.wr.usgs.gov/zones/TephraFall.html

Eruptions inside Nevada are not likely in the near future, judging from past activity and lack of earthquakes that would suggest current movement of magma. This opinion may change if seismic signals indicate possible movement of magma in the future. Our ability to monitor small tremors associated with magma at depth is limited by the currently limited number of seismographs that are operated in Nevada. The Nevada Seismological Laboratory and the U.S. Geological Survey have joint responsibilities for earthquake monitoring and warnings. The Advanced National Seismic System, which is authorized by Congress but currently has been funded at only a fraction of its intended size, will help to monitor for earthquakes and pending volcanic eruptions.

The Soda Lake and Little Soda Lake (near Fallon in Churchill County) maars (volcanoes that form by explosions when magma rises near the surface of the earth and boils the groundwater) are probably the youngest volcanoes within the borders of the State. They have not erupted in recorded history, although they definitely are younger then the last high stand of Lake Lahontan, about 13,000 years ago because deposits from these volcanoes overlie sediments deposited in the lake. On the basis of preliminary helium isotopic studies (Thure Cerling, University of Utah, personal communication, 1997), the eruption at Soda Lake may be younger than 1,500 years before present.

Other relatively young volcanoes occur in the Crater Flat – Lunar Crater Zone, Nye County, which includes basaltic volcanoes ranging in age from about 38,000 to 1 million years old (Smith, E.I. Keenan, D.L., Plank, T. 2002, Episodic Volcanism and Hot Mantle: Implications for Volcanic Hazard Studies at the Proposed Nuclear Waste Repository at Yucca Mountain, Nevada: GSA Today, v.12, no.4, p. 4-10); in Clayton Valley, near Silver Peak in Esmeralda County; near Winnemucca in Humboldt County; and near Reno in Storey County. Most of these are basaltic volcanoes, which typically form small cinder cones and small lava flows. There are also some one million-year-old rhyolitic lava flows in the Reno area near Steamboat Hot Springs, but volcanoes in this area are thought to be extinct.

5.2.8 Wildland Fire

Planning Significance - High

5.2.7.1 Nature

A wildland fire is a type of fire that spreads through consumption of vegetation. It often begins unnoticed, spreads quickly, and is usually signaled by dense smoke that may be visible from miles around. Wildland fires can be caused by human activities (such as arson or campfires) or by natural events such as lightning. Wildland fires often occur in forests, rangelands or other areas with ample vegetation. This vegetation can occur adjacent to the community such as in a classic interface condition, throughout the community such as in an intermix configuration or on large open space within the interior of a community. However in all cases the wildland fire burns natural vegetation and rapidly spreads and threatens communities and infrastructure.

The following three factors contribute significantly to wildland fire behavior and can be used to identify wildland fire hazard areas.

Topography

As slope increases, the rate of wildland fire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildland fire behavior. However, ridge tops may mark the end of wildland fire spread, since fire spreads more slowly or may even be unable to spread downhill. Within Douglas County, there are areas, especially those along the Eastern Sierra Front which frequently experience fire behavior that is not consistent with normal slope effects, in these areas; fire may make extremely rapid and prolonged downhill runs intermingled with traditional topographic fire behavior.

Fuel

The type and condition of vegetation plays a significant role in the occurrence and spread of wildland fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the “fuel load”). The ratio of living to dead plant matter is also important. The risk of fire is increased significantly during periods of prolonged drought, as the moisture content of both living and dead plant matter decreases. The fuel’s continuity, both horizontally and vertically, is also an important factor.

Weather

The most variable factor affecting wildland fire behavior is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildland fire activity. By contrast, cooling and higher humidity often signals reduced wildland fire occurrence and easier containment. In Northern Nevada there is a history of large fires that burn in relatively cool conditions as the winds from an approaching (typically dry) storm system cause fires to spread rapidly. Some of the most damaging and costly fires in Nevada history have occurred during these types of weather conditions.

The frequency and severity of wildland fires also depends upon other hazards, such as lightning, drought, and infestations. If not promptly suppressed, wildland fires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy structures and infrastructure. In Douglas County wildland fire can have significant impact on agricultural infrastructure such as fences, irrigation ditches and livestock support equipment. Wildland fire events may require emergency watering/feeding, evacuation, and shelter of livestock.

The indirect effects of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may become hydrophobic and prone to erosion, mud slides or mass wasting. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby increasing flood potential, harming aquatic life, and degrading water quality. Agricultural infrastructure such as irrigation ditches, stock ponds or canals can become impaired by siltation and erosion. Soot, dust and debris from fires typically impact nearby, downwind residential and commercial areas for months if not years after a significant fire.

Wildfires can affect wildlife habitat. Douglas County contains several areas considered critical habitat by the Nevada Department of Wildlife and United States Geological Survey. Some of these areas have been identified as critical habitat because of the bi-state population of Greater Sage Grouse which is currently a candidate for listing under the Endangered Species Act. Such a listing would have economic impact on Douglas County, neighboring communities and Nevada as a whole.

Wildland Fuel Types

Douglas County Nevada is located in the Great Basin on the eastern slopes of the Sierra Nevada. Douglas County has several biotic zones which determine wildland fuel types including:

- Mixed conifer forests surrounding the Lake Tahoe Basin and in major drainages in the Sierra Nevada
- Sub-alpine mixed conifer forests at the higher elevations of the Sierra Nevada
- Sagebrush communities in the lower elevations of the Carson Valley and of the valleys in the eastern portions of the county
- Pinion juniper plant communities particularly in the Pine Nut Mountains and at the mid elevations of the Sierra Nevada

Each of these biotic zones will produce vegetation that can support large damaging fires that may threaten life and property. The multitude of fuel types creates a difficulty in informing the community about relative fire hazards as dry years may lead to increased fire hazard in the timber fuel types and wet years may cause vegetation growth and increased fire hazard in the sagebrush and cheat grass fuels, as a result the public hears every year has the potential to be a bad fire year.

Fire Ecology

Some plant communities have evolved to burn frequently with low intensity, for example mature Jeffrey pine forests. Under a natural fire regime, low-intensity surface fires reduce fuel loading from grasses and shrubs, suppress regeneration of shade-tolerant white fir seedlings, and leave the adult Jeffrey pine trees unaffected, protected by thick, fire-resistant bark. Forests with frequent fire occurrence often have an open, "park-like" appearance with an understory of grass or low shrubs. Though shaded by large, mature trees, spacing between trees is sufficient to allow sunlight to reach the forest floor and encourage regeneration of shade-intolerant species like Jeffrey pine trees. Pockets of heavy fuels exist in these conditions, but their discontinuous nature reduces the likelihood that a fire will burn with enough intensity to negatively impact mature trees. In the absence of frequent surface fires, accumulated dead-and-down woody fuels and the green "ladder fuels" can carry flames into the coniferous overstory, potentially provoking a catastrophic, stand-destroying crown fire.

Big sagebrush communities are the most common vegetation types in Nevada with an altered fire regime, now characterized by infrequent, high-intensity, catastrophic fires. Sagebrush requires ten to twenty or more years to reestablish on burned areas, and most often these areas provide the conditions for establishment and spread of invasive species before sagebrush reestablishment can occur. Cheatgrass is the most common invasive species to reoccupy sagebrush and pinyon-juniper burned areas in northern Nevada.

Singleleaf pinyon and Utah juniper are the dominant components of a plant community commonly referred to as Pinyon-Juniper (P-J). P-J woodlands were once characterized by a discontinuous distribution on the landscape and a heterogeneous internal fuel structure: a mosaic pattern of shrubs and trees resulting from the canopy openings created by small and frequent wildfires. Both pinyon and juniper trees have relatively thin bark with continuous branching all the way to the ground. In dense stands, lower tree branches frequently intercept adjacent ladder fuels, e.g. shrubs, herbaceous groundcover, and smaller trees. This situation creates a dangerous fuel condition where ground fires can be carried into tree canopies, which often results in crown fires

Effect of Cheatgrass on Fire Ecology

Cheatgrass is a common, non-native annual grass that aggressively invades disturbed areas, especially burns. Replacement of a native shrub community with a pure stand of cheatgrass increases the susceptibility of an area to repeated rapidly spreading wildfires, especially in mid to late summer when desiccating winds and lightning activity are more prevalent. The annual production, or volume of cheatgrass fuel produced each year, is highly variable and dependent on winter and spring precipitation. Plants can range from only a few inches tall in a dry year to over two feet tall on the very same site in wet years. In a normal or above normal precipitation year, cheatgrass can be considered a high hazard fuel type. In dry years, cheatgrass is generally sparse and low in stature and poses a low fire behavior hazard because it tends to burn with a relatively lower intensity. However, in both dry and wet years, dried cheatgrass creates a highly flammable fuel bed that is easily ignited with the propensity to rapidly burn into adjacent fuel types that may be characterized by more severe and hazardous fire behavior. The ecologic risk of a fire igniting in and spreading from a cheatgrass stand into adjacent, unburned native vegetation is that additional disturbed areas are thereby opened and vulnerable to cheatgrass invasion. Associated losses of natural resource values such as wildlife habitat, soil stability, and watershed functions are additional risks.

Eliminating cheatgrass is an arduous task. Mowing defensible space and fuelbreak areas annually before seed maturity is effective in reducing cheatgrass growth. In areas where livestock may be utilized, implementing early-season intensive grazing up to and during flowering may aid in depleting the seed bank and reduce the annual fuel load (BLM 2003, Davison and Smith 2000, Montana State University 2004). It may take years and intensive treatment efforts to control cheatgrass in a given area, but it is a desirable conservation objective in order to revert the landscape to the natural fire cycle and reduce the occurrence of large, catastrophic wildfires. Community-wide efforts in cooperation with county, state, and federal agencies are necessary for successful cheatgrass reduction treatments.

5.2.7.2 History

Nevada averages 1022 wildland fires per year that consume over 675,194 acres based upon current ten year average. Of the 900,498 acres burned during a normal year like 2007, 76 were large fires of 300+ acres, consuming a total of 95% of the total acres burned. This information was obtained by the Department of Conservation and Natural Resources, Nevada Division of Forestry from the Western Great Basin Intelligence Reports.

Several large wildfires have occurred in the recent history of Douglas County. Between 1992 and 2012, 45,068 acres burned in wildland fires. In July of 2013 Douglas County experienced its largest fire on record. The Bison Fire, started by lightning in the Pine Nut Creek community (as referenced in Table 5-13), burned 24,140 acres, 99% (approximately 23,899 acres) in Douglas County. The fire destroyed some abandoned buildings while threatening several homes and prompting evacuations of residential areas.

Douglas County has a history of losing buildings to wildland fire. The 1996, 3800 acre Autumn Hills Fire, in the Sheridan community, destroyed four homes and damaged several others. The TRE Fire, in the Topaz Ranch Estates community, in 2012 destroyed two homes, damaged several others and destroyed several outbuildings.

Table 5-12 summarizes the large fire history and fire ignitions recorded by year within Douglas County. Total fire acreage data was obtained for public lands. Several wildland fires have occurred on private lands within the county. Often these fires are not reported to federal agencies and are therefore, not reflected in some total fire acreage data in Table 5-12.

	Table 5-12 Summary of Reported Fire History Data 1992-2012		
Year	**Total Number of Ignitions**	**Number of Large Fire Ignitions**	**Total Fire Acreage**
•	•	•	•
• 1993	• N/A	• 0	• NA
• 1994	• N/A	• 1	• 7,444
• 1995	• N/A	• 0	• NA
• 1996	• N/A	• 2	• 7,426
• 1997	• N/A	• 1	• 18
• 1998	• N/A	• 0	• NA
• 1999	• N/A	• 0	• NA
• 2000	• N/A	• 2	• 2,314
• 2001	• N/A	• 1	• 445
• 2002	• N/A	• 3	• 1,457
• 2003	• N/A	• 0	• NA
• 2004	• N/A	• 0	• NA
• 2005	• N/A	• 1	• 580
• 2006	• N/A	• 1	• 6,213
• 2007	• 89	• 4	• 1,101
• 2008	• 53	• 0	• NA
• 2009	• 60	• 2	• 97
• 2010	• 61	• 0	• NA
• 2011	• 91	• 3	• 5,061
• 2012	• 101	• 7	• 12,911
• 2013*	• **36***	• **1***	• **24,140***
• **TOTAL**	• **483**	• **29**	• **72,708**
	Source: Fire history and fire acreage is derived from BLM and USFS fire perimeter data and specific to fire acreage within Douglas County. Numbers of ignitions were obtained from fire district's records management systems and Douglas County Communications. Data prior to 2007 was unavailable because of dispatching system change or was considered inaccurate. * 2013 to date, July 18, 2013		

5.2.7.3 Location, Extent, Probability of Future Events

The following information originates from the Nevada Community Wildfire Risk/Hazard Assessment Projects for Douglas County and for the Tahoe Douglas Fire Protection District. Several excerpts from this document are incorporated in this portion of the Mitigation Plan.

The Nevada Fire Safe Council contracted with Resource Concepts, Inc. (RCI) to assemble a project team of experts in the fields of fire behavior and suppression, natural resource, ecology and geographic information systems (GIS) to complete the assessment for each Douglas County community listed in the Federal Register as a community at-risk.

Five primary factors that affect potential fire hazard were evaluated to develop a community hazard assessment score: Community design, construction materials, defensible space, availability and capability of fire suppression resources, and physical conditions such as the vegetative fuel load and topography. Information on fire suppression capabilities and responsibilities for Douglas County communities was obtained through interview with local Fire Chiefs and local agency Fire Management Officers (state and federal). The fire specialists on the RCI Project team assigned an ignition risk rating of low, moderate, or high to each community. That rating was based upon historical ignition patterns, interviews with local fire department personnel, interviews with state and federal agency fire personnel, field visits to each community, and the Fire Specialist's professional judgment based on experience with wildland fire ignitions in Nevada. The Spooner Lake Unit of Lake Tahoe State Park is located in the western portions of both Carson City and Douglas County along US Highway 50 in the southern portion of Lake Tahoe State Park. Because there is no permanent community, very few structures and no features listed in the National Register of Historic Places within the State Park, the Risk/hazard assessment was not completed. However, the Spooner Lake Unit of the State Park is listed as a critical feature potentially at risk.

Existing Bureau of Land Management fuel hazard data for the wildland-urban interface was evaluated and field-verified by the RCI Project team wildfire specialists and natural resource specialists. The risk of catastrophic wildfire is summarized in the following tables:

Table 5-13

Risk of Catastrophic Wildland Fire in Valley Portion of Douglas County

Community	Interface Classification	Interface Fuel Hazard Conditions	Ignition Risk Rating	Community Hazard Rating
Alpine View	Intermix	High to Extreme	High	Moderate
Bodie Flats	Intermix	High to Extreme	High	Extreme
China Springs	Intermix / Rural	Low to Extreme	High	High
Dresslerville	Classic	Low to Moderate	Low	Moderate
East Valley	Intermix	Moderate	Moderate	Low
Fish Springs	Intermix	High	High	High
Gardnerville	Classic	Low	Low	Low
Gardnerville Ranchos	Classic	Low	Low	Low
Genoa	Intermix	Low to Extreme	High	High
Holbrook Junction	Intermix	Moderate to Extreme	High	High
Jacks Valley/Indian Hills	Classic / Intermix	Low to High	High	Moderate
Job's Peak Ranch	Intermix	Moderate to High	High	High
Johnson Lane	Classic / Intermix	Low to High	Moderate	Moderate
Minden	Classic	Low	Low	Low
North Foothill Road Corridor	Intermix	Low to Extreme	High	High
Pine Nut Creek	Intermix	High	High	High

Ruhenstroth	Intermix	Moderate to High	Moderate	Moderate
Sheridan Acres	Intermix	Low to Extreme	High	High
Spring Valley/Double Springs	Intermix	Low to High	High	High
Topaz Lake	Intermix	Low to High	High	Moderate
Topaz Ranch Estates	Intermix	Low to Extreme	High	High

Table 5-14

Risk of Catastrophic Wildland Fire in Lake Portion of Douglas County

Community	Interface Classification	Overall Fuel Density	Potential Ignition Risk	Fire Hazard Rating
Cave Rock/Skyland	Intermix	Heavy	High	High
Elk Point/Zephyr Heights/Round Hill	Intermix	Heavy	High	High
Glenbrook	Intermix	Heavy	High	High
Kingsbury	Intermix	Heavy	High	High
Logan Shoals	Intermix	Heavy	High	High
Stateline	Interface/Intermix	Medium	Moderate	Moderate
Chimney Rock	Intermix	Heavy	High	Extreme

Areas with elevated hazard ratings are attributed to inadequate defensible space, combustible building materials, steep slopes, and moderate to extreme fuel hazards, often in either volatile cheatgrass, pinion-juniper or Jeffrey pine/bitterbrush fuel types.

Areas with moderate hazard ratings are attributed to either reduced fuel hazards or adequate implementation of defensible space, which has partially mitigated the potential for a destructive wildfire in these communities.

Low hazard ratings are attributed to a combination of irrigated agricultural lands, adequate defensible space, and fire-resistant construction materials have mitigated the primary risks and hazards associated with wildfire in these areas.

The County Commission has actively worked to increase wildfire response capabilities in the County through installation of static water tanks and additional firefighting personnel. The Tahoe Douglas Fire District has implemented an aggressive fuels management program that includes a seasonal firefighting crew, a chipping program and fuels consultation with landowners. Future efforts to mitigate this hazard should incorporate the concepts of the Cohesive Strategy, which has been developed by a number of cooperators at the national level. This strategy calls for a three pronged approach to reduce the risk of wildfire; resilient landscapes, fire adapted communities and adequate suppression response. Applying the concepts of the Cohesive Strategy will require fuels management activities throughout the county, including the use of prescribed fire. It will also require full implementation of the International Wildland Urban Interface Code, including the provisions which require ignition resistant construction in the wildland urban interface.

The County Commission must consider necessary modification to existing Master Plan, Open Space Plan and County Building Code (Title 20) to reduce risk due to wildfire.

As shown in Table 5-12, every year there is a 100% chance of wildland fire ignitions in Douglas County. There is a 65% chance of a large wildland fire each year.

Values At-Risk from Wildfire

Douglas County Nevada is primarily a rural county with several towns with urban characteristics. Thus the county has limited areas that are classic wildland urban interface where wildland fuels abut a community that has suburban characteristics, such as dense housing, irrigated lawns and landscaping and paved drives and roads. The county has many areas characterized as intermix. The intermix is characterized by widely spaced structures where wildland fuels surround individual structures and the presence of adjacent structures has little influence on the fire behavior. This difference in interface types was then used to determine the values at-risk from catastrophic wildfire.

To determine the values at-risk, a GIS shapefile of all parcels with structures present was obtained from the Douglas County GIS. Then an analysis by Chief Officers of Tahoe Douglas FPD and East Fork FPD was conducted where they used aerial photography and personal knowledge to identify those communities that had a classic wildland urban interface. Developed parcels outside of the classic urban interface communities where then considered intermix parcels and are by definition at-risk from catastrophic wildfire. Structures within the classic urban interface boundaries are at reduced risk with increasing distance from the urban interface boundary. To account for this all structures within 400 feet of the interface boundary were considered at-risk, and all structures greater than 400 feet from the interface boundary were considered to be at low risk and excluded from the calculation of values at-risk.

The floor area of structures at-risk from catastrophic fire where then multiplied by the reconstruction cost for of residential and commercial buildings for the Lake Tahoe Basin or Carson Valley. The following table shows the floor area at-risk from catastrophic fire in Douglas County. Figure 5-15 on the next page demonstrates the wildland fire interface parcels in Douglas County.

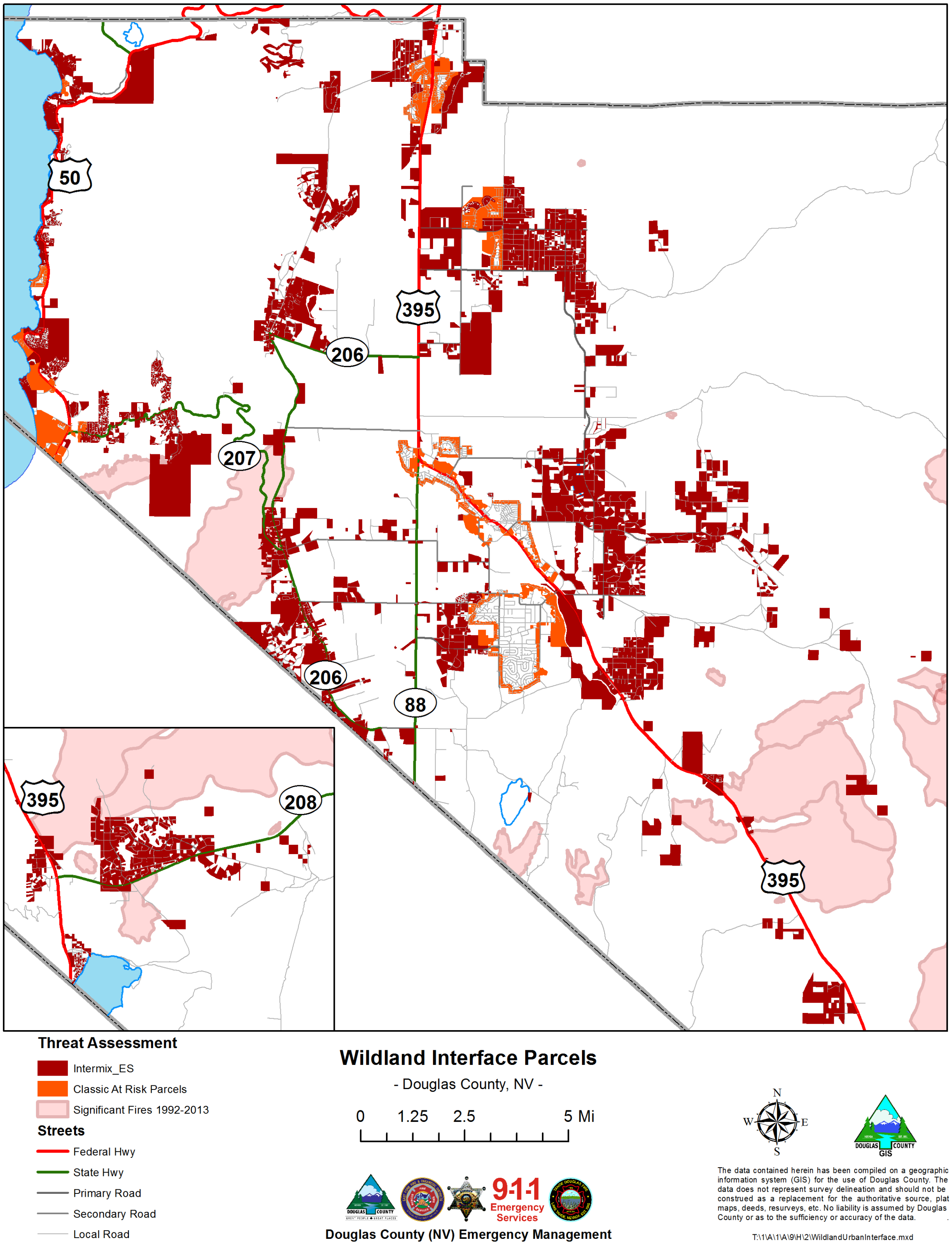
Table 5-15

Floor Area at Risk

Classic Interface Communities		
	Residential Floor Area	Commercial Floor Area
Tahoe	1,501,740	4,289,145
Valley	7,598,402	3,216,313
Total	**9,100,142**	**7,505,458**
Intermix Communities		
	Residential	Commercial
Tahoe	6,669,228	341,187
Valley	15,803,480	4,453,320
Total	**22,472,708**	**4,794,507**

Figure 5-15

Wildland Interface Parcels



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6.1 ASSET INVENTORY

Asset inventory is the first step of a vulnerability analysis. Assets within each community that may be affected by hazard events include population, residential and non-residential buildings, and critical facilities and infrastructure. Assets and insured values throughout the County are identified and discussed in detail below.

6.1.1 Population and Building Stock

Population data for the County was obtained from the NV State Demographer and verified from the 2010 U.S. Census and shown in Table 6-1. The Nevada State Demographer's Office maintains annual population estimates by county. Estimated numbers and replacement values for residential and nonresidential buildings, as shown in Table 6-1, were obtained from the Douglas County Assessor's Office Statistical Analysis data and Geographic Information Systems (GIS).

The residential buildings considered in this analysis include single-family dwellings, mobile homes, multi-family dwellings, temporary lodgings, institutional dormitory facilities, and nursing homes. Nonresidential buildings were also analyzed including commercial, industrial, agricultural, government, educational, and religious centers.

The HAZUS-MH 2009 run for earthquake by the Bureau of Mines & Geology, UNR, was reviewed the HAZUS-MH software presents a data limitation by which this software identifies nonresidential buildings by square footage resulting in some nonresidential buildings not being counted. Additionally, the County Assessor's Office supplied residential and non-residential costs as much higher than the HAZUS-MH software and it was determined by the Committee Chair to use the Assessor's values data from the Assessor's Office Statistical Analysis. The buildings' values were calculated by adding 20% to the net assessed value of buildings to get the replacement value unless otherwise noted. Un-reinforced masonry (URM) building information was obtained from the HAZUS-MH 2009 run for earthquake by the Bureau of Mines & Geology, UNR and Douglas County GIS.

Although the building count or value may not be precise, whether residential or nonresidential, this analysis will meet the intention of DMA 2000 by providing Douglas County residents with an accurate visual representation of their community's risk by hazard. This data is the most complete dataset available at the time and will be updated in future version of the HMP.

Table 6-1

Estimated Population and Building Inventory

Population		Residential Buildings		Nonresidential Buildings	
2010 Census Population Count	NV Demographer Projected 2018 Population	Total Building Count	Total Value of Buildings (in millions)	Total Building Count	Total Value of Buildings (in millions)
46,997	50,000	26,525	7,215	1,497	3,112

Source: *U.S. Census 2010 population data, http://censtats.census.gov/data/NV/05032510.pdf , State of Nevada Demographer, Douglas County Assessor's Office /Geographic Information Systems (2013)*

6.1.2 Critical Facilities and Infrastructure

A critical facility is defined as a public or private facility that provides essential products and services to the general public, such as preserving the quality of life in the County and fulfilling important public safety, emergency response, and disaster recovery functions. They include:

- 3 sheriff station
- 15 fire stations (career, volunteer and combination stations)
- 1 emergency operation center (EOC)
- 12 public primary and secondary schools
- 1 hospital w/emergency room & urgent care
- 2 urgent care facilities
- 3 communication facilities

Similar to critical facilities, critical infrastructure is defined as infrastructure that is essential to preserving the quality of life and safety in the County. Critical infrastructure, as referenced in the HAZUS-MH 2009 run, includes:

- 114 miles of State and Federal highways
- 1 airport facilities
- 29 bridges, including 12 County bridges
- 2,332 miles of pipe (utilities)

The County's critical facilities are listed in Table 6-2. Facilities vulnerable to hazardous events are shown in Figure 6-4.

Table 6-2

Critical Facilities and Infrastructure

Category	Type	Number	Estimated Value Per Structure/Mile (millions of $)
Critical Facilities	Sherriff Stations	3	24
	Fire Stations	15	17.5
	EOCs	1	1.5
	Public Primary and Secondary Schools	12	200
	Hospital w/Emergency Room	1	55
	Urgent Care Facilities	2	1.6
	Communication Facilities	3	.20
	State Owned Critical Buildings	2	25
	State and Federal Highways (miles)	114	777.6
Critical Infrastructure	Airport Facilities	1	65
	Bridges	29	16.8
	Utilities (Water, Waste Water, Gas, Electrical)	n/a	107.3

6.2 METHODOLOGY

A conservative exposure-level analysis was conducted to assess the risks of the identified hazards. Hazard areas were determined using information provided by the U.S. Seasonal Drought Monitor, EPA, HAZUS, Nevada Bureau of Mines and Geology, NWS and Douglas County GIS. This analysis is a simplified assessment of the potential effects of the hazard on values at risk without consideration of probability or level of damage.

Using GIS, the building footprints of critical facilities were compared to locations where hazards are likely to occur. If any portion of the critical facility fell within a hazard area, it was counted as impacted. Using census block level information, a spatial proportion was used to determine the percentage of the population and residential and nonresidential structures located where hazards are likely to occur. Census blocks that are completely within the boundary of the hazard area were determined to be vulnerable and were totaled by count. HAZUS-MH was used to determine the amount of linear assets, such as highways and pipelines, within a hazard area. The exposure analysis for linear assets was measured in miles. For drought, population was the only asset analyzed, as drought mainly affects people and agricultural lands. Agricultural lands values were not considered in this version of the HMP.

Replacement values or insurance coverage were developed for physical assets. These values were obtained from the Douglas County Assessor's Office, Community Development, GIS, and HAZUS-MH 2009 run. For facilities that did not have specific values per building in a multibuilding scenario (e.g., schools), the buildings were grouped together and assigned one value. For each physical asset located within a hazard area, exposure was calculated by assuming the worst-case scenario (that is, the asset would be completely destroyed and would have to be replaced). Finally, the aggregate exposure, in terms of replacement value or insurance coverage, for each category of structure or facility was 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 estimate of the number of potential injuries or deaths was prepared.

6.3 DATA LIMITATIONS & FUTURE DEVELOPMENT

The vulnerability estimates provided herein use the best data currently available, and the methodologies applied result in an approximation of risk. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their effects on the built environment, as well as approximations and simplifications that are necessary for a comprehensive analysis.

The resulting analysis was compiled to the highest degree possible with the hardware, software and data availability limitations discovered during plan preparation. HAZUS was able to determine the population and critical facilities within a given hazard area and from there a limited assessment was derived. In the situation of Drought & Epidemic, where structures would not usually be affected the term N/A (not applicable) is used.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings, and critical facilities and infrastructure to a hazard. It was beyond the scope of this HMP to develop a more detailed or comprehensive assessment of risk (including annualized losses, people injured or killed, shelter requirements, loss of facility/system function, and economic losses). Such impacts may be addressed with future updates of the HMP.

Future Development

An analysis of maximum development potential was prepared for the Douglas County Master Plan. The analysis included a review of existing vacant residential acreage, the existing residential zoning, and the maximum number of dwelling units that would be allowed under the current zoning. There are currently 9,250 acres of vacant residential zoning in the Carson Valley Community Plans. Based on existing zoning, the maximum housing units totaled 8,322. Based on the persons per household factor of 2.38 from the 2010 Census, the build out population for Douglas County is 66,803.

When examined by Community Plan, the greatest development potential exists in the Indian Hills Community Plans and the Towns of Minden and Gardnerville. The build out analysis showed that the population in the Indian Hills Community Plan could increase from 5,406 (2010 Census) to 9,010 based on current residential zoning. In the Minden and Gardnerville Community Plans, the total population could increase from the 8,619 to 14,235. The existing residential zoning will support an estimated increase of 19,806 persons in Douglas County, increasing the total population to 66,803. However, it is not expected that the County will reach this building out estimate before 2030. The average growth rate of 1.39% places the county population at 61,940 by the year 2030.

From 2010 to 2012, the population of Douglas County showed no change (46,997 to 46,996) based on the 2012 population estimates from the Census Bureau. However, current building permit statistics demonstrate increases in new development. Developers and individual property owners are submitting residential permits at a much higher rate, indicating a potentially higher growth rate for the next few years. The historical average population growth rate has been 1.39% (2000 to 2010) but this may be too conservative based on current development trends.

Building Permits

The most significant development projects have included the new Wal-Mart in Gardnerville, the new commercial development taking place at the Minden Gateway Center, and the new 30 unit affordable senior housing complex (Parkway Vista) in Gardnerville.

For Fiscal Year 2012-2013, there were 75 permits for new Single Family Dwellings, including 3 at Lake Tahoe. In addition, the permit for the new Parkway Vista affordable senior housing in Gardnerville (30 units) was issued in April. The total value of all single family dwelling permits for the fiscal year 2012-2013 was $25,556, 873, an increase of 118 % from Fiscal Year 2011-2012, which was $11,722,927. During Fiscal year 2011-2012, there were 38 permits for new Single Family Dwellings.

It is expected that population growth will continue to be concentrated in the Carson Valley (East Fork Township) portion of Douglas County and not in the Tahoe Basin (Tahoe Township).

6.4 EXPOSURE ANALYSIS

The requirements for a risk assessment, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Assessing Vulnerability, Overview

Assessing Vulnerability: Overview

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Element

- Does the new or updated plan include an overall summary description of the jurisdiction's vulnerability to each hazard?
- Does the new or updated plan address the impact of each hazard on the jurisdiction?

Source: FEMA 2008.

DMA 2000 Recommendations: Assessing Vulnerability, Identifying Structures
Assessing Vulnerability: Identifying Structures Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area. **Element** • Does the new or updated plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas? • Does the new or updated plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?
Source: FEMA 2008.

DMA 2000 Recommendations: Assessing Vulnerability, Estimating Potential Losses
Assessing Vulnerability: Estimating Potential Losses Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate. **Element** • Does the new or updated plan estimate potential dollar losses to vulnerable structures? • Does the new or updated plan reflect changes in development in loss estimates? • Does the new or updated plan describe the methodology used to prepare the estimate?
Source: FEMA 2008.

The results of the exposure analysis are summarized in Tables 6-3 and 6-4 and in the discussion below. The results in this exposure analysis were greatly affected by the hardware, software and data availability limitations described above.

Table 6-3

Potential Hazard Vulnerability Assessment – Population and Buildings

Hazard	Population[4]	Buildings			
		Residential		Nonresidential	
	Number	Number[3]	Value ($)[1]	Number[3]	Value ($)[1]
Total for Douglas County	46,997	26,525	7,215,071	1497	3,112,131
Drought	46,997	26,525	N/A	885	N/A
Earthquake – 100yr Magnitude 6.0[2]	46,997	2477	415,046.12	120	139,281.6
Epidemic	46,997	N/A	N/A	N/A	N/A
Flood - 100-Year Flood Zone	20,133	3,772	1,144,650	640	1,408,040
Severe Weather – High – 25% of population & .5% buildings	11749	108.07	18,108	4.42	5136
Seiche (tsunami)	2,409	1,449	441,258	144	849,279[5]
Wildland Fires	24,557	20,406	5,652,107	1,240	2,784,822[5]
Volcano/Ash	46,997	21,614	N/A	885	N/A

[1] Value = Estimated Replacement value (x1000) Data acquired from Douglas County Assessor's Office/County GIS

[2] Data acquired from Nevada Bureau of Mines and Geology Open-file Report 09-8, HAZUS-MH

[3] Data acquired from Douglas County Assessor's Office/County GIS.

[4] Data source Nevada State Demographer

[5] Parcels included buildings of fire resistive construction in Stateline casino core.

N/A = Not Applicable

Table 6-4

Potential Hazard Vulnerability Assessment – Critical Facilities

	Sheriff Station (1 facility)		Fire Station/EOC Ambulance (15 facilities)		Hospital/Urgent Care (3 facilities)		Schools (11 facilities)		Communications (6 facilities)		Water / Sewer (2 facilities)	
Hazard	**Number**	**Value ($)[1]**	**Number**	**Value ($)[1]**	**Number**	**Value ($)[1]**	**Number**	**Value ($)[1]**	**Number**	**Value ($)[1]**	**Number**	**Value ($)[1]**
Drought	0	0	0	0	0	0	0	0	0	0	0	0
Earthquake - 100yr Magnitude 6.0 [2]	1	8,000	3	3,480	1	55,000	2	334,0 00	3	200	2	109,000
Epidemic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flood - 100-Year Flood Zone	0	0	3	3,500	1	8,000	0	0	0	0	0	0
Seiche	0	0	1	433	0	0	0	0	0	0	247	N/A
Severe Weather	0	0	0	0	1	250	0	0	1	300	0	0
Wildland Fire	0	0	0	0	1	100,00 0	1	50,00 0	1	1,000	1	23,000
Volcano/Ash	0	0	0	0	1	200	12	500	0	0	2	200
Total	**1**		**3**		**5**		**15**		**5**		**3**	

[1] Value = Estimated Market value (x1000)

[2] Data acquired from Nevada Bureau of Mines and Geology Open-file Report 09-8, HAZUS-MH with additions estimated by Planning Committee

N/A = Not Applicable or Not Available

6.4.1 Drought

According to the U.S. Seasonal Drought Monitor, the entire area of the County is at equal risk to a drought event. The entire population of Douglas County, 46,997, may be affected by drought however building and critical facilities would just be limited in their use but would not be damaged.

6.4.2 Earthquakes

Using HAZUS-MH earthquake perimeters of a 100-year 6.0 magnitude event, 11.5% of the buildings will be at least moderately damaged. This includes the addition of all structures including sheds, carports, detached garages and other auxiliary buildings. The 11.5 % estimated damages sustained from moderate to severe could be up to 2477 residential buildings (worth $41.5 million), and 120 non-residential buildings (worth $13.9 million) all within close proximity to fault lines.

Although the HAZUS run indicated that only one school would be affected, the Planning Committee determined that due to the proximity of faults that numerous critical facilities are at risk to perceived severe shaking. They include: One sheriff station valued at $8M , three first-responder buildings (Fire) valued at $3.5M; one hospital valued at $55M; two schools valued at $334M , three communication facilities valued at $200K , and two water/sewer facilities valued at $109M. The entire population of Douglas County is considered impacted by an earthquake due to potential road and utility damage, critical infrastructure damage leading to reduced services, in addition to building damage.

The percentage of building damage (11.5 %) was obtained from the HAZUS-MH run dated August 14, 2009 from the Bureau of Mines and Geology. Information on building numbers and values were obtained from "Earthquake Hazards and Seismic Risk Mitigation in Douglas County" by Dr. Craig M dePolo, Nevada Bureau of Mines and Geology, University of Nevada, Reno, and the Nevada State Demographer.

The Bureau of Mines and Geology have been conducting a study to inventory the unreinforced masonry buildings within the State. During the writing of this update and after County GIS provided parcel and assessor data, the Bureau'data was made available. The report showed that 237 commercial buildings, 1,363,285 sq ft, and 439 residential buildings (750K sq ft) were constructed of unreinforced masonry. These buildings would have significantly more damage during an earthquake than other buildings. Unreinforced masonry buildings accounted for 750K sq ft or $135 M (using $180 /sq ft replacement value) in residential buildings and 1,363,285K sq ft or $310M (using $228/sq ft replacement value) in commercial buildings. The data from the report can be used by the County to identify and target structures for reinforcement. UNR will be using the data to up-grade information for the HAZUS runs. County GIS gathered data necessary to identify commercial building square footage from Assessor's data and Nevada Bureau of Mines and Geology study (Price and others, 2012).

6.4.3 Epidemics

Epidemic was included as a possible hazard to the citizens of Douglas County . The entire population of Douglas may be affected by the illness however building and critical facilities would just be limited in their use but would not be damaged.

6.4.4 Floods

Digital FIRMs were used for the Douglas County area to estimate at risk population and buildings. Within the 100-year floodplain area, the population at risk is 20,133 or 43% of the population. Within Douglas County, the risk posed by the 100-year flood is high with 3,772 homes within or immediately adjacent to the 100-year floodplain. The exposure to the 3,772 residential buildings are $1.1 billion, exposure to the 640 nonresidential buildings is $1.4 billion, which includes exposure to the following critical facilities – 3 fire stations, ($3.5 million), two urgent care facilities and one hospital ($8 million). The affected population, building inventories, and values were calculated from the State Demographer and Douglas County Assessor's office through Douglas County GIS. Historically, there have been five repetitive loss properties (one has been mitigated) and no severe repetitive loss structures (as defined by NFIP) within the 100-year flood plain. A current change in federal definition has removed all repetitive loss properties in the county.

6.4.5 Seiche (tsunami)

Using Douglas County GIS and historical data from the University of California at Davis' Tahoe Environmental Research Center, a map contour forty feet above Lake Tahoe's water rim was identified as the water height and additional probable wave action of a Lake Tahoe tsunami and subsequent seiche. This elevation was determined by a ten-mile landslide, triggered by an earthquake, that created McKinney Bay on the West Shore thousands of years ago. The population at risk 2,409 residents, not including visitors. Residential losses would be 1,449 homes at a value of $441 million. Non-residential losses would be 144 buildings at a value of $850 million. Additionally, one fire station ($433 K) and 247 water and sewer utility components would be destroyed (value unknown). The affected population, building inventories, and replacement values were calculated from the State Demographer, Douglas County Assessor's office through Douglas County GIS and HAZUS-MH run.

6.4.6 Severe Weather

Using winter storm data provided by the NWS, the risks posed by winter storms were calculated for the County . All the population and buildings are within the severe winter storm hazard area however occupied homes and buildings within Douglas County are built to withstand a degree of severe weather. The Planning Committee determined that a severe winter storm or wind event may affect 25% of population (due to road closures) and .5% of the buildings which are 11,749 people, 108 residential buildings (worth $18.1 million), four nonresidential buildings (worth $5.3 million) which include two critical facilities (worth $750 K). The affected population, building inventories, and values were calculated from the Nevada State Demographer and the County's Assessors office through Douglas County GIS.

6.4.7 Volcanic Activity

The volcano risk is mainly due to ash fall out from a volcano in the Inyo/Mammoth, CA area to the south. Although the total population (46,997) is at risk to illness from ash in the air, the damage to buildings is limited to ventilation systems which may be contaminated from the ash and need replacement.

6.4.8 Wildland Fires

Using Douglas County GIS, areas and populations threatened by wildland fire were identified and overlaid with population and parcel maps. High density areas, such as the Gardnerville Ranchos, with wildland exposure primarily on the perimeter were classified as "interface" communities. The wildland fire threat was calculated to be 400 feet within the perimeter of these areas. Other threatened structures were considered "intermix" areas with no distance limitation. The population at risk is 24,557 or 52% of the total County population. 20,406 homes are considered threatened at a value of $5.6 billion. 1240 non-residential buildings are threatened at a value of $2.8 billion. The affected population, building inventories, and replacement values were calculated from the Nevada State Demographer and the County's Assessors office through Douglas County GIS.

6.5 REPETITIVE LOSS PROPERTIES

The requirements for a risk assessment, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Assessing Vulnerability, Addressing Repetitive-Loss Properties

Assessing Vulnerability: Addressing Repetitive Loss Properties
Requirement §201.6(c)(2)(ii): [The risk assessment **must** also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.

Element

- Does the updated plan document how the planning team reviewed and analyzed this section of the plan and whether this section was revised as part of the update process?
- Does the new or updated plan describe vulnerability in terms of the types and numbers of repetitive loss properties located in the identified hazard areas?

Source: FEMA 2008.

A current change in federal definition has removed all repetitive loss properties in Douglas County, though historically, the County has had five repetitive loss properties (one has been mitigated).

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While not required by the DMA 2000, an important component of a hazard mitigation plan is a review of the County's resources to identify, evaluate, and enhance the capacity of those resources to mitigate the effects of hazards. This section evaluates Douglas County's resources in three areas: legal and regulatory, administrative and technical, and financial, and assesses capabilities to implement current and future hazard mitigation actions.

7.1 LEGAL AND REGULATORY CAPABILITIES

Douglas County currently supports hazard mitigation through its regulations, plans, and programs. The Douglas County Building Code outlines hazard mitigation-related ordinances. Additionally, the Douglas County Master Plan identifies goals, objectives, and actions for natural hazards, including floods, drought, and earthquakes. In addition to policies and regulations, the County carries out hazard mitigation activities by participating in the National Flood Insurance Program (NFIP) see section 7.4.1.

The following table, Table 7-1, summarizes the County's hazard mitigation legal and regulatory capabilities.

Table 7-1

Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Title	Effect on Hazard Mitigation
Plans	Master Plan	Updated 2011. Lists goals for coordination, neighborhood design, public awareness, floodplain & hazard area development, and geologic hazards to guide land use planning.
	Capital Improvements Plan	Provides earthquake & flood identification.
	Carson River Watershed Regional Floodplain Management Plan	Manages economic development without sacrificing floodplain and river form and function, ensures public safety and other functions. This plan includes counties in Nevada and California along the Carson River.
	Economic Development Plan	Business Development.
	Emergency Response Plan	Provides emergency response.
	Master Sewer and Water Plan	Provides guidelines for sewer and water infrastructure needs.
	Open Space and Agricultural Lands Preservation Implementation Plan	Provides guidelines for open space and agricultural lands, including flood mitigation.
Programs	National Flood Insurance Program	Douglas County adopts and enforces a floodplain management ordinance to reduce future flood damage. In exchange, the NFIP makes Federally backed flood insurance available to homeowners, renters, and business owners.
Ordinances and Policies	County Building Code (IBC, IRC 2006)	Affects the Consolidated Development Code (Title 20), Master Plan, Land Use Plan Element. Provides regulations to reduce hazard impact.
	Zoning Ordinances	
	Subdivision ordinance or regulations	
	Development Standards	

Table 7-1

Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Title	Effect on Hazard Mitigation
	Special purpose ordinances	Floodplain management, storm water management, hillside or steep slope ordinances, wildfire ordinances.

7.2 ADMINISTRATIVE AND TECHNICAL CAPABILITIES

The administrative and technical capability assessment identifies the staff and personnel resources available within the County to engage in mitigation planning and carry out mitigation projects. The administrative and technical capabilities of the County are listed in Table 7-2.

Table 7-2

Administrative and Technical Resources for Hazard Mitigation

Staff/Personnel Resources	Department / Agency
Planner(s) or engineer(s) with knowledge of land development and land management practices	Community Development, Public Works
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Community Development, Fire Districts
Planner(s) or engineer(s) with an understanding of manmade or natural hazards	Community Development, Fire Districts
Staff with education or expertise to assess the community's vulnerability to hazards	Community Development, Fire, Public Works
Floodplain Manager	Public Works
Personnel skilled in GIS and/or HAZUS-MH	GIS ,Community Development, Public Works
Scientist familiar with the hazards of the community	UNR, Bureau of Mines & Geology for Earthquakes, seismology lab
Emergency Services	Fire Districts / Emergency Management, Sheriff
Finance (Purchasing) – Fiscal Management	Controller, purchasing
Public Information Officers, Planner(s)	Sheriff's Office, Fire Districts, County Executive Staff

7.3 FINANCIAL CAPABILITIES

The fiscal capability assessment lists the specific financial and budgetary tools that are available to the County for hazard mitigation activities. These capabilities, which are listed in Table 6-3, include both local and Federal entitlements.

Table 7-3

Financial Resources for Hazard Mitigation

Financial Resources	Effect on Hazard Mitigation
Local	
Authority to levy taxes for specific purposes	Yes. Upon approval of the Douglas County Commission, staying within the stipulations set forth in the Nevada Revised Statues.
Capital Improvement Plans and Impact Fees	Assigns impact development fees to finance fire and flood control capital improvement programs.
Community Development Block Grants	Yes. Subject to grant from Fed/State.
Incur debt through general obligation bonds	Yes. Upon voter approval, staying within the stipulations set forth in the Nevada Revised Statues.
Incur debt through special tax and revenue bonds	Yes. Upon voter approval, staying within the stipulations set forth in the Nevada Revised Statues.
Incur debt through private activity bonds	Yes. Upon voter approval, staying within the stipulations set forth in the Nevada Revised Statues.
Withhold spending in hazard-prone areas	Yes.
State	
Question #1 State Bond	Funding for Parks which can include re-vegetation.
Federal	
FEMA Hazard Mitigation Project Grants (HMPG) and Pre-Disaster Mitigation (PDM) grants	Provides technical and financial assistance for cost-effective pre-disaster and post-disaster mitigation activities that reduce injuries, loss of life, and damage and destruction of property.
FEMA Flood Mitigation Grant Program (FMA)	Mitigate repetitively flooded structures and infrastructure.
USFA Assistance to Firefighters Grant (AFG) Program	Provide equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire.
FEMA/DHA Homeland Security Preparedness Technical Assistance Program (HSPTAP)	Build and sustain preparedness technical assistance activities in support of the four homeland security mission areas (prevention, protection, response, recovery) and homeland security program management.
US HUD Community Block Grant Program Entitlement Communities Grants	Acquisition of real property, relocation and demolition, rehabilitation of residential and non-residential structures, construction of public facilities and improvements, such as water and sewer facilities, streets, neighborhood centers, and the conversion of school buildings for eligible purposes.
EPA Community Action for a Renewed Environment (CARE)	Through financial and technical assistance offers an innovative way for a community to organize and take action to reduce toxic pollution (i.e., storm water) in its local environment. Through CARE, a community creates a partnership that implements solutions to reduce releases of toxic pollutants and minimize people's exposure to them.
EPA Clean Water State Revolving Fund (CWSRF)	A loan program that provides low-cost financing to eligible entities within state and tribal lands for water quality projects, including all types of non-point source, watershed protection or restoration, estuary management projects, and more traditional municipal wastewater treatment projects.
CDC Public Health Emergency Preparedness (PHEP) Cooperative Agreement.	Funds are intended to upgrade state and local public health jurisdictions' preparedness and response to bioterrorism, outbreaks of infectious diseases, and other public health threats and emergencies.

7.4 CURRENT MITIGATION CAPABILITIES & ANALYSIS

Douglas County's current mitigation programs, projects, and plans, as shown in Table 7-4, are listed as follows.

Table 7-4

Douglas County Local Mitigation Capability Assessment

Agency Name (Mission/ Function)	**Programs, Plans Policies, Regulations, Funding, or Practices**	**Point of Contact Name and Phone**	**Effect on Loss Reduction**			**Comments**
			Support	Facilitate	Hinder	
Community Development	Code Enforcement, Economic Development	Mimi Moss 775-782-6230	✓	✓		Engineering and planning support
	Roads, water, flood plain management, sewer, capital projects, building maintenance		✓	✓		Engineering, detailed knowledge of infrastructure
Emergency Management Fire Districts	Emergency Management, Public Safety, fuels mitigation, public education, mitigation plan	Tod Carlini, East Fork FPD 775-782-9040 Tod Carlini, East Fork FPD 775-782-9040 Ben Sharit, Tahoe-Douglas FPD 775-586-1572	✓ ✓	✓ ✓		Familiar w/fire grants; detailed knowledge of vulnerability Familiar w/fire grants; detailed knowledge of vulnerability
School District	Identify and implement mitigation actions for school property	Lisa Noonan 782-5134	✓	✓		Familiar w/school district infrastructure
Sherriff's Office	Public Safety	Ron Pierini 782-9935	✓	✓		Familiar w/terrorist mitigation
Community Health Nurse	Health	Tamara Baumann 775-782-9825 775-283-7235	✓	✓		Familiar w/ epidemic and CDC grants, health capability

The programs, plan, policies and regulations listed above provide a basic framework for mitigation projects. These programs cover Douglas County's infrastructure and program needs and are effective, however the funding for mitigation projects may not always be available.

Douglas County has strong legal, administrative and financial capabilities in relation to other counties within Nevada. Douglas County is able to enforce the International Building Code & International Fire Code, Building Code Title 12.09 and 15.05 which restrict building within a floodway and is a member of the NFIP, in addition to programs for public safety, health and human services, Community Development and the school district. These programs are run by trained Douglas County staff, who are provided the resources to implement and promote the programs. Future implementation may be constrained by budget reduction in the next few years due to the possibility of continuing recession.

The County has participated in the Community Rating System (CRS) since 1986. Participation in both programs has been continuous since initiation. The CRS is a voluntary program for the NFIP-participating communities. The goals of the CRS are to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance. Douglas County is rated a CRS Class 6 community, one of only two counties in Nevada to have this rating.

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The following provides an overview of the four-step process for preparing a mitigation strategy: developing mitigation goals and objectives, identifying and analyzing potential actions, prioritizing mitigation actions, and implementing an action plan.

8.1 MITIGATION GOALS AND OBJECTIVES

The requirements for the local hazard mitigation goals, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy
Local Hazard Mitigation Goals Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards. **Element** • Does the new or updated plan include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards? *Source: FEMA, March 2008.*

The previous plan's goals were as follows:

Goal 1 – Promote disaster-resistant development

Goal 2 – Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters.

Goal 3 - Reduce the possibility of damage and losses due to natural hazards

Using the 2006, Hazard Mitigation Plan Goals, as a starting point, local planning documents as guidelines and the State's requested format, the lead committee reorganized the 3 long term goals and developed goals to reduce or avoid long-term vulnerabilities to the identified hazards (Table 8-1).

The lead committee determined the 5 highest rated hazards would have a goal. For the lowest rated hazards with no previous occurrence, the lead committee agreed the benefit versus the cost would be prohibitive for project actions, however, actions under current Goals 1 and 2 can be used to advance hazard mitigation for these hazards as well as all the hazards profiled in Section 5.

Mitigation goals are defined as general guidelines that explain what a community wants to achieve in terms of hazard and loss prevention. Goal statements are typically long-range, policy-oriented statements representing community-wide visions.

Table 8-1

Mitigation Goals

Goal Number	Goal Description
1	Promote increased and ongoing Douglas County involvement in hazard-mitigation planning and projects.
2	Build and support local capacity to enable the public to prepare for, respond to, and recover form disasters
3	Reduce the possibility of damage and losses due to earthquakes
4	Reduce the possibility of threat to life and losses due to epidemic
5	Reduce the possibility of damage and losses due to floods
6	Reduce the possibility of damage and losses due to severe weather
7	Reduce the possibility of damage and losses due to wildland fires

8.2 IDENTIFYING MITIGATION ACTIONS

The requirements for the identification and analysis of mitigation actions, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy

Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Element

- Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?
- Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure?
- Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?
- Does the mitigation strategy identify actions related to the participation in and continued compliance with the NFIP?

Source: FEMA, March 2008.

During July 2013, the Planning Lead met with Planning Committee members with expertise and reviewed the updated hazard profiles in Section 5 as a basis for developing mitigation actions. The group also reviewed the previous plan goals and actions, determined their current status and considered them while formulating new actions. A table of those goals, actions and current status is contained in Appendix G. Many future actions in the 2006 HMP were not included because the action was not considered mitigation by definition or are repetitive and are now addressed as a single action in this plan. The balance are clarified through discussions and were re-instated or revised. Some of the hazards in the previous plan were eliminated and some hazards were added by the planning Committee in the new plan. These actions have no carry-over from plan to plan.

Mitigation actions are usually grouped into six broad categories: prevention, property protection, public education and awareness, natural resource protection, emergency services, and structural projects. As such, Table 8-2 was developed and sent out via e-mail to the committee members for their consideration and comments. A meeting with the Planning Committee was held to update, revise, add, and delete goals, and action items. Comments and suggestions were incorporated in the table. The table details all the actions considered important to hazard mitigation by the committee.

Although mitigation planning is fairly new to Douglas County, it has embraced the concept of mitigation policies, programs, and capabilities. The 2011 Douglas County Master Plan update included considerations for hazard mitigation. The 2006 International Building Code revisions were adopted. Another revision is in process of adoption. In partnership with NDOT, Highway 395 flood mitigation projects completed and alternative funding sources sought. Applications have been submitted, though denied, for the highway 88 flood mitigation project. Several public facilities obtained equipment to provide continuity of operations to critical public utilities and infrastructure. Numerous public awareness programs for earthquake, wildland fire, evacuation and mitigation programs in general have been provided.

The Tahoe Douglas FPD also has an active defensible space inspection program. Property owners can call the Tahoe Douglas FPD and obtain a defensible space inspection and get site specific advice about creating defensible space. Additionally the Tahoe Douglas FPD conducts blanket inspections one of one quarter of all of the residential parcels in the district on a yearly basis. The results of the curbside inspections are then mailed to the property owner along with information on how to comply with defensible space requirements. The Tahoe Douglas FPD is also active in obtaining grant funding for defensible space implementation and in providing homeowners with free residential chipping services. When grants are available, homeowners can obtain up to 50 percent of the cost of an initial defensible treatment. This program motivates homeowners to take action and subsidizes what can be the very high cost of the initial treatment of a parcel. Homeowners can also call the Tahoe Douglas FPD and schedule free residential chipping services. The Tahoe Douglas FPD will chip slash from cut trees and brush and haul the chip from the parcel for any homeowner in the fire district. Finally, the State of Nevada has adopted the defensible space requirements in the International Wildland Urban Interface Code (2009 Ed.). Currently both fire districts are actively working to educate property owners prior to enforcement of the WUI Code.

The lesson learned in this update is that hazard mitigation actions have been implemented. More mitigation has been done than realized at the beginning of the planning effort. Actions can be specific projects as well as more broad based programs so that over the course of five years additional projects can be implemented.

Table 8-2 Mitigation Goals and Potential Actions

Goals	Action	New or Existing **Buildings**	Description
Goal 1: Promote increased and ongoing Douglas County involvement in hazard-mitigation planning and projects	1.A	N	Update the Master Plan, Open Space and Agricultural Lands Preservation Implementation Plan and County Title 20 to be consistent with the hazard and hazard area maps and implementation strategies developed in the HMP every 10 years. Review & update ordinances & code every 3 years.
	1.B	N/E	Identify & educate Douglas County personnel on high hazard areas.
	1.C	N/E	Coordinate existing Geographic Information Systems (GIS) capabilities to identify hazards through the County.
	1.D	N/E	Develop the data sets that are necessary to test hazard scenarios and mitigation tools, including HAZUS-MH.
	1.E	N/E	Utilize the Internet as a communication tool, as well as an education tool.
	1.F	N	Develop county building codes and ordinances that protect people and structures from drought, earthquake, flood, severe weather & wildfire.
Goal 2: Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters	2.A	E	Develop emergency evacuation programs for neighborhoods in flood prone areas and wildland fire areas by increasing the public awareness about evacuation programs.
	2.B	N/E	Annually review the County's Emergency Operations Plan and identify needed plan updates.
	2.C	E	Conduct a minimum of one disaster exercise each year
	2.D		Establish a budget and identify funding sources for mitigation outreach.
	2.E		Work with school districts to develop a public outreach campaign that teaches children how to avoid danger and behave during an emergency.
	2.F	N/E	Utilize Business for Innovative Climate Change (BICEP) to increase awareness and knowledge of hazard mitigation and encourage businesses to develop/implement hazard mitigation actions.
	2.G	N/E	Prepare, develop, & distribute appropriate public information about hazard mitigation programs and projects at County - sponsored events and on the County's /Fire Districts' websites.

Table 8-2 Mitigation Goals and Potential Actions

Goals	Action	New or Existing **Buildings**	Description
Goal 3: ***Reduce the possibility of damage and losses due to earthquakes***			
	3.A	E	Survey and assess earthquake vulnerabilities of buildings and facilities, including critical facilities, schools, public buildings, high occupancy buildings, historical buildings, and utilities.
	3.B	E	Ground truth the unreinforced masonry building list developed by the State.
	3.C	E	Mitigate the earthquake vulnerabilities of buildings and facilities, including critical facilities, schools, public buildings, high occupancy buildings, historical buildings, and utilities.
	3.D	E	Enforce the seismic provisions in building codes.
	3.E	E	Create an earthquake awareness and mitigation website that links to the Nevada Shakeout page, includes information on mitigating hazardous building contents, and promotes personal and homeowner mitigation of earthquake risks.
	3.F	N	Create late Quaternary fault, potential liquefaction, and potential seismically induced landscape maps.
	3.G	E	Encourage the purchase of earthquake insurance.
Goal 4: ***Reduce the possibility of threat to life and losses due to epidemic***	4.A		Update Mass Illness Plan and integrate with local Hazard Mitigation Plan.
	4.B		Create & implement a training and exercise program relative to epidemics.
	4.C		Prepare by acquiring/storing needed medical equipment.

Table 8-2 Mitigation Goals and Potential Actions

Goals	Action	New or Existing **Buildings**	Description
Goal 5: ***Reduce the possibility of damage and losses due to floods***	5.A	N/E	Add rain gauges to existing warning system.
	5.B	N	Adopt or update policies that discourage growth in flood-prone areas.
	5.C	N/E	Complete FEMA floodplain mapping of Johnson Lane, Buckbrush, and Sunrise Washes.
	5.D	N/E	Complete FEMA floodplain mapping of the entire Carson River from Alpine County to Churchill County.
	5.E	N/E	Identify, acquire and develop locations for upstream regional detention basins (Ruhenstroth, Pine Nut, Buckeye, Buckbrush, and Calle Hermosa).
	5.F	N/E	Initiate State Route 88 culvert expansion at Mottsville Lane, Cottonwood Slough and Rocky Slough.
	5.G	N/E	Provide emergency access to homes east of 395. (Buckeye, Zerolene, Lucerne or Gilman Road).
	5.H	N/E	Initiate park ditch improvements.
	5.I	N/E	Replace at grade dip sections with culverts (30 locations).
	5.J	N/E	Initiate Johnson Lane ditch expansion and culvert replacement.
	5.K	N/E	Education of public regarding flood hazards and damage potential.
	5.L	N	Continue to strictly enforce the County's building code Title 20, Open Space Plan and Master Development Plan.
	5.M	E	Evaluate the new FEMA criteria for repetitive loss properties within the County.
Goal 6: ***Reduce the***	6.A	E	In areas at risk to severe weather, retrofit public buildings to withstand snow loads and severe winds to prevent roof collapse/damage.

Table 8-2 Mitigation Goals and Potential Actions

Goals	Action	New or Existing **Buildings**	Description
possibility of damage and losses due to Severe Weather	6.B	N/E	Develop a storm water management plan for snow melt.
Goal 7: ***Reduce the possibility of damage and losses due to wildland fires***	7.A	N/E	Adopt the International Wildland Urban Interface Code (IWUI) including ignition resistant building construction provisions.
	7.B	E	Develop and implement public education program regarding the requirements of IWUI Code and defensible space best practices.
	7.C	E	Develop/continue an inspection program to enforce the defensible space requirements of the IWUI Code.
	7.D	E	Develop/continue curb-side dead tree and weed removal pick-up program. Continue curbside chipping programs. Continue community biomass collection point programs.
	7.E	N/E	Work with the Nevada Division of Forestry, Nevada State Lands, the Bureau of Land Management and U.S. Forest Service to implement fuels reduction projects on state and federal lands in and around communities.
	7.F	E	Implement fuels reduction projects on private lands as identified in the CWPP. Mitigation projects should consist of both fuel breaks and defensible space based upon site-specific conditions.
	7.G	N/E	Retrofit buildings in the wildland urban interface with

Table 8-2 Mitigation Goals and Potential Actions

Goals	Action	New or Existing **Buildings**	Description
			non-combustible roofing materials.
	7.H	N/E	Review, update and enforce the Master Plan, Open Space Plan and building codes relative to defensible space requirements for new development.

8.3 NATIONAL FLOOD INSURANCE PROGRAM (NFIP) COMPLIANCE

DMA 2000 Requirements: Mitigation Strategy – National Flood Insurance Program

National Flood Insurance Program (NFIP) Compliance)
Requirement: §201.6(c)(3)(iii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.
Element

- Does the updated plan document how the planning team reviewed and analyzed this section of the plan and whether this section was revised as part of the update process?
- Does the new or updated plan describe the jurisdiction(s) participation in the NFIP?)
- Does the mitigation strategy identify, analyze and prioritize actions related to continued compliance with the NFIP?

Source: FEMA, March 2008.

Douglas County has identified special flood-hazard areas and entered the National Flood Insurance Program (NFIP) on January 4, 1975 under the Emergency Program and then on March 28, 1980 under the regular program. The first Flood Insurance Rate Maps (FIRMs) for Douglas County were dated March 28, 1980. The most recent FIRMs are dated January 20, 2010. The County is covered by 37 published FIRM panels. According to the State of Nevada Community Assistance Visit (CAV) findings from February 2012, there are currently 1,077 flood insurance policies in Douglas County totaling $287,798,100 in coverage. There have been 117 losses in Douglas County totaling $2,943,995 in paid losses.

The County has participated in the Community Rating System (CRS) since 1986. Participation in both programs has been continuous since initiation. The CRS is a voluntary program for the NFIP-participating communities. The goals of the CRS are to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance. Douglas County is rated a CRS Class 6 community, one of only two counties in Nevada to have this rating. To support its continued voluntary participation in the CRS of the NFIP, Douglas County has outlined mitigation actions listed under goals 5 and 6 detailed in Table 8-3, Mitigation Goals and Potential Actions. County Code Title 20 12.09 and 15.05 restricts future building within a special flood hazard area.

8.4 EVALUATING AND PRIORITIZING MITIGATION ACTION

The requirements for the evaluation and implementation of mitigation actions, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions

Implementation of Mitigation Actions
Requirement: §201.6(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Element

- Does the mitigation strategy include how the actions are prioritized? (For example, is there a discussion of the process and criteria used?)
- Does the mitigation strategy address how the actions will be implemented and administered? (For example, does it identify the responsible department, existing and potential resources, and timeframe?)
- Does the prioritization process include an emphasis on the use of a cost-benefit review (see page 3-36 of *Multi-Hazard Mitigation Planning Guidance*) to maximize benefits?

Source: FEMA, March 2008.

The mitigation actions were finalized during the Planning Committee meeting on July 25, 2013. At this time the Planning Committee evaluated and prioritized each of the actions. To complete this task, the Planning Committee completed the STAPLE+E evaluation criteria using rankings of one for lowest and five for highest priority, acceptance, feasibility etc. The rankings for each action were totaled and used as a starting point by the committee. See Table 8-3 for the evaluation criteria.

Table 8-3

STAPLE+E Evaluation Criteria for Mitigation Actions

Evaluation Category	Discussion "It is important to consider…"	Considerations
Social	The public support for the overall mitigation strategy and specific mitigation actions.	Community acceptance; adversely affects population
Technical	If the mitigation action is technically feasible and if it is the whole or partial solution.	Technical feasibility; Long-term solutions; Secondary impacts
Administrative	If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.	Staffing: Funding allocation; Maintenance/operations
Political	What the community and its members feel about issues related to the environment, economic development, safety, and emergency management.	Political support; Local champion; Public support
Legal	Whether the community has the legal authority to implement the action, or whether the community must pass new	Local, State, and Federal authority; Potential legal challenge

Table 8-3

STAPLE+E Evaluation Criteria for Mitigation Actions

Evaluation Category	Discussion "It is important to consider…"	Considerations
	regulations.	
Economic	If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete a FEMA Benefit Cost Analysis.	Benefit/cost of action; Contributes to other economic goals; Outside funding required; FEMA Benefit Cost Analysis
Environmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community.	Effect on local flora and fauna; Consistent with community environmental goals; Consistent with local, State and Federal laws

Upon review by the Planning Committee, mitigation actions were selected for Douglas County that best fulfill the goals of the HMP and were appropriate and feasible to implement during the 5-year lifespan of this version of the HMP. In reviewing the actions the Planning Committee considered the following:

Actions that strengthen, elevate, relocate, or otherwise improve buildings, infrastructure, or other facilities to enhance their ability to withstand the damaging impacts of future disasters

Actions in which the benefits (which are the reduction in expected future damages and losses) are greater than the costs considered as necessary to implement the specific action

Actions that either address multi-hazard scenarios or address a hazard that present the greatest risk to the jurisdiction

The Planning Committee used the Staple+E results as a starting point and then through discussion and consensus made adjustments to include actions that were considered a high, moderate and low priority to the County. These are shown in Table 8-4.

8.5 IMPLEMENTING A MITIGATION ACTION PLAN

The Mitigation Action Plan Matrix which was prepared detailing how the overall benefit-cost were taken into consideration and how each mitigation action will be implemented and administered. This matrix is Table 8-4.

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
1.A	Update Master Plan, Open Space and Agricultural Lands Preservation Implementation Plan and County Title 20 to be consistent with the hazard area maps and implementation strategies developed in the HMP every 10 years. Review and update ordinances and codes every 3 years.	Community Development	Local General Fund	2 Years	Protection of lives due to better infrastructure and building codes.	High
1.B	Identify & educate Douglas County personnel on high hazard areas.	Planning Committee/ Emergency Mgmt.	Local General Fund	18 months	Provide information for planning & Public Works project to protect lives and property.	High
1.C	Coordinate existing GIS capabilities to ID hazards through the County.	Community Development, Technology Services	Local General Fund	Ongoing	Provide information to agencies in their efforts to protect lives and property.	High
1.D	Develop the data sets that are necessary to test hazard scenarios and mitigation tools, including HAZUS MH.	Emergency Management	UNR, HMGP	Ongoing	Provide information to agencies in their efforts to protect lives and property.	Moderate
1.E	Utilize the Internet as a communication tool, as well as an education tool.	Emergency Management	Local General Fund	Ongoing	Provide information to the community in their effort to protect lives and property.	High
1.F	Develop County building codes and ordinances that protect people and structures from drought, earthquake, flood, severe weather & wildfire.	Community Development	Local General Fund	Ongoing	Protection of lives due to better infrastructure and building codes.	High

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
2.A.	Develop emergency evacuation programs for neighborhoods in flood prone & wildland fire areas by increasing the public awareness about evacuation programs.	Community Development / Emergency Management	EMPG, SERC, USEPA, NDEP, NDCNR, Utility Service Charge	18-24 months	Protection of lives due to pre-planning.	High
2.B	Annually review the County's EOP & identify needed plan updates.	Emergency Management	HMGP, PDM, SERC, EMPG, USEPA, NDEP, NDCNR; DHS, Local General Fund	Ongoing	Protection of lives and property due to pre-planning.	High
2.C	Conduct minimum of one disaster exercise each year.	Emergency Management	EMPG, SERC, USEPA, NDEP, NDCNR, Local General Fund	Ongoing	Protection of lives and property due to pre-planning.	High
2.D	Establish a budget and identify funding sources for mitigation outreach.	Emergency Management	EMPG, HMGP, NV Health & Human Services, CDC, USFS	18-24 Months	Protection of lives & property due to awareness.	Moderate
2.E	Work with school districts to develop a public outreach campaign that teaches children how to avoid danger and behave during an emergency.	Emergency Management	EMPG, HMGP, NV Health & Human Services, CDC, USFS	18-24 Months	Protection of lives & property due to awareness.	Moderate

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
2.F	Utilize Business for Innovative Climate Change (BICEP) to increase awareness and knowledge of hazard mitigation and encourage businesses to develop/implement hazard mitigation actions.	Emergency Management	EMPG, HMGP, NOAA, USFS	18-24 Months	Protection of lives & property due to awareness.	Low
2.G	Prepare, develop, & distribute appropriate public information about hazard mitigation programs and projects at Douglas County -sponsored events and on the County's Fire Districts' website.	Emergency Management	EMPG, HMGP, NV Health & Human Services, CDC, USFS	18-24 Months	Protection of lives & property due to awareness.	High
3.A	Survey and assess earthquake vulnerabilities of buildings and facilities, including critical facilities, schools, public buildings, high occupancy buildings, historical buildings and utilities.	Community Development	Local General Fund	Ongoing	Protection of lives and property through improved infrastructure.	High
3.B	Ground truth the unreinforced masonry building list developed by the State.	Community Development	Local General Fund, HMGP, PDM	24-48 Months	Protection of lives and property through improved infrastructure.	Low

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
3.C	Mitigate the earthquake vulnerabilities of buildings and facilities, including critical facilities, schools, public buildings, high occupancy buildings, historical buildings and utilities.	Community Development, School District, Public Works, Non-County utilities	Local General Fund, PDM, HMGP, CDBG	Ongoing	Protection of lives and property through improved infrastructure.	Moderate
3.D	Enforce the seismic provisions in building codes.	Community Development	Local General Fund	2 Months	Protection of homes, businesses, infrastructure, and critical facilities.	Moderate
3.E	Create an earthquake awareness and mitigation website that links to the Nevada Shakeout page, includes information on mitigating hazardous building contents, and promotes personal and homeowner mitigation of earthquake risks.	Douglas County	Local General Fund	Ongoing	Protection of homes, businesses, infrastructure, and critical facilities.	High
3.F	Create a Quaternary fault, potential liquefaction, and potential seismically induces landscape maps.	Community Development	Local General Fund	Ongoing	Protection of lives, homes, businesses, infrastructure, and critical facilities.	Low
3.G	Encourage the purchase of earthquake insurance.	Emergency Management		Ongoing	Protection of lives, homes, businesses, infrastructure, and critical facilities.	Low
4.A	Update Mass Illness Plan & integrate with local Hazard Mitigation Plan.	Emergency Management	NV Health & Human Services, CDC	Ongoing	Protection of lives due to pre-planning.	Low

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
4.B	Create and implement a training and exercise program relative to epidemics.	Emergency Management	Nevada State Health and Human Services, Public Health Nurse	1 year	Protection of lives by training and exercise.	Low
4.C	Prepare by acquiring/storing needed medical equipment.	Health Dept.	NV Health & Human Services, CDC, Carson Hospital	6-12 months	Protection of lives due to pre-planning.	Low
5.A	Add rain gauges to existing warning system.	Community Development, 911 Emergency Services	Local General Fund, PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NDCNR, 319(h) grants (Clean Water Act), USGS	5 years.	Additional data collection will lead to more accurate floodplain maps and storm water design.	High
5.B	Adopt or update policies that discourage growth in flood-prone areas.	Community Development	Local General Fund	Ongoing	Protection of homes, businesses, infrastructure, and critical facilities.	High
5.C	Complete FEMA floodplain mapping of Johnson Lane, Buckbrush, and Sunrise Washes.	Community Development	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NDRCS, Local General Fund	24 months	Remove numerous homes that were incorrectly mapped into the floodplain by FEMA during the 2010 FIRM update.	High
5.D	Complete FEMA floodplain mapping of the entire Carson River from Alpine County to Churchill County.	Carson Water Subconservancy District	Local General Fund, EMGP, FEMA, USACE	36 months	Provide basin wide coordination of floodplain hazards of the Carson River. Provide floodplain depths in areas that were previously	High

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
					approximate or undetermined.	
5.E	Identify acquire and develop locations for upstream regional detention basins (Ruhenstroth, Pine Nut, Buckeye, Buckbrush, and Calle Hermosa).	Community Development	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NRCS, Local Gen. Fund	5 years	Upstream floodwater storage will remove residences from the floodplain and help attenuate the high water level.	High
5.F	State Route 88 culvert expansion at Mottsville Lane, Cottonwood Slough and Rocky Slough.	Community Development	PDM, HMGP, USFS, BLM, Local General Fund	Ongoing	Eliminate backwater ponding of runoff.	High
5.G	Provide emergency access to homes east of 395. (Buckeye, Zerolene, Lucerne or Gilman Road).	Community Development	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NRCS, Local General Fund	5 years	Provide a minimum of one emergency access route to a large portion of the County's population.	Moderate
5.H	Initiate Park Ditch improvements.	Community Development	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NRCS, FEMA, 319(h) grants (Clean Water Act)	5 years	Increase channel capacity reducing peak flood heights	Low
5.I	Replace at grade dip sections with culverts (30 locations).	Community Development, Public Works	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NRCS, FEMA, 319(h) grants (Clean	Ongoing	Provide better emergency access to neighborhoods.	High

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
			Water Act)			
5.J	Initiate Johnson Lane ditch expansion and culvert replacement.	Community Development	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NRCS, FEMA, 319(h) grants (Clean Water Act), USGS	5 years	Maintain storm runoff in the roadside ditch.	Moderate
5.K	Education of public regarding flood hazards and damage potential.	Community Development, Carson Water Subconservancy District	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NRCS, FEMA, 319(h) grants (Clean Water Act), USGS	Ongoing	Maintains a higher level of risk awareness by the general public.	High
5.L	Continue to strictly enforce the County's building code Title 20, Open Space and Master Development Plan.	Community Development	Local General Fund	Ongoing	Protection of lives due to better infrastructure and building codes.	High
5.M	Evaluate the new FEMA criteria for repetitive loss properties within the County.	Community Development	PDM, HMGP, Local General Fund	Ongoing	Protect lives and property by eliminating structures in flood areas.	Low
6.A	In areas at risk to severe weather, retrofit public buildings to withstand snow loads and severe winds to prevent roof collapse/damage.	Community Development	PDM, HMGP, Local General Fund	Ongoing	Protection of homes, businesses, infrastructure, and critical facilities.	Low

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
6.B	Develop Storm Water Management Plan for snow melt.	Community Development, Carson Sub Conservancy District	PDM, HMGP, FMA, RFC, USDA, NDEP, USEPA, NRCS, FEMA, 319(h) grants (Clean Water Act), USGS, CC PW	12-14 months	Protection of homes, businesses, infrastructure, and critical facilities.	Low
7 .A	Adopt the International Wildland Urban Interface Code (IWUI) including ignition resistant building construction provisions.	Board of County Commissioners	Douglas County	6-12 Months	Mitigation Project will ensure a greater number of residential structures and critical facilities and infrastructure benefit from actions to protect lives and property from wildfire.	Moderate
7 .B	Develop and implement public education program regarding the requirements of IWUI Code and defensible space best practices.	Fire Districts, UNR Cooperative Extension	HMGP, PDM, NDF, BLM, National Fire Plan, USFS, Fire Districts SNPLMA	Ongoing	Mitigation Project will ensure a greater number of residential structures and critical facilities and infrastructure benefit from actions to protect lives and property from wildfire.	High
7 .C	Develop/continue inspection program to enforce the defensible space requirements of the IWUI code.	Fire Districts	Fire Districts, NDF, PDM, HMGP, National Fire Plan, SNPLMA	12-24 Months ongoing	Mitigation Project will ensure a greater number of residential structures and critical facilities and infrastructure benefit from actions to protect lives and property from wildfire.	High

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
7 .D	Develop/continue curb-side dead tree and weed removal pick up program. Continue curbside chipping programs. Continue community biomass collection point programs.	Fire Districts, towns, GID's, HOA's	HMGP, PDM, National Fire Plan, USFS, Fire Districts, SNPLMA	12-24 Months ongoing	Mitigation Project will ensure a greater number of residential structures and critical facilities and infrastructure benefit from actions to protect lives and property from wildfire.	High
7 .E	Work with the Nevada Division of Forestry, Nevada Division of State Lands, the Bureau of Land Management and the US Forest Service to implement fuels reduction projects on state and federal lands in and around communities.	Fire Districts	HMGP, PDM, BLM, National Fire Plan, USFS, Fire Districts, SNPLMA	Ongoing	Mitigation Project will ensure a greater number of residential structures and critical facilities and infrastructure benefit from actions to protect lives and property from wildfire.	High
7 .F	Implement fuels reduction projects on private lands as identified in the CWPP. The scope of such projects to include both fuel breaks and defensible space based upon the nature of the risk.	Fire Districts, Resource Conservation District	HMGP, PDM, Fire District s, National Fire Plan, USFS, NDF, SNPLMA	Ongoing	Mitigation Project will ensure a greater number of residential structures and critical facilities and infrastructure benefit from actions to protect lives and property from wildfire.	High
7 .G	Retrofit buildings in the Wildland Urban Interface with non-combustible roofing materials.	Fire Districts	HMGP, PDM, Fire Districts	12-24 Months	Mitigation Project will ensure a greater number of residential structures and critical facilities and infrastructure benefit from actions to protect lives and property from wildfire.	Low

Table 8-4 Action Plan Matrix

Action Number	Action Item	Department / Division	Potential Funding Source	Implementation Timeline	Economic Justification	Priority Level
7.H	Review, update and enforce the Master Plan, Open Space Plan and building codes relative to defensible space requirements for new development.	Fire Districts, Community Development	Local General Fund, CDBG	Ongoing	Protection of homes, businesses, infrastructure, and critical facilities.	Moderate

BLM= Bureau of Land Management
CDBG= Community Development Block Grant
DHS= Dept. of Homeland Security
EMPG = Emergency Management Performance Grant
GID= General Improvement District
HMGP = Hazard Mitigation Grant Program
HOA= Home Owner's Association
HUD= Housing Urban Development
NDEP = Nevada Division of Environmental Protection
NDF = Nevada Department of Forestry
PDM = Pre-Disaster Mitigation
SERC = State Emergency Response Commission
SNPLMA= Southern Nevada Public Land Management Act
USACE= U.S. Army Corps of Engineers
USDA = U.S. Department of Agriculture
USEPA = U.S. Environmental Protection Agency
USFS = U.S. Fire Service
USGS = US Geological Survey

The following three process steps are addressed in detail below:

Monitoring, evaluating, and updating the HMP

Implementation through existing planning mechanisms

Continued public involvement

9.1 MONITORING, EVALUATING, AND UPDATING THE HMP

The requirements for monitoring, evaluating, and updating the HMP, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Monitoring, Evaluating, and Updating the Plan

Monitoring, Evaluating and Updating the Plan
Requirement §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
Element

- Does the new or updated plan describe the method and schedule for monitoring the plan? (For example, does it identify the party responsible for monitoring and include a schedule for reports, site visits, phone calls, and meetings?)
- Does the new or updated plan describe the method and schedule for evaluating the plan? (For example, does it identify the party responsible for evaluating the plan and include the criteria used to evaluate the plan?)
- Does the new or updated plan describe the method and schedule for updating the plan within the five-year cycle?

Source: FEMA 2008.

Maintenance on the previous plan was not conducted. This may be due to administrative changes in Douglas County Emergency Management or it may be due to the previous plan suggesting a review every 2 years which may have been too long of a period. However, success in implementing many of the actions from the previous plan was accomplished. The Planning Committee recognizes the need for plan maintenance and wanted to include tools into the plan for improved maintenance. The HMP was prepared as a collaborative effort between the Planning Committee and Nevada Division of Emergency Management. To maintain momentum and build upon this hazard mitigation planning effort and successes, the Planning Committee will monitor, evaluate, and update the HMP. The Planning Committee will be responsible for implementing the Mitigation Action Plan. Douglas County Emergency Manager, the Planning Committee leader, will serve as the primary point of contact and will coordinate all local efforts to monitor, evaluate, and revise the HMP. He stated he will include a reminder on his MS Outlook calendar for the annual maintenance meeting.

The Planning Committee will conduct an annual review of the progress in implementing the HMP, particularly the Mitigation Action Plan. As shown in Appendix F, the Annual Review Questionnaire and Mitigation Action Progress Report will provide the basis for possible changes in the overall Mitigation Action Plan by refocusing on new or more threatening hazards, adjusting to changes to or increases in resource allocations, and engaging additional support for the HMP implementation. The Douglas County Emergency Manager will initiate the annual review one month prior to the date of adoption. The State of Nevada has also developed a tabletop exercise to promote and ensure annual evaluation and review of local hazard mitigation plans. Douglas County, upon FEMA approval, will schedule the tabletop exercise to coincide with the anniversary in 2014. The findings from these reviews will be presented annually to the County Manager.

The review will include an evaluation of the following:

- Participation of Douglas County agencies and others in the HMP implementation.
- Notable changes in the County's risk of natural or human-caused hazards.
- Impacts of land development activities and related programs on hazard mitigation.
- Progress made implementing the Mitigation Action Plan (identify problems and suggest improvements as necessary).
- The adequacy of resources for implementation of the HMP.

The process of reviewing the progress on achieving the mitigation goals and implementing the Mitigation Action Plan activities and projects will also be accomplished during the annual review process. During each annual review, a Mitigation Action Progress Report will be submitted to the Planning Committee and provide a brief overview of mitigation projects completed or in progress since the last review. As shown in Appendix F, the report will include the current status of the mitigation project, including any changes made to the project, the identification of implementation problems and appropriate strategies to overcome them, and whether or not the project has helped achieve the appropriate goals identified in the plan.

In addition to the annual review, the Planning Committee will update the HMP every five years. To ensure that this occurs, in the third year following adoption of the HMP, the Planning Committee will initiate the following activities:

Thoroughly analyze and update the County's risk of natural and man-made hazards.

Provide a new annual review (as noted above), plus a review of the three previous annual reports.

Provide a detailed review and revision of the mitigation strategy.

Prepare a new action plan with prioritized actions, responsible parties, and resources.

Prepare a new draft HMP and submit it to the County Commission for adoption.

Submit an updated HMP to the Nevada State Hazard Mitigation Officer and FEMA for approval.

9.2 IMPLEMENTATION THROUGH EXISTING PLANNING MECHANISMS

The requirements for implementation through existing planning mechanisms, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Incorporation into Existing Planning Mechanisms

Incorporation into Existing Planning Mechanisms

Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

Element

- Does the new or updated plan identify other local planning mechanisms available for incorporating the requirements of the mitigation plan?
- Does the new or updated plan include a process by which the local government will incorporate the requirements in other plans, when appropriate?

Source: FEMA 2008.

Although the maintenance process did not track the past five years activity, the following actions did occur and additional planning mechanisms which were adopted and include hazard mitigation can be found in section 4.4 of this plan:

- A new Master Plan 2011 included consideration of and references to Hazard Mitigation.
- Douglas County Fire Code 2006 was adopted which includes a wildland/urban interface section that delineates regulations for building and maintaining homes in wildland fire prone areas.
- Douglas County Building Code 2006 was adopted which includes updates the code to include the 2006 US Building and Residential Codes.

This activity is considered successful due to the volume of plans which now include hazard mitigation activities. After the adoption of the HMP, the Committee will continue to ensure that the HMP, in particular the Mitigation Action Plan, is incorporated into existing planning mechanisms. Each member of the Planning Committee will achieve this incorporation by undertaking the following activities:

- Conduct a review of the community-specific regulatory tools to assess the integration of the mitigation strategy. These regulatory tools are identified in Table 7-1.
- Work with pertinent divisions and departments to increase awareness of the HMP and provide assistance in integrating the mitigation strategy (including the action plan) into relevant planning mechanisms. Implementation of these requirements may require updating or amending specific planning mechanisms.
- Participate in the annual hazard mitigation tabletop exercise.

9.3 CONTINUED PUBLIC INVOLVEMENT

The requirements for continued public involvement, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Continued Public Involvement

Continued Public Involvement
Requirement §201.6(c)(4)(iii): [The plan maintenance process **shall** include a] discussion on how the community will continue public participation in the plan maintenance process.
Element

- Does the new or updated plan explain how **continued public participation** will be obtained? (For example, will there be public notices, an ongoing mitigation plan committee, or annual review meetings with stakeholders?)

Source: FEMA 2008.

Public participation was not solicited between the previous plan's adoption until the current planning process due to the maintenance of the plan not being conducted or tracked. However, many of the actions and planning mechanism changes did occur and since these are public documents the public was included. Additionally, each time one of the planning mechanisms mentioned above was completed it was included on the County's website.

However, the County is dedicated to involving the public directly in the continual reshaping and updating of the HMP. Hard copies of the HMP will be provided to each department. In addition, a downloadable copy of the plan and any proposed changes will be posted on the County's Web site. This site will also contain an e-mail address and phone number to which interested parties may direct their comments or concerns.

The Planning Committee will also identify opportunities to raise community awareness about the HMP and the County's hazards. This could include attendance and provision of materials at Douglas County-sponsored events such as the annual Genoa Candy Dance, Carson Valley days, the Economic Forum, Douglas County Business Showcase and various service club presentations. Any public comments received regarding the HMP will be collected by the Planning Committee leader, included in the annual report to the County Manager, and considered during future HMP updates. A press release and notice on the County's website will be issued each year before the annual maintenance meeting inviting the public to participate. A sample press release can be found in Appendix F.

The following documents or websites were accessed between September, 2012 and August, 2013 and have not been previously listed in Sections 1-9 of this document.

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Appendix A

Adoption Resolution

Appendix A
Adoption Resolution

Appendix B

Complete Earthquake, Wildland Fire and Flood Reports

Earthquake Hazards and Seismic Risk Mitigation in Douglas County, Nevada

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Earthquake Hazards in Douglas County

Overview/Executive Summary

Earthquakes will continue to occur in Douglas County and there is a significant likelihood for a damaging earthquake in the county within the next 50 years. Progress towards earthquake resiliency has been made in Douglas County through the adoption of "above code" building standards and the purchase of earthquake insurance. Additionally, a number of residents still recall the 1994 Double Spring Flat earthquake (M5.8) and at least partially believe and understand the earthquake threat. Nevertheless, systematic steps need to be taken to put Douglas County on a surer footing for future earthquakes.

Earthquakes in Douglas County can be large and accompanied by strong shaking. The evidence for this earthquake potential is shaking and damage from larger historical earthquakes, numerous small earthquakes, and many late Quaternary faults in and surrounding Douglas County that are potential sources of earthquakes. For example, significant damage occurred in Genoa and surrounding areas from the 1887 Carson Valley earthquake. Background earthquake activity is persistent. Over 3,700 earthquakes were recorded in Douglas County between 1970 and 2010. The largest event was the 1994 Double Spring Flat earthquake, Mw 5.8, which occurred south of Gardnerville. There are seven major earthquake faults in Douglas County, and one adjacent fault that projects into the county, that were modeled as potential earthquake sources. Estimated potential maximum earthquake magnitudes for these faults range from 6.5 to 7.2. These faults have major earthquakes along them every few thousand to tens of thousands of years. In addition to these, there are hundreds of other smaller earthquake faults in Douglas County. In some cases, several fault traces may be involved in a single event.

Three approaches were used to estimate the chances of having an earthquake in Douglas County. The first approach was to use earthquakes recorded in the county between 1970 and 2009 to create an earthquake occurrence relationship. This approach indicated a 48% chance of a magnitude 6 or greater earthquake occurring within 50 years and a 73% chance of an event occurring within 100 years, assuming a Poisson model. The second approach calculated the chances of potentially damaging earthquakes striking Douglas County communities over a 50 year time period using the USGS National Seismic Hazard Map website. In general, the chance of a magnitude 6 occurring within 50 km (31 mi) of communities was 52% to 64%. When magnitudes and distances that correspond to Modified Mercalli Intensity VII damage in communities were considered (the level of ground motion that corresponds to damaged chimneys and similar affects), the chances of an event were between 29% and 49% over 50 years. When these calculations were performed for a 100 year period, the chances of an earthquake causing MMI VII to Minden were 55% to 70%. The third approach was to use hazard curves created using the USGS Seismic Hazard Map website and published ranges of intensity versus ground motion relationships to estimate the chances of strong ground motion and damaging impacts for several Douglas County communities. Using these plots and considering a 50 year time period, the chances of a community having intensity VI are 68% to 78%, intensity VII are 39% to 48%, intensity VIII are 11% to 19%, and intensity IX are 2% to 8%. Over a 100 year time period the chances of an earthquake causing intensity VI damage is 90% to 95%. Considering the potential consequences of a serious earthquake in Douglas County, these various probability calculations indicate a substantial threat of a damaging earthquake over 50 years and very high likelihood of a damaging event over 100 years. These probabilities indicate that there is a good chance that the benefits of earthquake preparedness and mitigation will be realized over the next few to several decades in Douglas County.

The greatest hazard associated with earthquakes is violent shaking that can occur for tens of seconds, and can reach peak ground accelerations of ~0.5 g to ~0.9 g in Douglas County. There are also secondary hazards that can create problems during earthquakes, called collateral hazards. Collateral hazards include fault surface rupture, liquefaction effects, rock falls, landslides, snow avalanches, lake tsunami, and lake seiche. All of these hazards are generally identifiable and mitigation strategies exist for life safety and property protection.

Earthquake scenarios based on the largest latest Quaternary faults in Douglas County and a centrally located background earthquake were created to gain a perspective on the overall damage and impact future earthquakes might cause. These scenarios are some of the largest events Douglas County can face. Earthquakes modeled in the western and central parts of the county have potential costs of several hundreds of millions of dollars. Large earthquakes in the eastern and southern part of the county have lower cost estimates of about $80 million to $200 million, but still affect the entire county. Smaller events were not modeled but if they are located near a community, historical events indicate they could cost a couple to tens of millions of dollars. These costs would be borne by individuals, private companies, local governments, and the state. Disaster assistance, loans, and grants can amount to around half of disaster amounts, or less. Such potential losses are huge for communities, which is why earthquake preparedness and mitigation is a wise and cost effective strategy in areas of significant earthquake risk. Weaker building types, such as unreinforced masonry buildings that are vulnerable to damage from earthquake shaking, should be systematically addressed to lower the injuries and costs of future earthquakes. A preliminary analysis of Douglas County's assessor's data indicated the potential for 408 unreinforced masonry buildings in the county, 294 that are residential and 114 that are commercial. A more field analysis needs to be conducted to know how many of these buildings are truly unreinforced masonry, what their occupancy is, and how they might be seismically rehabilitated.

The overall objective of an earthquake mitigation plan is to create an earthquake-resilient community where no lives are lost from earthquakes, and injuries and property losses are minimal. To achieve this objective, several levels of planning and action are required, including county, community, neighborhood, family, and individual preparedness. The recommended goals for an earthquake resilient Douglas County include:

1) Adopt and enforce current building codes and their seismic provisions,
2) Assess earthquake vulnerabilities of existing buildings and create strategies to reduce earthquake risks from these buildings,
3) Reduce nonstructural hazards in homes, businesses, and public buildings,
4) Encourage the purchase of earthquake insurance
5) Provide leadership encouraging earthquake preparedness and mitigation activities at all levels in the county,
6) Encourage and plan for appropriate land use to minimize earthquake damage and losses,
7) Plan for a successful earthquake disaster emergency response and recovery.

Actions from these goals have been extracted and combined for the 2012 Douglas Hazard Mitigation Plan.

Historical Earthquakes in and near Douglas County

Douglas County is earthquake country. Earthquakes have strongly shaken Douglas County in 1887, 1932, 1933, and 1994 (table 1) and over 3,700 earthquakes were recorded in the county between 1970 and 2010 (fig. 1). This section briefly describes some of the earthquakes that have strongly shaken Douglas County to give some background of the earthquake hazard.

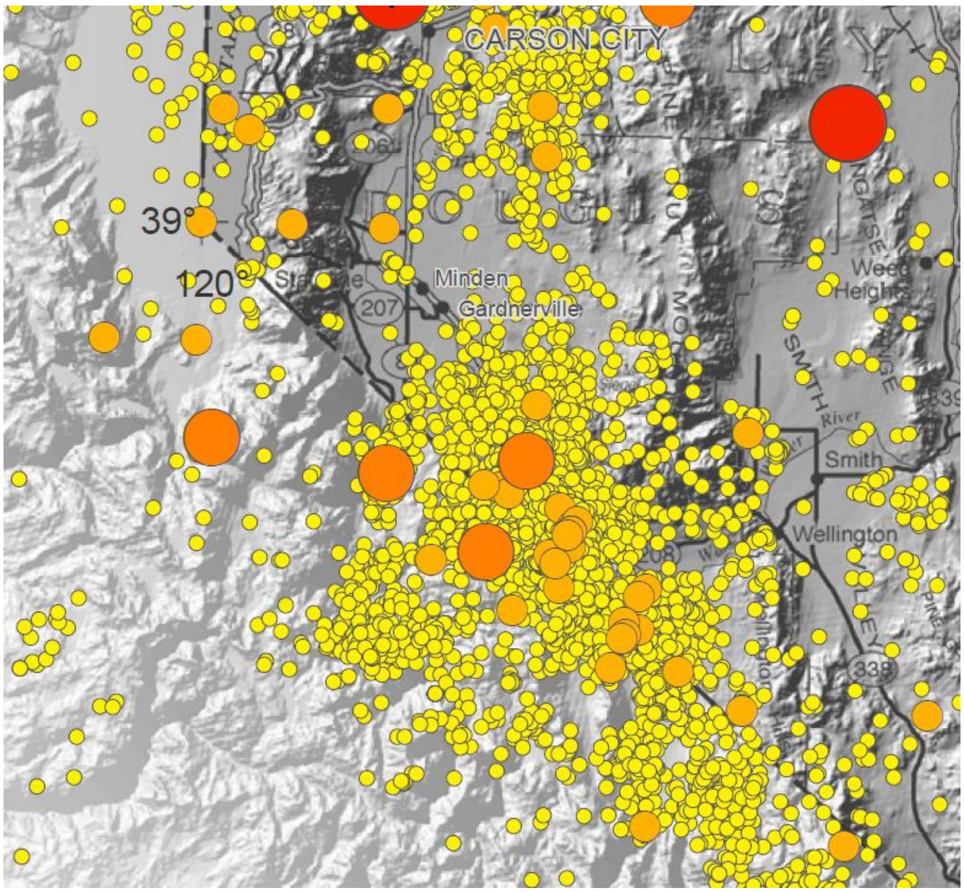


Figure 1 Earthquakes recorded in Douglas County from the 1840s to 2010. Yellow dots are earthquakes with magnitudes less than M4, smaller orange dots are earthquakes with magnitudes 4 to 4.9, larger orange dots are earthquakes with magnitudes between 5 and 5.9. The cut-off red dot near the top is the questioned location of the magnitude ~6.5 Carson City earthquake and the red dot in the upper right of the figure is the 1933 magnitude 6 Wabuska earthquake. Over 3,700 earthquakes have been recorded in Douglas County. From dePolo and dePolo (2012).

The effects of earthquakes are described by a scale called the Modified Mercalli Intensity. The lower part of this scale is related to human perception of an earthquake, the middle part is based on earthquake damage, and the upper part is related to ground effects from an earthquake. The scale is described in Appendix A.

Table 1 Major Historical Earthquakes That Have Strongly Shaken Douglas County

Date	Magnitude	Nearest Community	Effects
June 3, 1887	6.5	Carson City	Building damage, liquefaction
Dec. 20, 1932	7.1	Gabbs	Surface rupture, chimney damage
June 25, 1933	6.0	Wabuska	Building and chimney damage
Sept. 12, 1994	5.8	Gardnerville	Chimney damage, foundation cracking

1887 Carson Valley earthquake

The June 3, 1887 Carson Valley magnitude 6.5 earthquake was one of the most violent earthquakes in western Nevada's history. The event occurred at 2:40 in the morning. Buildings were severely damaged in Carson City and Genoa, some so bad that they likely had to be partially torn down and rebuilt. The earthquake, which was preceded by a heavy rumbling sound, was strong enough to throw some people to the ground in Carson City and caused general hysteria in Carson City, Genoa, and Virginia City, where people ran out of buildings wearing only their sleeping garments (The Nevada Tribune, 6/3/1887).

The following account chronicled in the June 6, 1887 edition of The Nevada Tribune on the effects in Genoa and at the Boyd property in Carson Valley:

Earthquake in Douglas County

> The shaking of brick and stone walls in Genoa was apparently much more severe than at the Capital. The County Building is so much cracked in the upper story, that it will have to be attended to at once, for it is certainly dangerous. The stone and brick buildings belonging to Mr. Harris were jammed against each other, and the rear parts of both were cracked very severely. The plaster in Mr. Kinsey's dwelling house was scattered all over every room, and an old stone wall opposite was thrown completely down. A high brick chimney on the Nevada Hotel was twisted like a corkscrew, but fortunately did not fall Thursday night. …
>
> Professor J.L. Smith, principal of the public school departments of the county, drove the Tribune reporter across the bridge to the Boyd property, for the purpose of looking at the effects of the earthquake. The brick residence erected about three years since is of two stories and not a part of the building is as it was, so violent must have been the strike. There are cracks all through the building and it is entirely unsafe. In the

> corral, walking across either way, the ground seems as though all was hollow underneath, and by driving a pole down two or three feet, water flows immediately to the surface, and wherever a fissure is seen, black sand several inches deep has been thrown up. …

In Genoa, nearly all chimneys were damaged and there was building damage and in Glenbrook chimneys were broken off at the roof level, plaster was cracked, and lamps and dishes were broken (dePolo, 2012). These effects indicate that Modified Mercalli Intensity levels of VII to VIII were experienced in northern Douglas County from the 1887 earthquake.

1932 Cedar Mountain and 1933 Wabuska earthquakes

In the 1930s several earthquakes shook Nevada, including the 1932 magnitude 7.1 Cedar Mountain and the 1933 magnitude 6 Wabuska earthquakes, which were both strongly felt in Douglas County. The December 20, 1932 Cedar Mountain earthquake initiated just north of Gabbs, Nevada and ruptured to the south, into Monte Cristo Valley (Gianella and Callaghan, 1934; Bell and others, 1999). The earthquake occurred at 10:10 p.m. PST and was felt from Los Angeles to Salt Lake City and throughout Nevada (fig. 2). This earthquake was located in a remote part of Nevada, but nevertheless had severe effects on local towns. Some miner's cabins near the earthquake collapsed (Gianella and Callaghan, 1934). Damage in the town of Luning, where china was thrown across rooms and chimneys and walls collapsed, was considered to be Modified Mercalli Intensity IX (U.S. Coast and Geodetic Survey, 1968). There were some injuries in Mina; a man suffered a skull fracture when he fell from operating a small mining train (Nevada State Journal 12/26/1932) and two children were injured when an adobe house collapsed (Reno Evening Gazette 12/21/1932). Chimneys fell as far away as Fallon and Reese River Valley (Reno Evening Gazette 12/21/1932 and 12/22/1932).

The earthquake produced scattered ground breaks over about 75 km (46 mi), with the most pronounced and continuous surface rupture near the southern end, where as much as 2 m (6.6 ft) of right-lateral offset occurred along one fault trace.

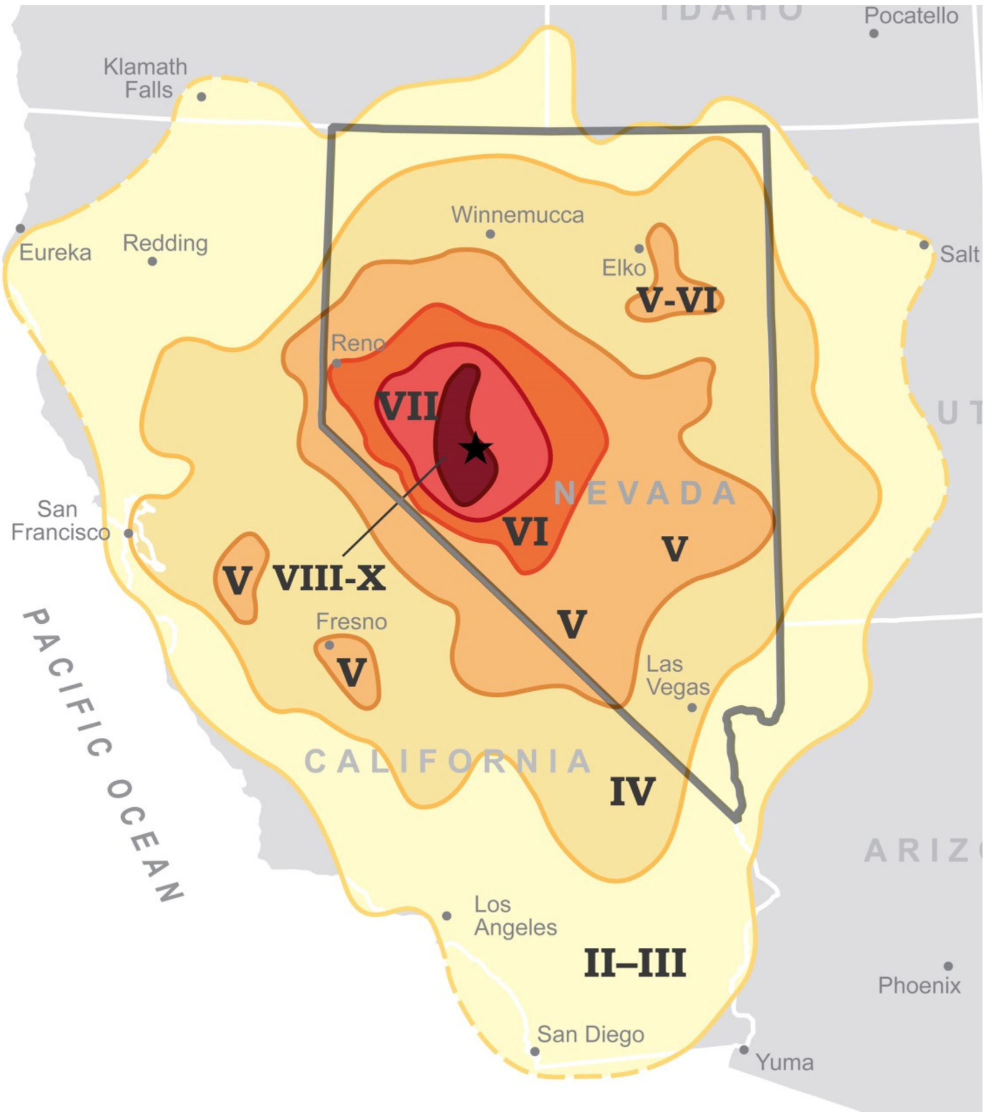


Figure 2 Modified Mercalli Intensity Map of the moment magnitude 7.1 1932 Cedar Mountain Earthquake. For descriptions of Intensity levels please see Appendix A. Modified from Stover and Coffman (1993).

In Douglas County, the shaking from the 1932 earthquake was characterized as Modified Mercalli Intensity V at Minden, Gardnerville, and Zephyr Cove (U.S. Coast and Geodetic Survey, 1968), which would be strong enough to be felt by all and awaken sleeping people up, but not strong enough to cause widespread damage, shy of some isolated cases of cracks in walls. As an interesting side note, earthquake lights in the direction of the earthquake area were reported by residents in Carson Valley (Gardnerville Record-Courier, 2/1/1933). Prospectors closer to the earthquake reported lightning near the peak of Pilot Mountain (Reno Evening Gazette, 2/2/1933), indicating an electrostatic discharge may have occurred in the earthquake area and been the source of lights observed in Carson Valley.

The 1933 Wabuska earthquake occurred on June 25, at 12:45 p.m. PST on a Sunday afternoon. It was a magnitude 6 event that strongly shook western Nevada and caused damage over 60 km (37 mi) from the epicenter. The earthquake caused some severe damage in Yerington and Wabuska and liquefaction in Mason Valley. In Yerington, the rear wall of the three-story brick Courthouse was cracked and separated from the building by 5 cm (2 in), plaster was cracked throughout the building, and the window in the county clerk's office was broken (The Mason Valley News 6/30/1933; Reno Gazette Journal 6/27/1933). The Mason Valley News reports that "at the Parker ranch cracks running from an inch to three inches traversed the property. For some time water shot from the openings and floated the land for a distance of 200 feet." This is evidence of liquefaction occurring during this event.

In Carson Valley people scrambled from stores and homes (Garnerville Record-Courier 6/30/1933) "The duration of the quake was not as long as the one in December [1932 Cedar Mountain earthquake] but was more violent while it lasted" (Gardnerville Record-Courier 6/30/1933). The Gardnerville Record-Courier notes that "A few residents of Gardnerville report that when they started to hasten from their homes the floors rocked so violently they could not keep on their feet." At Minden, damage was reported at Modified Mercalli Intensity VI, with cracked plaster and small objects overturned (Neumann, 1935).

1994 Double Spring Flat earthquake

The M 5.8 September 12, 1994 Double Spring Flat earthquake was felt throughout Douglas County and western Nevada, and from Sacramento to Elko (Ichinose and others, 1998; Ramelli and others, 2003). The earthquake occurred about 15 km (9.3 mi) south of Gardnerville, in a remote location in the southern Pine Nut Mountains. Damage was limited from the earthquake, consisting of a damaged chimney in Minden, a cracked foundation in Double Spring Flat, and minor damage from objects knocked off of shelves (Ramelli and others, 2003). Although the earthquake was distinctly felt throughout Douglas County, there were fortunately no injuries.

The 1994 earthquake was a normal-left-oblique event that occurred along a northeast-striking fault that crossed the north-central part of the Double Spring Flat fault zone (Ichinose and others, 1998). Triggered slip and microseismicity occurred along the Double Spring Flat fault zone following the earthquake and created cracks along several faults within 4 km (2.5 mi) of the epicentral area (Ramelli and others, 2003; Amelung and Bell, 2003). Additionally there were ground cracks along some regional faults, including a 1.5 km (0.9 mi) long zone of cracks along a fault in western Fish Spring Flat and ground cracking to the east in Smith Valley (Ramelli and others, 2003).

Late Quaternary Faults in and near Douglas County

There are hundreds of individual fault strands in Douglas County (fig. 3) that could be earthquake sources. Eight of the largest faults are identified and discussed in this report. These are the largest earthquake sources in the county and these have been modeled for their earthquake potential and scenario earthquakes have developed for them.

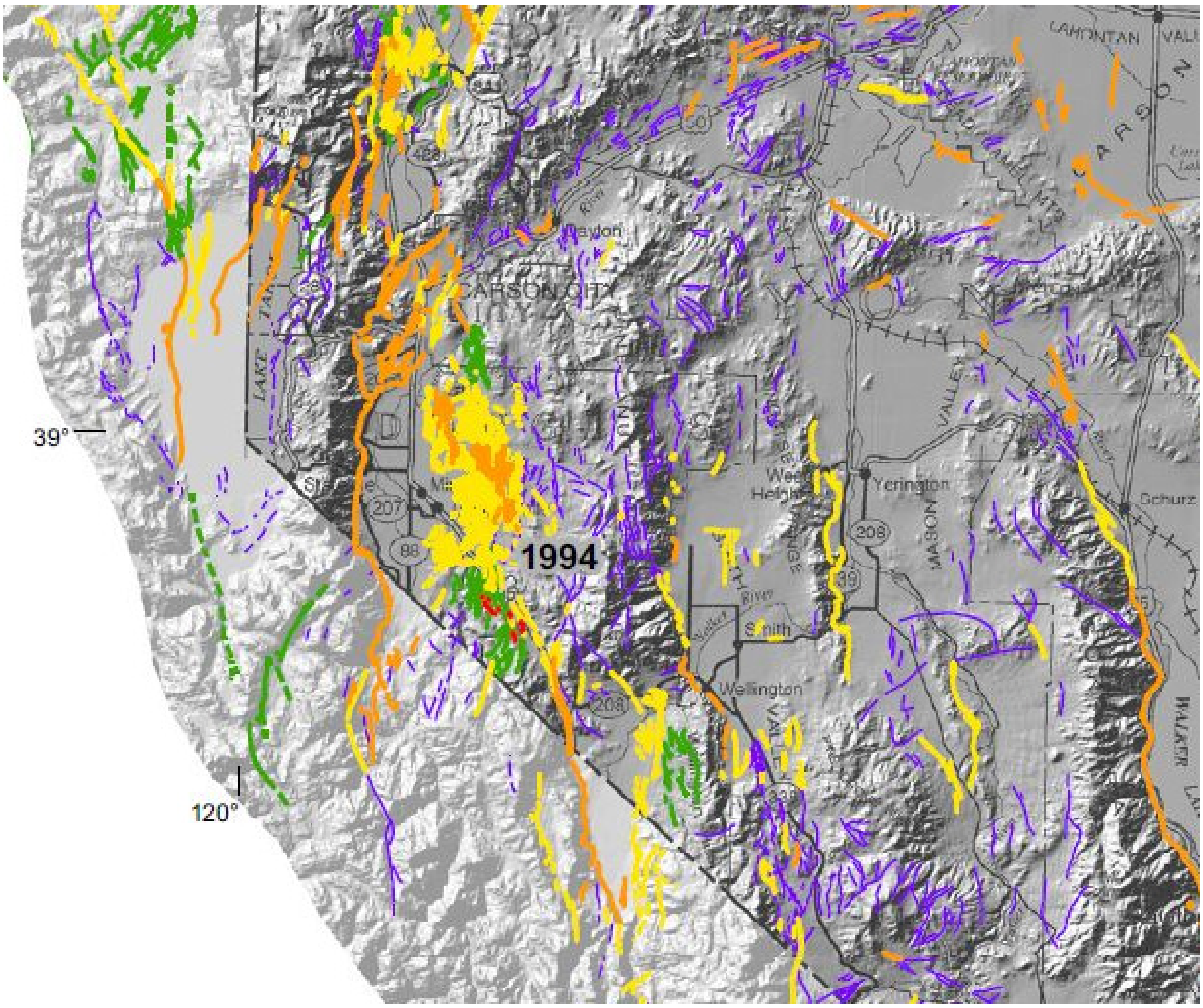


Figure 3 Quaternary fault map of the Douglas County region. The different colors represent time since the latest rupture on the fault, with red for historical ruptures (1994 Double Spring Flat), orange for ruptures in the last 15,000 years, yellow for ruptures in the last 130,000 years, green for ruptures in the last 750,000 years and purple are largely undefined but are ruptures in the Quaternary, the last 2.6 My. From dePolo (2008).

Quaternary faults in Douglas County accommodate normal dip-slip movement and strike-slip movement. The normal dip-slip movement is related to the tectonic extension of the crust in Nevada and the Great Basin as a whole, and the strike-slip movement is related to the relative movement between the Pacific and North American plates, which is wrenching the Sierra Nevada to the northwest relative to central Nevada.

The larger normal dip-slip faults in Douglas County commonly bound mountains and form steep, prominent range fronts. Strike-slip faults, in contrast, are more difficult to identify because they offset the ground laterally and can be more easily buried. Some faults have a combination of the two types of motion and are called oblique-slip faults. Within Douglas County there are four major late Quaternary normal dip-slip faults and four late Quaternary oblique-slip faults where strike-slip motion may be important (Table 2). One of these faults, the West Tahoe-Dollar Point fault, intersects the ground surface in California, but dips to the east and is below ground in Douglas County. Late Quaternary activity, which is fault movement in the last 130,000 years, is used for the time-frame of faults to consider as earthquake hazards (dePolo and Slemmons, 1998). Most of these eight faults have moved within the Holocene, the last 13,700 years, which is a commonly used California earthquake fault hazard criterion. There have been initial geologic studies to identify paleoearthquakes and earthquake potential along several of these faults and the sizes of potential earthquakes can be estimated based on fault length. More detailed studies are needed to confidently understand how often earthquakes occur along the faults. For earthquake planning and mitigation purposes, the information available today allows fault-specific scenario earthquakes to be created and simulations of their impacts and effects via the HAZUS computer program can be produced. These faults also serve as important evidence of the earthquake hazard in Douglas County.

This compilation of major late Quaternary faults in Douglas County was based on existing published and unpublished literature. There have been compilations of faults in Douglas County at regional levels (e.g., Dohrenwend, 1982; USGS Fault and Fold Database: http://earthquake.usgs.gov/hazards/qfaults/), but a study that focuses on identifying and characterizing late Quaternary faults in Douglas County and uses LiDAR and other modern fault exploration techniques was not available. There are some faults in the county that deserve further investigation as potential earthquake hazards, such as the southern part of the Pine Nut Mountains fault zone and a possible fault zone that connects the Eastern Carson Valley fault zone with the Eastern Antelope Valley fault zone. Additionally, faults that could produce hazardous earthquakes would likely be found during a detailed fault investigation. Late Quaternary faults also likely exist in the valleys and are buried by young alluvium. Given the possibility of other faults, a major earthquake on a fault other than those identified in this report would not be scientifically surprising. Background earthquakes are used to account for the earthquake hazards from the hundreds of other faults in Douglas County.

Eight major late Quaternary faults were identified in Douglas County (fig 4; table 2). These are the largest earthquake hazards there are in the county.

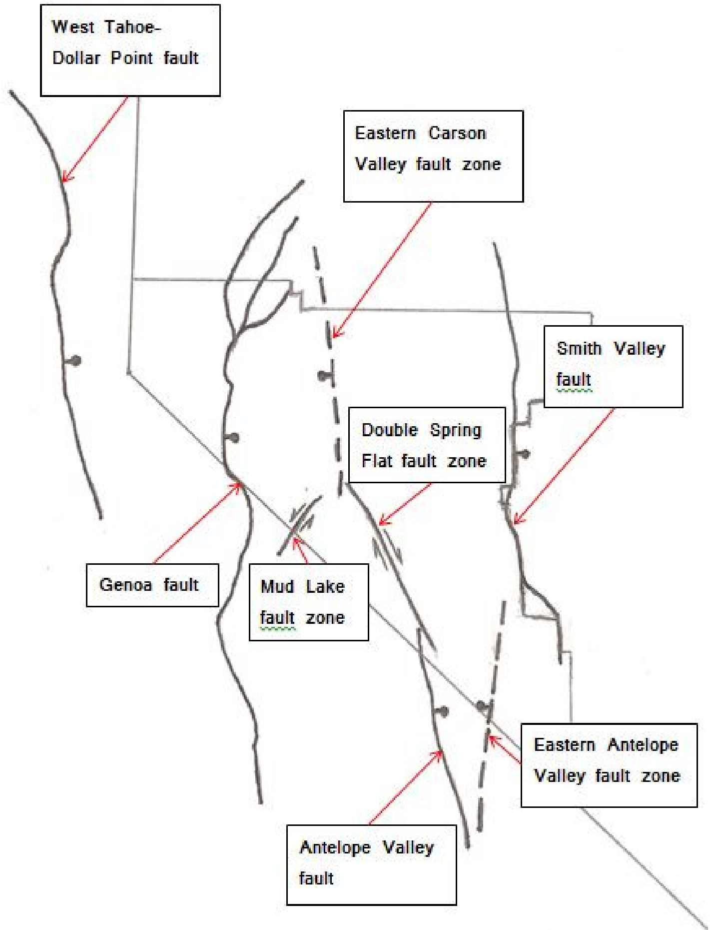


Figure 4 Schematic map of the eight largest faults in Douglas County.

Table 2 Major Late Quaternary Faults in Douglas County

Normal Dip-Slip Faults

Genoa fault (GF)
Eastern Carson Valley fault zone (ECVFZ)
Smith Valley fault (SVF)
Antelope Valley fault (AVF)
Eastern Antelope Valley fault zone (EAVFZ)
West Tahoe-Dollar Point fault* (WTDPF)

*The West Tahoe fault intersects the surface in California, but dips to the west and is a threat to South Lake Tahoe.

Possible Strike-Slip Faults

Double Spring Flat fault zone (right-lateral) (DSSFZ)
Eastern Carson Valley fault zone (right-lateral oblique)
Mud Lake fault zone (left-lateral) (MLFZ)
Eastern Antelope Valley fault zone (right-lateral? oblique)

The normal faults in Table 2 are two general types, large east-side-down range-bounding faults and smaller, generally west-side-down distributed fault zones. The large normal faults are all northerly striking and the relative down-dropping of their eastern sides created Carson, Antelope, Tahoe, and Smith Valleys. These faults appear to have large earthquakes that offset the ground vertically by 1 to 5 m (3 to 16 ft). The smaller, west-side-down normal faults are more of an enigma. They are antithetic to the larger range-bounding normal faults and are on the opposite side of the basin created by the larger faults. The west-side-down faults appear to have a role in the breakup of the hanging wall of the range-bounding faults and based on rupture patterns, may also accommodate right-lateral strike-slip motion.

Two of the eight faults identified likely accommodate dominantly strike-slip movement, the Double Spring Flat and the Mud Lake fault zones. These faults are limited in their length and thus, their earthquake potential. They appear to have apparent secondary tectonic roles, connecting normal faults to one another. It is likely that other strike-slip faults exist in the county but have not been mapped.

The estimated maximum magnitude earthquakes for the major faults in Douglas County range from magnitude 6.5 to 7.2. These major earthquakes usually occur every few thousand years to tens of thousands of years along any individual fault. The high earthquake hazard in Douglas County is the result of these larger faults and hundreds of other smaller faults. For earthquake preparedness, risk mitigation, emergency and recovery planning purposes, understanding the largest earthquakes that can occur in the county are the most important.

There are also several major faults that surround Douglas County and earthquakes along these faults can also cause damage in the county. The major faults that immediately surround the county are tabulated (table 3), but they are not discussed or modeled. The potential effects from earthquakes on these faults are covered by the modeling of the major faults within Douglas County.

Table 3 Major Late Quaternary Faults Near Douglas County

Normal Dip-Slip Faults

North Tahoe fault
Incline Village fault
Waterhouse Peak fault
Slinkard Valley fault
Northern Carson Range fault zone faults
Singatzse Range fault zone
Pine Nut Mountains fault zone

Possible Strike-Slip Faults

Wabuska lineament (left-lateral?)

Genoa fault

The Genoa fault is the largest and most spectacular late Quaternary fault in Douglas County. It is part of the Carson Range fault system, which bounds the eastern side of the Carson Range and underlies adjacent valleys to the east, including Carson Valley. The Genoa fault is an east-side-down normal dip-slip fault. Fault scarps, fault facets, and other geomorphic expression indicate earthquake rupture lengths were between 25 and 75 km (16 and 47 mi) and coseismic ground offsets were as much as 5.5 m (18 ft)(Ramelli and others, 1999). Studies of the fault's activity indicate the most recent large event occurred about 300 to 400 years ago and the prior event was about 1,800 years ago (Ramelli and others, 1999; Alan Ramelli, 2012, personal communication). The size of the ground offsets and the probable length of paleoearthquakes indicate a moment magnitude 7.2 for these events. Such an earthquake would cause severe damage to Douglas County and general damage to the entire Reno-Carson City urban corridor. Figure 2, the Modified Mercalli Intensity of the 1932 Cedar Mountain earthquake, gives an idea of the area an earthquake of this magnitude can affect. Surface rupture from the Genoa fault could occur in Genoa, Jacks Valley, and Indian Hills.

The Genoa fault appears to have had two recent events that were clustered in time and doesn't always have earthquakes that frequently because older deposits have insufficient offsets. The short-term fault slip rate appears to be about 2-3 m/ky, whereas the longer term slip rate may be closer to 0.3 to 0.8 m/ky (Ramelli and others, 1999). If the large earthquake offsets along the Genoa fault are considered with the longer term slip rates, large events are separated by several thousand to over 10,000 years. Unfortunately, it is not clear whether the recent activity of the Genoa fault will continue at a higher rate or at a longer-term rate.

Eastern Carson Valley fault zone

The Eastern Carson Valley fault zone is 18 to 26 km (11 to 16 mi) long and is unusual because it is made up of many fault traces spread out over ~10 km (~6 mi) cross-strike distance, rather than a narrower zone of faults. There are literally hundreds of individual fault traces that are part of this zone

(dePolo and others, 2000). The fault zone is in the eastern half of Carson Valley and movement along these faults has created the foothill topography of the Pine Nut Mountains.

How earthquakes occur along the Eastern Carson Valley fault zone is complicated. It is likely there are at least two modes of faulting during earthquakes. These are normal dip-slip movement, possibly involving several parallel faults, and north-northwest right-lateral strike-slip movement involving multiple surface faults failing together in left stepping breaks. The normal dip-slip mode is the predominant structural makeup of the fault zone, with parallel normal dip-slip faults. The strike-slip rupture mode is indicated by the most recent event, which occurred about 520 to 920 years ago (dePolo and Sawyer, 2005). This event created small fault scarps that were partially arranged in a left-stepping en-echelon pattern. This pattern is consistent with right-lateral faulting.

Earthquake magnitude estimates for the Eastern Carson Valley fault zone were based on overall length and do not consider the possibility of significant parallel fault trace ruptures potentially increasing the fault length. The length-based estimate is magnitude 6.7. A minimum displacement of >1.4 m (4.6 ft) was found in one trench along the Eastern Carson Valley fault zone by dePolo and Sawyer (2005). This correlates to a magnitude of 6.8 (or larger) and this value was adopted for the estimated potential magnitude to account for the possible underestimation based on length. More paleoseismic studies are needed to understand the rupture modes of earthquakes and how often earthquakes occur along the Eastern Carson Valley fault zone.

Many communities are located within the Eastern Carson Valley fault zone. Strong shaking and surface faulting from this fault zone could affect Johnson Lane, East Valley. Fish Springs, Ruhenstroth, Gardnerville Ranchos, and possibly Gardnerville and Minden. Minden and Gardnerville would be affected by shaking, but the surface faulting potential from the Eastern Carson Valley fault zone is unclear. The Eastern Carson Valley fault zone is centrally located within Douglas County and has the potential to adversely affect the entire county.

Mud Lake fault zone

The late Quaternary Mud Lake fault zone is a short, northeast-striking left-lateral fault that appears to connect the southern Genoa fault to the Eastern Carson Valley fault zone. The left-lateral displacement is indicated by slickensides and the left-stepping pull-apart nature of fault traces across the depression that makes up Mud Lake. This fault zone is short, 9 to 18 km in length, but is prixmal to Minden and Gardnerville, increasing its importance. The September 4, 1978 Diamond Valley earthquake, a magnitude 5.0 event (Somerville and others, 1980), may have occurred along its southern end and would indicate a southwestern extension of this zone towards the Genoa fault.

There are no detailed studies of the Mud Lake fault zone. Paleoseismic studies that constrain the age and amount of offset that occurs should be conducted to understand the earthquake potential of this fault zone better. Earthquake magnitude estimates based on length are near background earthquake levels and there are no single-event displacements to cross check these magnitudes. A maximum

magnitude of 6.5 is estimated for the Mud Lake fault zone. The scenario earthquake would potentially cause damage to Minden, Gardnerville, Dresserville, Ruhenstroth, Gardnerville Ranchos, and southern Carson Valley.

Double Spring Flat fault zone

The Double Spring Flat fault zone is a northwest-striking fault zone that roughly follows Highway 395 from southern Carson Valley to Holbrook Junction and the Topaz Lake area. The valley Highway 395 was built through appears to have been created by down drop and erosion along the zone. The fault zone is complicated and is made up of many fault traces in complex geometric patterns. The orientation of the fault in the western Nevada stress field and InSAR modeling of the 1994 Double Spring Flat earthquake (Amuldung and Bell, 2003) indicate a significant right-lateral strike-slip component.

The Double Spring Flat fault zone is at least 17 km (mi) long and may be as long as 30 km (mi) if it extends from an intersection with the Mud Lake fault zone to the eastern shore of Topaz Lake, as is indicated by seismicity (Ichinose and others, 1998). The 1994 moment magnitude 5.8 earthquake produced discontinuous secondary surface cracking over ~7 km of the Double Spring Flat fault zone, but the earthquake itself was conjugate to the fault zone and occurred on a northeast striking fault (Ramelli and others, 2003).

The Double Spring Flat fault has not had detailed paleoseismic studies to determine the age of the last largest event and the amount of potential offset. A maximum earthquake potential of magnitude 6.8 is assigned to the fault zone considering the maximum length and the potential for multiple fault ruptures. With the northwest alignment and position of the fault zone, a majority of Douglas County communities could be affected by the scenario earthquake, with surface rupture potential in Bodie Flats, China Springs, Spring Valley, Double Springs, Holbrook Junction, and possibly Topaz Lake.

West Tahoe – Dollar Point fault

The West Tahoe-Dollar Point fault is located on the western side of Lake Tahoe basin. The northerly striking surface and subaqueous fault trace is in California, but the fault dips to the east and is a major seismic hazard for Stateline and the area of Douglas County within Tahoe basin and in Carson Valley. The West Tahoe-Dollar Point fault is the largest fault in the Tahoe basin and is range-bounding along its southern reach. The fault is 50 to 60 km (~31 to 38 mi) long and has a maximum single event offset of ~3.7 m (~12 ft)(Brothers and others, 2009), indicating it is a significant earthquake source. The preferred age of the most recent event is 4,100 to 4,500 years ago (Brothers and others, 2009). The fault can also be the source of a tsunami in Lake Tahoe, by faulting and/or from triggered collapse and sliding of subaqueous sedimentary banks around the lake. Brothers and others (2009) determined a Holocene fault slip rate for the West Tahoe-Dollar Point fault of 0.4 to 0.8 m/ky from offset Tioga-aged glacial deposits.

Most estimations of earthquake magnitude potential along the West Tahoe-Dollar Point fault are magnitude 7.1, which is adopted as the maximum magnitude. A large earthquake along the West Tahoe-Dollar Point fault would be expected to create severe shaking in the communities surrounding Lake Tahoe, including South Lake Tahoe, Zephyr Cove, and Glenbrook. This scenario earthquake could also cause severe shaking in Carson Valley and throughout Douglas County. Lake tsunami and lake seiche could also occur in communities on the shores of Lake Tahoe.

Smith Valley fault

The Smith Valley fault is a range-bounding normal dip-slip fault that skirts along the eastern boundary of Douglas County. It bounds the eastern side of Smith Valley, has an overall north-south strike, is about 50 km (31 mi) long, and has prominent geomorphic expression along it, including fault scarps and fault facets. The fault was studied by Wesnousky and Caffee (2011), who trenched the fault and found the last major earthquake offset the ground by 3.5 m (11.5 ft) and occurred about 3,500 years ago. Wesnousky and Caffee (2011) estimate an initial late Pleistocene fault slip rate of 0.125 to 0.33 m/ky for the Smith Valley fault.

Maximum magnitude estimates for the Smith Valley fault are 7.0 or 7.1, and the magnitude 7.1 is adopted for the scenario earthquake magnitude. This event would cause surface ruptures along the eastern side of Smith Valley with large vertical offsets (1-3.5 m; 3.2-11.5 ft). The nearest Douglas County communities that would be subject to potential damage from this scenario earthquake are Topaz Ranch Estates, Holbrook Junction, and Topaz Lake, with progressively less damage occurring to communities to the west. There would be severe damage to neighboring Lyon County communities, especially in Smith Valley.

Antelope Valley fault

The Antelope Valley fault is a north-northwest-striking range-bounding normal dip-slip fault that bounds the western side of Antelope Valley. The Antelope Valley fault is 23 to 39 km (11.3 to 24.2 mi) long and has well-developed geomorphic expression of late Quaternary activity, including fault facets and fault scarps (Bryant, 1984). Sarmiento and others (2011) trenched and studied the Antelope Valley fault zone and found that the most recent event offset the ground by 3.6 m (11.8 ft) and occurred about 1,350 years ago. Sarmiento and others (2011) dated colluvial wedge deposits from the prior paleoearthquake along the Antelope Valley fault at 6,196 to 6,294 years before present (the second-most-recent event would have occurred just before this deposit was formed buttressing the earthquake offset) and estimate an intra-event slip rate of 0.7 m/ky.

There is a disparity of 0.3 to 0.4 magnitude units between estimates made from the length of the Antelope Valley fault and the maximum displacement measured by Sarmiento and others (2011). Because there is a high confidence in the displacement measurement and more uncertainty on the length of the potential rupture and whether it might have included other faults, like the Slinkard Valley fault to the west, the magnitude estimate from the maximum displacement, magnitude 7.1, is used for the scenario earthquake.

Eastern Antelope Valley fault zone

The Eastern Antelope Valley fault zone is an unstudied fault zone mapped by Dohrenwend (1982). It is made up of a series of north-striking faults and lineaments that follow the northwestern flank of the Sweetwater Mountains, cross the eastern part of northern Antelope Valley, and appear to continue to the north, into the Pine Nut Mountains. Fault traces from the Eastern Antelope Valley fault zone are located both within the valley and the range front, and have both east-side-down and west-side-down apparent movement (Dohrenwend, 1982). The most recent activity is mapped as late Pleistocene by Dohrenwend (1982) although he shows one trace within Antelope Valley as being <15,000 years old.

The length of the Eastern Antelope Valley fault zone is about 23 km along the Antelope Valley reach and as much as 30 km if faults to the north are included.

Potential earthquake magnitude estimates range from 6.7 to 6.8; magnitude 6.8 is adopted as the maximum magnitude. Detailed studies are needed along the Eastern Antelope Valley fault zone to further determine its seismic potential and in particular the sense-of-displacement along the zone. The southern Douglas County communities of Topaz Ranch Estates, Topaz Lake, and Holbrook Junction would be most affected by this scenario earthquake, with progressively less damage to the north.

Southern Pine Nut Mountains fault zone

The Southern Pine Nut Mountains fault zone is uncertain as an earthquake source due to a lack of investigative studies. The fault zone appears to have some geomorphic expression and closed depressions along it indicating likely late Quaternary activity, but it has been mapped as only having activity within the Quaternary Period, 2,600,000 years (Dohernwend, 1982), a relatively long time period for engineering practices. The Southern Pine Nut fault zone as currently mapped is made up of short discontinuous fault traces, which may indicate this is a secondary fault or a relatively new fault. The fault is close to and roughly parallels the Smith Valley fault zone, which has an earthquake

scenario and likely has a higher potential magnitude, so the Southern Pine Nut Mountains fault zone was not considered further for this study. Nevertheless, this is a source that should be investigated further.

Background Earthquakes

Although the larger faults in Douglas County have been mapped, many other potential earthquake faults have not been individually recognized because they are too numerous, inconspicuous, buried, or blind (a blind fault doesn't come to the surface). Thus, a background earthquake potential needs to be considered. A background earthquake is an event that can occur virtually anywhere in the county. In 2008, the magnitude 6 Wells earthquake, which occurred about 9 km (mi) north of the town of Wells (Smith and others, 2011), didn't rupture the surface and was considered a background event (Ramelli and dePolo, 2011). Douglas County is in a much more tectonically active setting than Wells and a similar event near one of its communities would not be surprising.

A magnitude 6.5 earthquake is considered the general threshold of faulting (dePolo, 1994) and is used for background earthquake hazard. It is acknowledged, however, that higher background earthquake levels, as high as magnitude 7, could occur if multiple faults fail in sequence during an earthquake, as appears to have happened in the 1932 Cedar Mountain earthquake (Bell and others, 1999).

Maximum Magnitude Analysis of Faults

A wide range of earthquake sizes can occur along a fault, from very small earthquakes to an earthquake that extends the maximum dimension of the fault zone. The largest event that will likely occur along a fault is termed the *maximum earthquake*. Most of the earthquake-planning scenarios produced in this report are based on the maximum earthquakes. It is a norm for planning scenarios to consider the largest reasonable event. Logically if you can handle the largest event, you can handle any smaller event as well (plan for the worse and hope for the best). Table 4 lists several parameters for the major faults in Douglas County, including those used in the magnitude analysis.

Two fault parameters and two studies were used to estimate maximum earthquake magnitudes. Maximum magnitudes were scaled based on fault length and maximum fault displacement. The relationships used between moment magnitude and these fault parameters were developed by Wells and Coppermith (1984) and Wesnousky (2008) and are shown in Table 5. Wells and Coppermith (1984) is the standard reference (e.g., National Seismic Hazard Map) and Wesnousky (2008) is a more contemporary study. These relationships are based on measured rupture lengths and surface displacements from historical earthquakes with known magnitudes. The "all fault types" relationship was used from each study because the statistics are more robust and there are multiple fault types in Douglas County; in other words, a distinction is not made between normal dip-slip or strike-slip earthquakes in the magnitude estimation. The results using the two studies were within 0.1 magnitude unit of each other (table 6).

Faults in Douglas County – Lengths, Offsets, and Age of the Most Recent Event

Fault	Lmin[1]	Lmax[1]	Dmax[2]	MRE[3]	Reference
Genoa flt.	25	75	5.5	300-400	Ramell+, 1999; 2012 p.c.
E. Carson V. fz.	18	26	>1.4	~520-920	dePolo and Sawyer, 2005
Mud Lake fz.	9	18		Holocene?	this report
Double Spr Flat fz.	17	30		Holocene?	Ramelli+, 2003
Smith V. flt.	45	50	3.5	~3,500	Wesnousky and Caffe, 2011
Antelope V. flt.	23	30	3.6	~1,350	Sarmiento+, 2011
E. Antelope V. fz.	23	30		late Quat.	Dohrenwend, 1982
W. Tahoe-D.P. f.	50	60	3.7	~4,300	Brothers+, 2009

1 – length of the fault zone in km, expressed in minimum and maximum values to encompass uncertainty.
2 – maximum displacement during a single earthquake.
3 - years before present; these ages are greatly simplified and are uncertain. Commonly ranges of potential ages are given or the ages act as one-sided constraints. Nevertheless a simplification is done to give the general public an approximate age of the last event.

Earthquake Magnitude Scaling Relationships Used for Estimating Maximum Earthquake Magnitudes

Wells and Coppersmith (1994) – All Fault Types

Length (L): Mw = 5.08 + 1.16 log (L)

Maximum Displacement (MD): Mw = 6.69 + 0.74 log (MD)

Wesnousky (2008) – All Fault Types

Length (L): Mw = 5.30 + 1.02 log (L)

Faults in Douglas County – Maximum Magnitude Estimates

Fault	Lmin-wc	Lmin-wy	Lmax-wc	Lmax-wy	Dmax-wc
Genoa flt.	6.7	6.7	7.3	7.2	7.2
E. Carson V. fz.	6.5	6.6	6.7	6.7	>6.8
Mud Lake fz.	(6.2)	(6.3)	6.5	6.5	
Double Spr. Flat fz.	6.5	6.6	6.8	6.8	
Smith V. flt.	7.0	7.0	7.1	7.0	7.1
Antelope V. flt.	6.7	6.7	6.8	6.8	7.1
E. Antelope V. fz.	6.7	6.7	6.8	6.8	
W. Tahoe-D.P. f.	7.1	7.0	7.1	7.1	7.1

L = fault length; D = surface displacement; wc = Wells and Coppersmith (1994); wy = Wesnousky (2008).

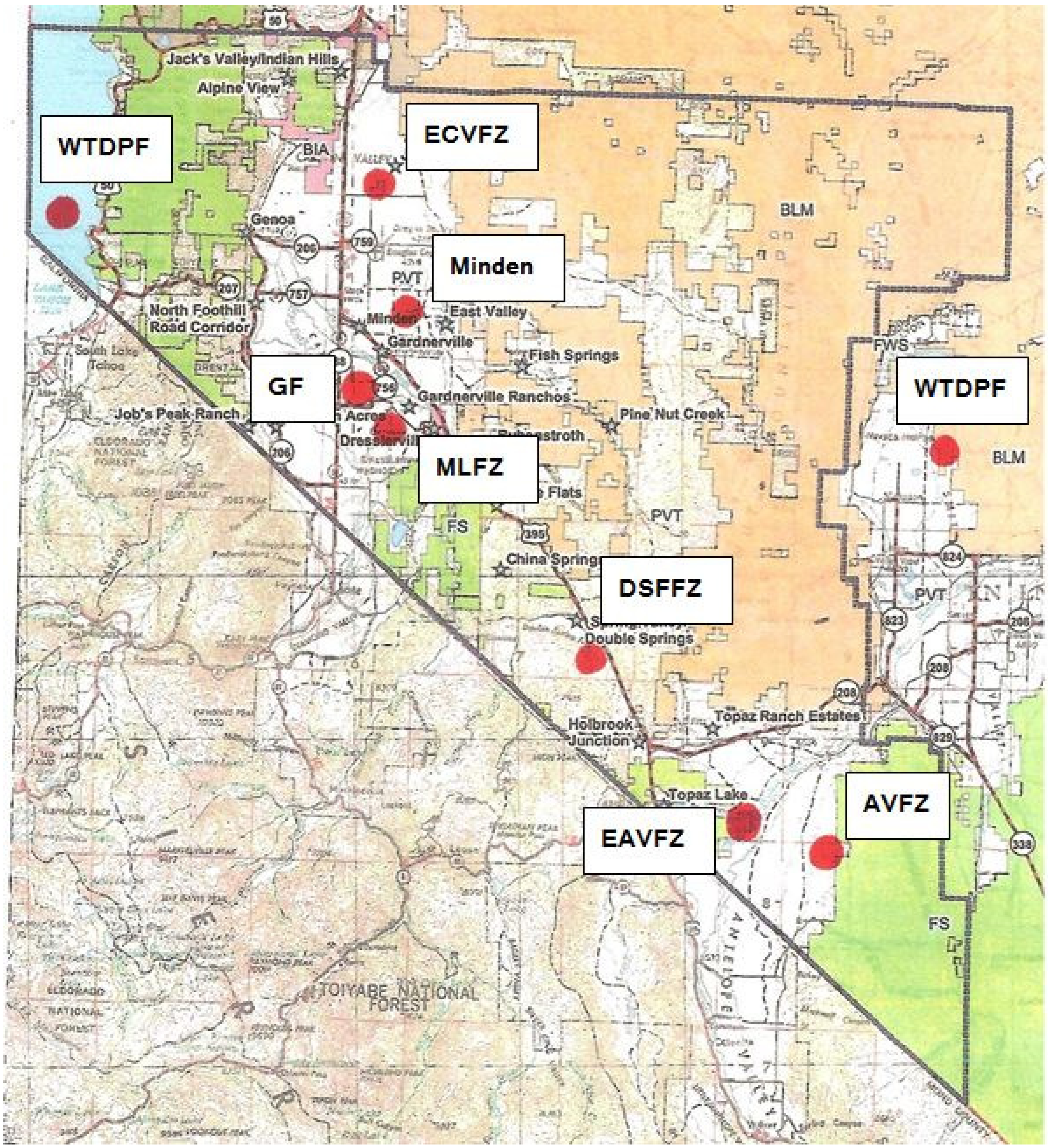
Planning Scenario Earthquakes

Scenario earthquakes have been developed for the major faults in Douglas County. Epicenters have been placed to represent earthquake hazards in different parts of the county. The epicenters are where the fault is at a depth of 10 km (~6 mi), a common initiation depth for earthquakes in Nevada. A single background scenario earthquake is considered just northeast of Minden. The HAZUS modeling for this event was done for a statewide compilation of community earthquake scenarios (Price and others, 2009; Seelye and others, in prep.). Maximum magnitude earthquakes are used so these events should represent the largest earthquakes that can occur in Douglas County. See HAZUS results for the estimated consequences of these scenario earthquakes.

Scenario Earthquakes for Faults in Douglas County

	Earthquake		Scenario Epicenter	
Fault	**Magnitude**	**Type**	**Latitude**	**Longitude**
GF	7.2	Normal Slip	38.878°	-119.753°
ECVFZ	6.8	Normal Slip	39.037°	-119.747°
SVF	7.1	Normal Slip	38.875°	-119.337°
AVFZ	7.1	Normal Slip	38.667°	-119.434°
DSFFZ	6.8	Strike Slip	38.788°	-119.608°
MLFZ	6.5	Strike Slip	38.863°	-119.720°
EAVFZ	6.8	Normal Slip	39.713°	-119.513°
WTDPF	7.1	Normal Slip	39.006°	-119.986°

Scenario earthquake epicenters and the acronyms of the faults they represent (see table 2 for fault names).



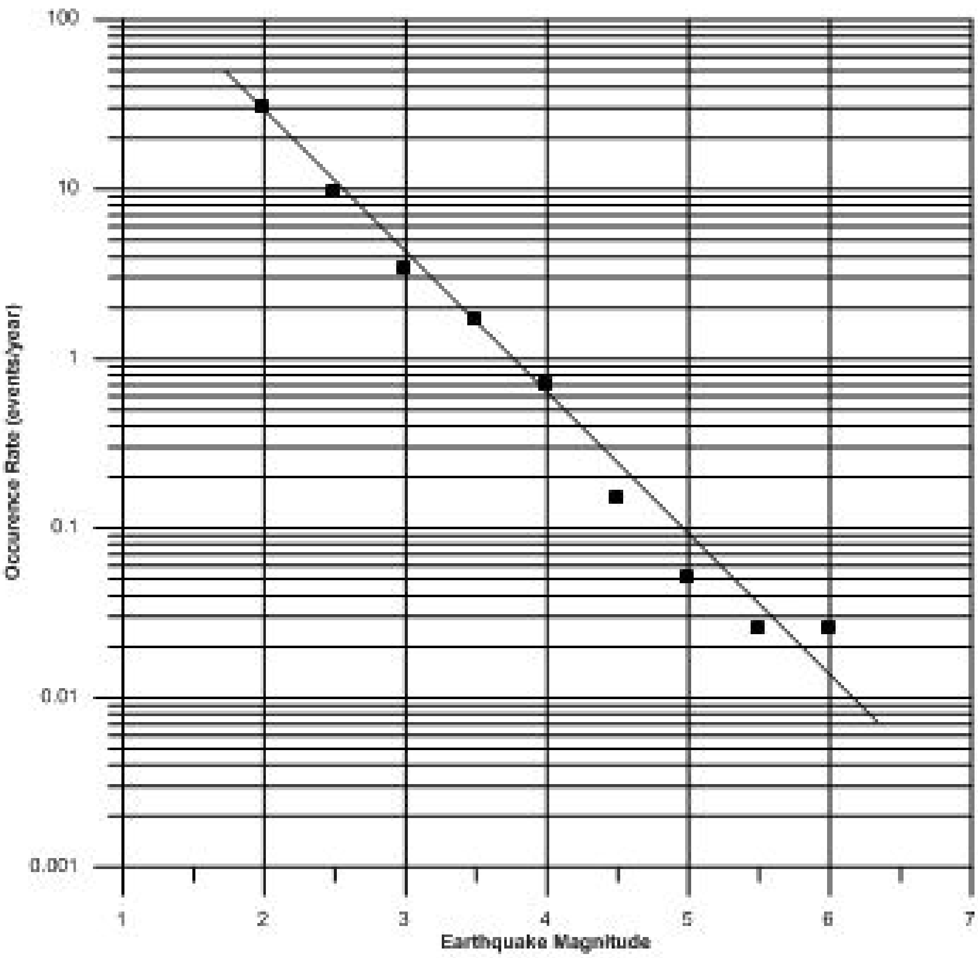
The Probability of an Earthquake in Douglas County

There is a near 50% chance of a damaging earthquake striking Douglas County within a 50-year timeframe. Over a 100-year timeframe, a damaging earthquake becomes likely. The chances of having an earthquake were estimated using three approaches to gain different perspectives on earthquake probability, make up for incomplete datasets, and to look for variations in probabilities across the county. The first approach was to use instrumentally recorded earthquakes from the Nevada Seismological Laboratory catalog and create an occurrence rate-versus-earthquake magnitude relationship. Then use this relationship to estimate the occurrence rates for the larger magnitude events. The second approach was to use web resources created by the U.S. Geological Survey for the 2008 National Seismic Hazard Map to calculate earthquake probabilities for eight communities for damaging and potentially damaging earthquakes, and the third approach was to use the same USGS web site to make seismic hazard curves for five communities.

Instrumental Earthquake Occurrence Curve for Douglas County

Earthquakes recorded instrumentally in Douglas County were used to estimate the occurrence rates and probabilities of potentially larger, damaging earthquakes. The Nevada Seismological Laboratory earthquake dataset was searched for events in Douglas County. The search found over 3,700 earthquakes recorded between 1970 and 2010, the time period that the laboratory had local instrumentation in place. For the earthquake occurrence rate analysis, events of magnitude 2 and larger that occurred during a 39-year period, 1970 and 2009, were used. The values shown in figure 4 are cumulative rates of earthquakes of the indicated magnitude or greater. The values are based on the number of events that have magnitudes within ±0.25 of the indicated magnitude values. A visually fit line was drawn through the points to show the relationship between the magnitude values and to allow a projection to the higher magnitude values. Figure 6 indicates that the earthquakes of magnitude 5 and greater occur every 11 years on average, earthquakes of magnitude 6 and greater occur every 77 years on average, and projecting the linear relationship to magnitude 7 and greater yields a once in every 500 years on average.

Occurrence rates of earthquakes of a given magnitude or greater for Douglas County, based on events that occurred from 1970 to 2009. A line was visually fit to the data to illustrate the relationship between events.



Assuming a Poisson process, the earthquake occurrence rate can be converted to the probabilities of an earthquake occurring over a given time period using $P = 1-e^{-NT}$, where P is the probability, N is the occurrence rate (events per year), and T is the timeframe of interest in years. The results for a 50-year timeframe are a 98.9% chance for a magnitude ≥5 earthquake occurring within Douglas County, a 48% chance of a magnitude ≥6 earthquake occurring, and a 9.5% chance of a magnitude ≥7 earthquake occurring (table 8). Considering a longer timeframe of 100 years yields 99.9% chance of and earthquake of magnitude ≥5 occurring, a 73% chance of a magnitude ≥6 earthquake, and a 18% chance of a ≥7 earthquake. Uncertainties in this analysis include the representativeness and completeness of the earthquake catalog for Douglas County over this time period and the assumptions associated with Poisson processes.

Probabilities of Earthquakes in Douglas County Based on Occurrence Rate Analysis of Instrumentally Recorded Earthquakes from 1970-2009

Earthquake	Occurrence	Timeframe	
Magnitude	Rate	50 Years	100 Years
≥5	0.091 events/y	98.9%	99.9%
≥6	0.013 events/y	48%	73%
≥7	0.002 events/y	9.5%	18%

Community Earthquake Probabilities and Hazard Curves

Earthquake probabilities and hazard curves were generated for several communities in Douglas County. These were made using web applications developed by the U.S. Geological Survey for the 2008 National Seismic Hazard Maps: http://earthquake.usgs.gov/hazards/ .

The earthquake probability estimations for several communities are given in table 9 and figures 5 and 6. These were generated using the website https://geohazards.usgs.gov/eqprob/2009/index.php . The probabilities were estimated for a magnitude ≥6 earthquake occurring within 50 years and 50 km (31 mi) to represent the general potential of a damaging earthquake affecting a community. These are the chances of an event similar to the 2008 Wells earthquake or larger occurring. A second set of probabilities were estimated to represent the chances of an earthquake occurring that is likely to damage a community. These are events that will likely have earthquake ground motion that will cause some Modified Mercalli Intensity VII level damage. Based on historical earthquakes and a quick examination of ground motion versus distance curves, reasonable parameters to use for earthquakes causing intensity VII damage are a magnitude ≥5 occurring within 3 km (1.9 mi), a magnitude ≥6 earthquake occurring within 20 km (12 mi), or a magnitude ≥7 occurring within 50 km (31 mi). The probabilities of these events were estimated for a 50-year timeframe and are presented in table 9. The collective probability of these events is the chances of a magnitude 5-5.9 earthquake occurring within 3 km, the chances of a magnitude 6-6.9 earthquake occurring within 20 km, and the chances of a magnitude ≥7 earthquake occurring within 50 km, added together.

The similarities in the values in the table above are more important than the differences. The chances for a strong earthquake next to a Douglas County community are around 10% in a 50-year timeframe. Chances for a nearby magnitude 6 or higher event causing damage are around 30% in 50 years. And chances for a large regional earthquake are about 15% to 20% in 50 years. As a perspective, there is a 12% chance a magnitude 6 or higher earthquake will occur within 50 km (31 mi) of Wells, Nevada over 50 years. A magnitude 6 occurred on February 21, 2008 within 9 km (5 mi) of Wells.

Maps showing the probability of a magnitude ≥6 and ≥7 within 50 years and 50 km (31 mi) are shown for Nevada in figure 7 and for the Douglas County region in figure 8. These maps clearly show the higher probabilities for earthquake occurrence in western Nevada and in Douglas County. The probabilities are similar to the 50 year values given in the table on the next page.

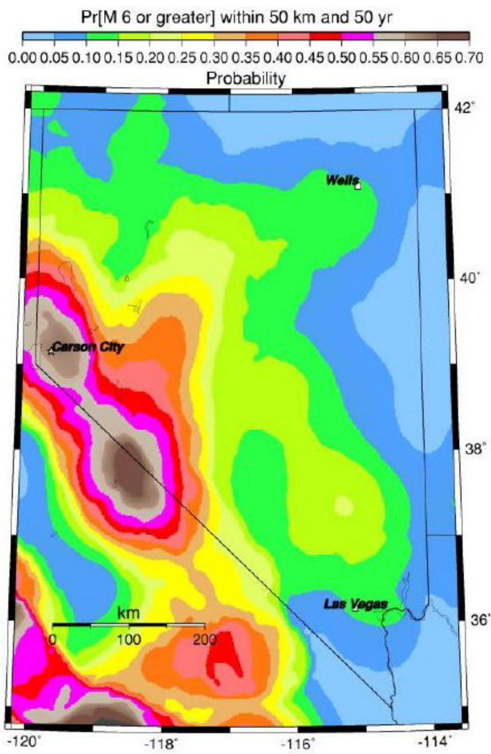
Probabilities of Potentially Damaging Earthquakes and Likely Damaging Earthquakes within 50 Years for Douglas County Communities

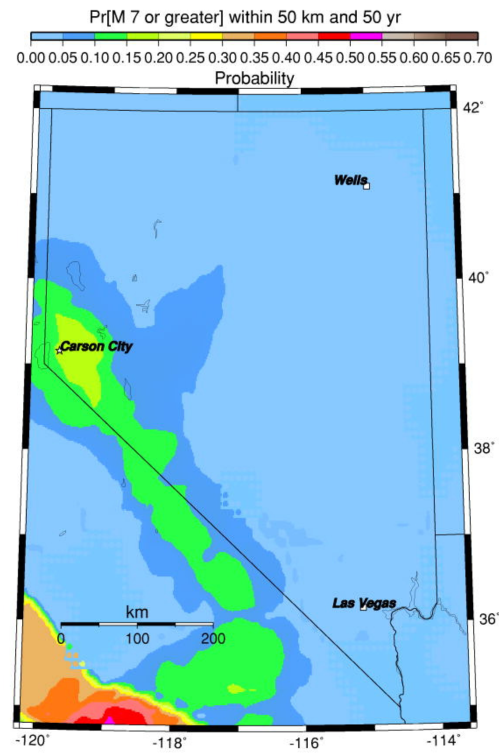
Potentially Damaging Earthquakes Likely Causing Intensity VII

Community	Mag≥6/50km	Mag≥5/3k	Mag≥6/20km	Mag≥7/50km
GARDNERVILLE R.	59-62%	14%	28-29%	15-20%
GENOA	59-63%	16%	27-28%	15-20%
GLENBROOK	59-62%	6%	33-34%	15-20%
INDIAN HILLS	61-64%	14%	34-35%	15-21%
JOHNSON LANE	61-64%	12%	31-33%	16-20%
MINDEN	60-63%	12%	29-30%	15-20%
STATELINE	57-61%	21%	26-27%	14-19%
TOPAZ LAKE	52-57%	9%	26-27%	14-18%

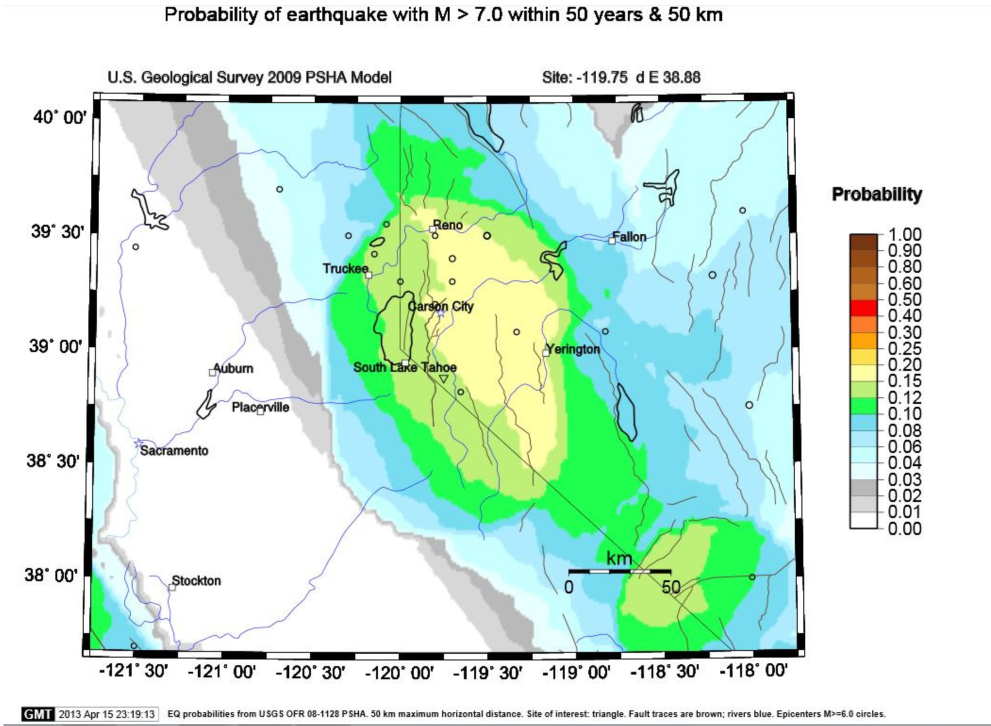
All Earthquakes Likely Causing Intensity VII

Community	Probability in 50 years
GARDNERVILLE R.	33-40%
GENOA	36-45%
GLENBROOK	39-48%
INDIAN HILLS	40-49%
JOHNSON LANE	36-45%
MINDEN	32-41%
STATELINE	29-38%
TOPAZ LAKE	30-38%





Probability of having an earthquake in Nevada. Over a timeframe is 50 years the probability was calculated for having a magnitude 6 or greater (left) or a magnitude 7 or greater (right) earthquake within 50 km (31 mi) of any point on the map. The highest probability of having a M ≥6 earthquake is in the western part of Nevada. However, the community of Wells in northeast Nevada, which has a 12% chance of having a magnitude ≥6 earthquake, was struck by a magnitude 6 in February 2008. These maps were made courtesy of Stephen Harmsen, US Geological Survey.



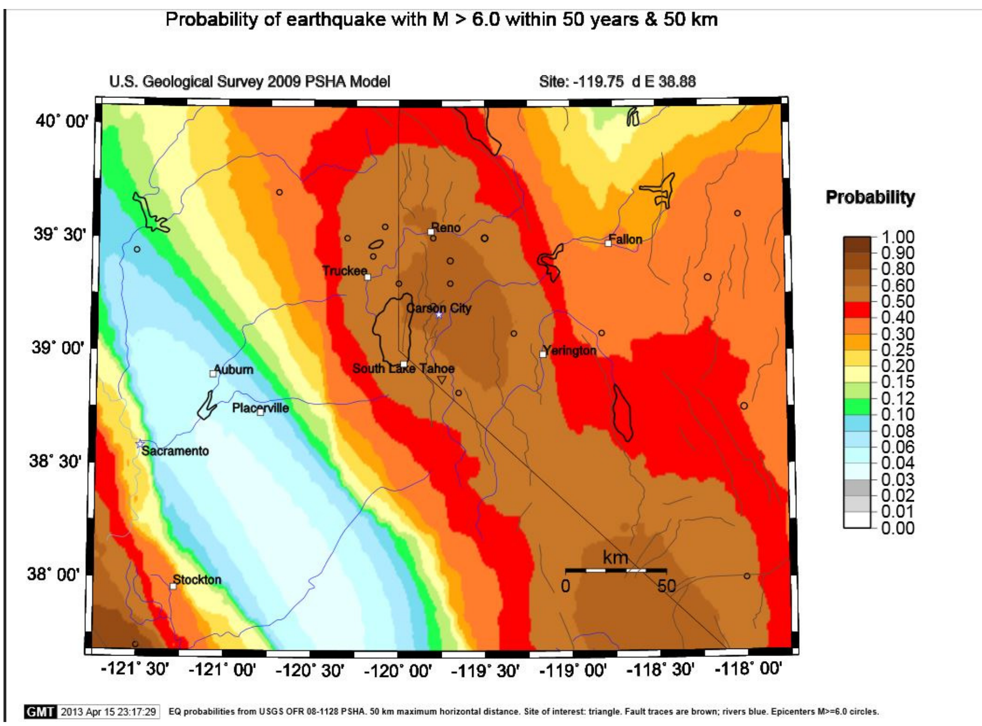


Figure 8 Probability of a magnitude ≥6 earthquake (upper map) and a magnitude ≥7 earthquake (lower map) striking the Douglas County region within 50 years and within 50 km (31 mi) of any location based on the U.S. Geological Survey's National Seismic Hazard Map data (USGS web application - see text for website).

A second approach for examining the potential damage to communities by earthquakes is to generate hazard curves for the communities, again using a web application provided by the U.S. Geological Survey. This application calculates the occurrence rate of the level of ground motion occurring at a location, based on the National Seismic Hazard Map (http://geohazards.usgs.gov/hazardtool/application.php). Dr. John Anderson of the Nevada Seismological Laboratory kindly made figure 9 using this application for several Douglas County communities. The similarity of the curves indicates that these give a general probability for the county and communities. Communities not listed should use the curve for the community closest to them. Included on this figure are potential Modified Mercalli Intensity values based on those given in Bolt (1999). Thus, the occurrence rate for when the level of ground motion, in acceleration, for a particular intensity can be approximated for a given community curve. Similar to instrumentally recorded earthquakes, the occurrence rates for a given magnitude can be converted to probabilities of occurrence for a given timeframe.

An example will help understand figure 9. The blue line is the earthquake hazard curve for Minden. The graph is occurrence rate versus ground acceleration, here expressed as a percent of gravity, or “g”. The larger the ground acceleration is the stronger the ground motion from an earthquake. Stronger ground motion is less frequent than weaker ground motion and the curve describes this relationship using occurrence rate, or events per year; in this case the number of times per year a level of acceleration occurs. If the occurrence rate is inverted (1 divided by the occurrence rate), the result is a once-in-so-many-years expression of the ground motion. Intensity VI is a level of ground motion that begins to crack walls. The central part of intensity VI ground motion begins at an acceleration of 0.06 g (fig. 7). The curve for Minden indicates a peak ground acceleration of 0.06 g occurs with an occurrence rate of 0.05 events per year, or once in 20 years on average. Thus, we learn how frequently Minden has ground motion from earthquakes that can crack walls - once every 20 years on average. The last such event occurred in 1994, which just happens to be about 19 years ago. The graph indicates that on average intensity VII ground motion occurs in Minden once every 77 years, intensity VIII ground motion occurs once every 233 years, and intensity IX ground motion occurs once every 588 years. Note that these statistics are based on average communities. Communities that work towards being earthquake resilient can experience higher levels of ground motion with less damage than estimated here. In other words, seismic risk mitigation can affect these estimates.

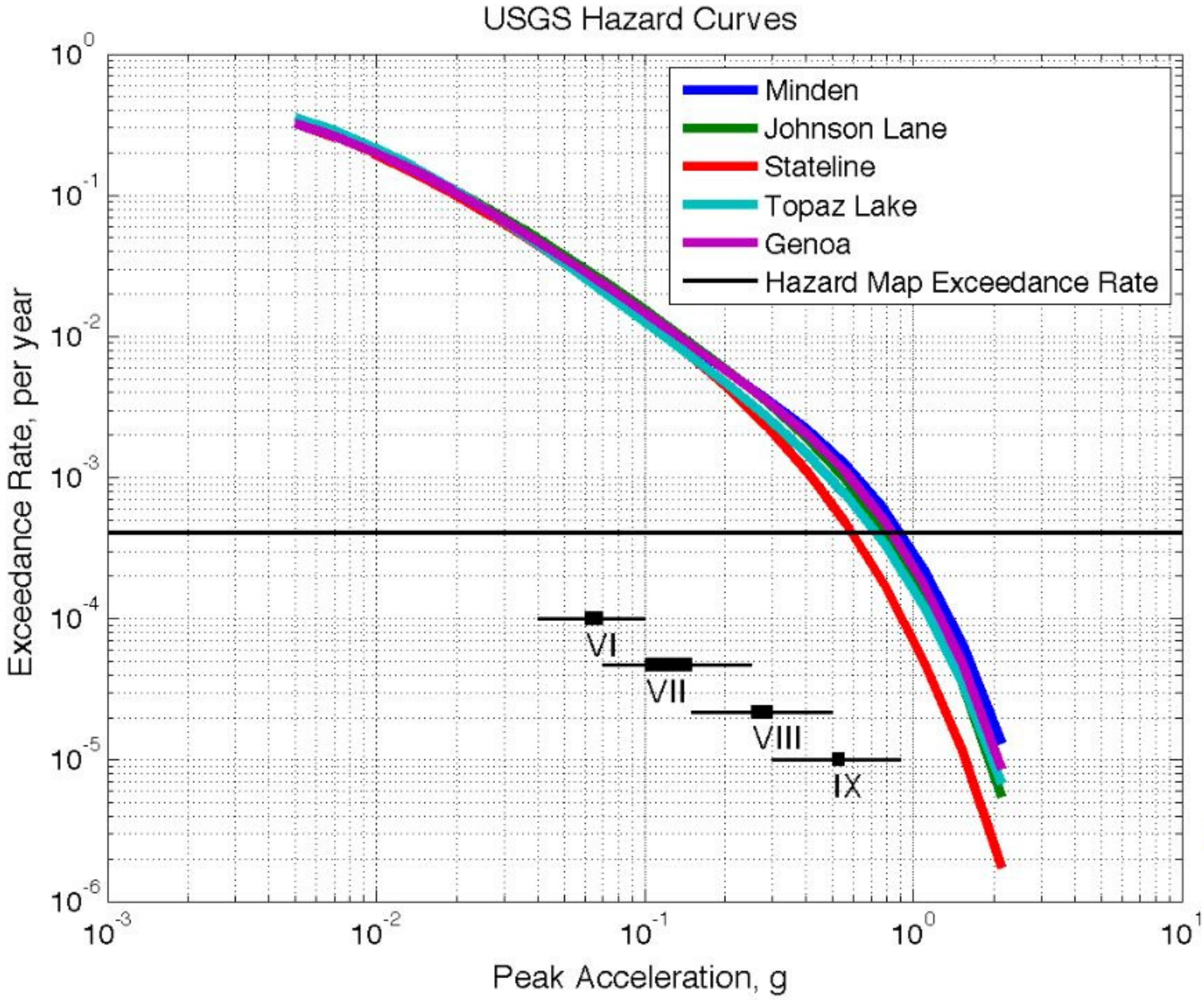


Figure 7 U.S. Geological Survey earthquake hazard curves for five Douglas County communities. Also shown are ranges of ground motion that can be associated with Modified Mercalli Intensity; these values are from Bolt (1999). This figure was prepared by Dr. John A. Anderson of the Nevada Seismological Laboratory.

Table 10
Probabilities of Modified Mercalli Intensity Levels Occurring in Douglas County Communities Based on the U.S. Geological Survey Hazard Curves

Earthquake Intensity	50-Year Probability	100-Year Probability
VI	**68-78%**	**90-95%**
VII	**39-48%**	**63-73%**
VIII	**11-19%**	**21-35%**
IX	**2-8%**	**5-16%**

Discussion

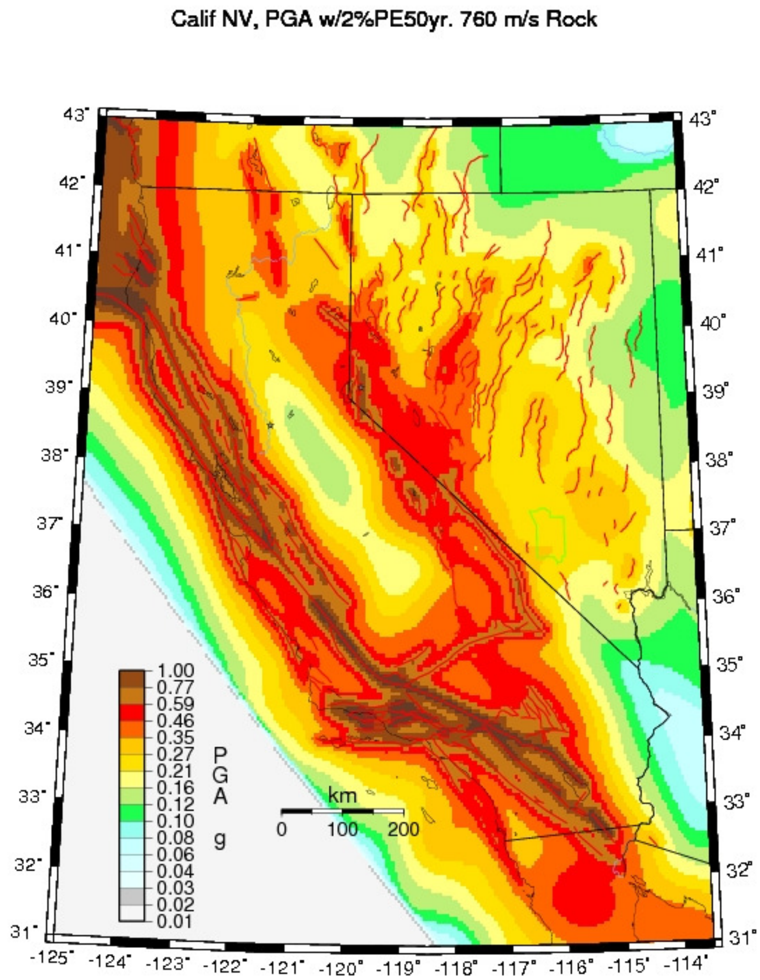
Within a 50-year timeframe, Douglas County has a 99% chance of having a magnitude 5 or larger earthquake, about a 50% to 60% chance of having a magnitude 6 or larger earthquake, and a 10% to 20% chance of having a magnitude 7 or larger earthquake. In terms of damage, over a 50-year timeframe there is a 39% to 48% chance of having ground motion levels that would correspond to Modified Mercalli Intensity VII, or strong enough to damage and topple chimneys. Thus, there is a substantial probability of a potentially damaging earthquake in Douglas County.

The values given in table 10 can also be used to estimate the chance that and emergency response to a damaging earthquake or a major recovery effort will be required in Douglas County. Assuming that an emergency response would be mounted for an earthquake that causes intensity VII or higher damage and that a major recovery effort for a community will be required with intensity VIII or higher damage, the probabilities of these operations can be estimated. Using the probabilities in table 10 and the assumptions stated, the chances for mounting an emergency response to an earthquake in Douglas County are 39% to 48% and the chances that a major recovery effort will be needed for an earthquake-damaged community are 11% to 19%.

Earthquake Strong Ground Motion Hazard

Shaking of the ground is the most damaging and widespread effect from earthquakes. Estimating the potential earthquake ground motion at a site is an involved process because several factors affect this motion including the size of an earthquake, its distance, whether there is rock or soft sediments, and the size and shape of sedimentary basin. Thus, seismologists and engineers need to have information on a number of parameters to make site-specific characterizations of potential earthquake ground motion.

Peak ground accelerations in percent of gravity (g) for bedrock are shown in figure 8 give a relative sense of the strong ground motion potential in Douglas County. The map is from the National Seismic Hazard Map project (http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/) and are used as earthquake ground motion input for the International Building Code. The graph presented in figure 7 also portrays these peak ground accelerations for several communities in Douglas County and has a black horizontal line indicating the 2% probability of exceedance in 50 years (a once in a 2,500 year event) used in the International Building Code and figure 8.



Peak ground acceleration map from the 2008 National Seismic Hazard Map for Nevada and California. These values have a 2% chance of being exceeded within 50 years. The highest peak ground acceleration values in the state are estimated for Douglas County.

The 2008 National Seismic Hazard Map indicates that some of the highest ground motion levels in the state can occur in Douglas County. The specific ground motions from the next earthquake cannot be precisely predicted because of the many variables involved that influence ground motion, but the peak ground accelerations indicated by the figure above range from ~0.5 g to ~0.9 g, with a 2% chance of being exceeded in 50 years. Such ground motions, if sustained for a short period of time, can cause damage commensurate with Modified Mercalli Intensity IX, or levels where significant damage occurs in buildings that lack earthquake resistance in their design and construction.

Peak ground velocity estimates, another measure of ground motion, are 49 cm/s to 140 cm/s, with a 2% chance of being exceeded in 50 years (2008 National Seismic Hazard Map). Ground motion values tend to mean more to engineers that have to design buildings to withstand them than the general public.

Earthquake Surface Rupture Hazard

When earthquakes reach magnitude 6.5 ±0.3, the rupture tends to offset the ground surface (c.f., dePolo, 1994). These offsets are known as earthquake surface or ground rupture. In Douglas County, evidence for surface rupture hazard includes paleo-earthquake ground ruptures and offset landforms that were created by repeated offset of the ground surface along a fault. Historical surface fractures were formed aseismically in 1980 along a fault on the west side of Fish Spring Flat (Bell and Helm, 1998) and on the same fault trace, fracturing was triggered by the 1994 Double Spring Flat earthquake (Ramelli and others, 2003).

The potential for ground surface rupture is along and immediately adjacent to the mapped traces of late Quaternary faults (faults that have moved in the last 130,000 years). This timeframe is longer than in places like western California, mostly because faults within this timeframe have had major earthquakes in the Basin and Range Province (dePolo and Slemmons, 1998). The 1887 magnitude 7.4 Sonoran, Mexico earthquake, the largest historical normal dip-slip earthquake in the province, occurred along a fault that hadn't moved in 100,000 years (Bull and Pearthree, 1988).

In Douglas County there are many late Quaternary fault traces and many fault traces with unknown activity. Some faults are relatively simple ruptures, such as sections of the Genoa fault, and others are broad and include many fault traces, such as the Eastern Carson Valley fault zone. Surface rupture hazard partly depends on the complexity fault traces, so the multi-trace Eastern Carson Valley fault zone poses a high surface rupture hazard.

The most straightforward way to mitigate for surface rupture hazard is to avoid building across late Quaternary faults. In denser housing developments, areas along faults can be used for alternative purposes, such as natural green belts, parks, and golf courses. Backyards can be placed along faults to help protect streets and utilities. Some structures, such as pipelines, cannot avoid crossing active faults. It is best to engineer and construct these crossings to limit damage from ground offset. For example, a pipeline packed with loose sand on the down-thrown side can pull out of the ground without being broken if vertical offset occurs. The key is to know where the faults are located, plan wisely for surface rupture hazard, and encourage the appropriated mitigation design of facilities that must cross faults.

In Douglas County, 1:24,000-scale fault maps of the urban areas should be made that identify known and possible fault traces. Guidelines need to be developed on the best exploratory and mitigation approaches when development approaches potentially hazardous faults. Exploration techniques, like trenching, are used to identify the specific locations of fault traces or the non-existence of a fault trace. When faults are recognized early in the planning phase of projects, it is easier to consider low-cost mitigation measures, such as fault avoidance. A surface rupture mitigation strategy for Douglas County will reduce structural losses and costs of future ground rupturing.

Earthquake-Induced Liquefaction Hazard

Liquefaction hazards exist in Carson Valley, along the shores of South Lake Tahoe, in northern Antelope Valley, and in several small basins. Liquefaction occurs in places where groundwater is shallow and sediments, classically fine sands, are young and unconsolidated. When these types of saturated sediments are shaken strongly for a period of time, they can consolidate and expel the water from pore spaces. When pore pressure increases rapidly and cannot be dissipated, a phenomenon known as liquefaction occurs. During liquefaction, the soil column can behave as a liquid. When this happens, a sand-water mixture can squirt out of the ground, the land surface can flow downhill or sideways, and the ground may no longer be able to support the weight of buildings. Buildings on liquefied ground can sink and break up. Other effects of liquefaction are the violent oscillations that are potentially damaging to buildings and infrastructure.

A preliminary representation of liquefaction was constructed for the 1996 Planning Scenario for a Western Nevada Earthquake (dePolo and others, 1996; shown in figure 9). This map was made with the information available at the time. It is generalized and does not include southern Douglas County. For planning and appropriate land use purposes a more detailed, county-wide liquefaction analysis is necessary. Updated detailed geologic mapping and groundwater information can be utilized for a more detailed map. The 1996 liquefaction map illustrates the hazard.

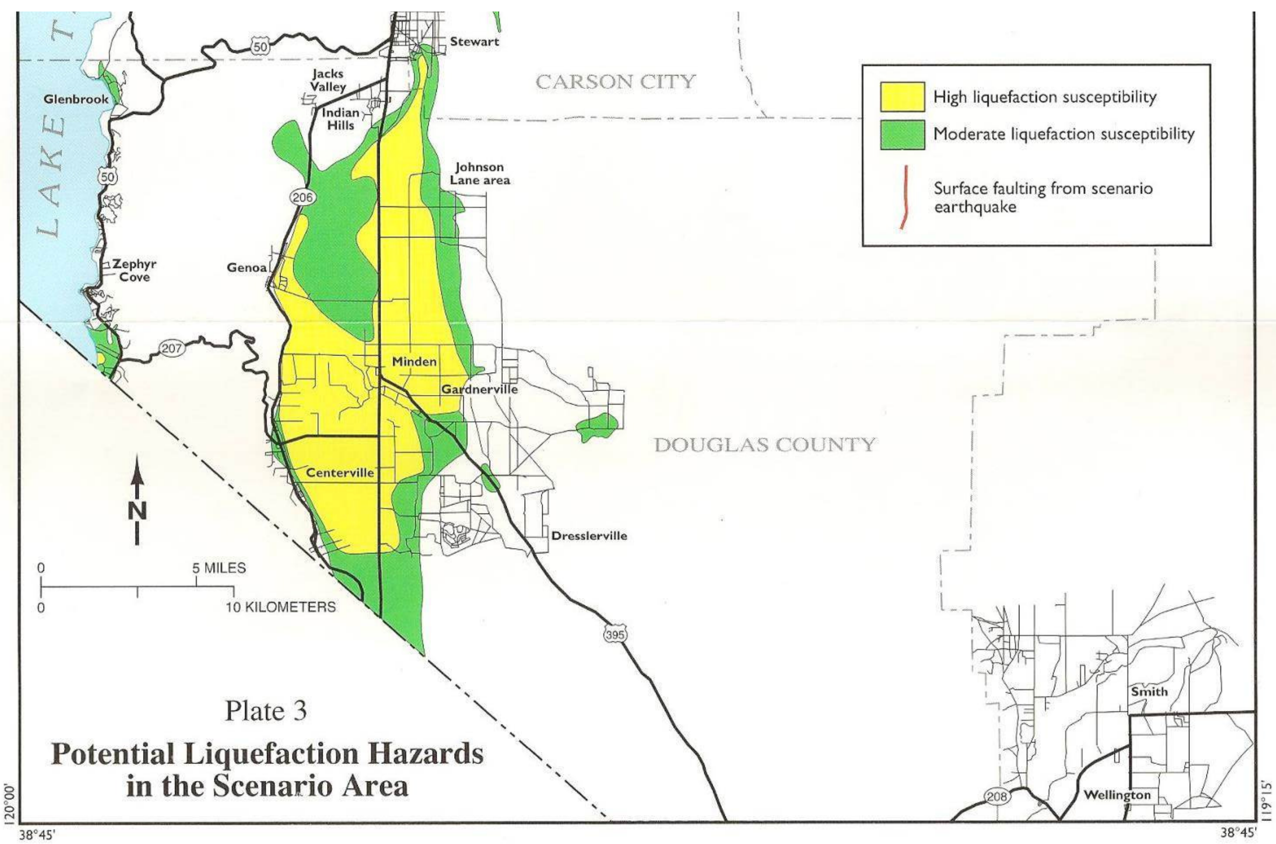


Figure 9 The southern part of the liquefaction map from the Western Nevada Planning Scenario (dePolo and others, 1996). This generalized map shows potential areas of liquefaction in northern Douglas County.

There were reports of liquefaction in Carson Valley during the June 6, 1887 Carson City earthquake. The Nevada Tribune reported that, “In the corral, walking across either way, the ground seems as though all was hollow underneath, and by driving a pole down two or three feet, water flows immediately to the surface, and wherever a fissure is seen, black sand several inches deep has been thrown up,” on the Boyd Property. This is a fairly precise description of liquefaction.Guidelines for building on lands that are potentially liquefiable should be developed. Then structures can be constructed with the appropriate resistance to potential ground oscillation and consideration of potential settlement and/or lateral movement caused by future liquefaction.

Earthquake-Induced Rock Fall, Landslide, and Snow Avalanche Hazard

Mountain and hill slopes can be subject to seismically induced rock falls, landslides, and snow avalanches. Depending on down slope vulnerabilities, some of these hazards can have potentially disastrous consequences and should be addressed in planning and mitigation. Potential consequences include rock and earth impact, inundation, and burial of people, homes, buildings, roadways, and other infrastructure.

Mitigation actions include the definition and characterization of potential landslides and rock falls in developed areas and planned expansion areas. These maps can be used to characterize the potential impact of landslides and rock falls. Based on the risk, possible mitigation actions might include warning signs with safety instructions and relocation or hardening of facilities. Some situations can be recognized but not be practically mitigated, such as large landslides or rock falls along roadways. In critical cases useful planning can still take place. The potential amount of landslide debris, the equipment required to remove this debris, and the location of this equipment can be prepared and would be useful in an earthquake emergency. Snow avalanches are generally covered by contemporary snow avalanche planning, but emergency planners and responders should keep this potential hazard in mind during wintertime disasters.

Earthquake Lake Tsunami and Lake Seiche Hazard

Earthquake-induced waves are possible immediately following a large earthquake along the shores of Lake Tahoe and Topaz Lake. The West Tahoe-Dollar Point fault has a large underwater section and an earthquake along the fault could down-drop the floor of Lake Tahoe within a matter of seconds. The column of water above this offset would be dropped, leading to an uneven water surface and a wave flowing towards the down-dropped side. This wave would move across the lake and run up on shorelines. In coves, the water would potentially be concentrated and have a higher run up. Lake tsunamis can be generated by fault offsets of the lake bottom, by large landslides into a lake, or failure of submerged shelves of sediment. Tsunamis in Lake Tahoe from different fault scenarios were modeled by Ichinose and others (2000), but run up distances were not generated by that study.

A seiche is an oscillatory wave set up in a closed body of water. Seiches can form from lake tsunamis or they can be induced by seismic waves from earthquakes that are farther away.

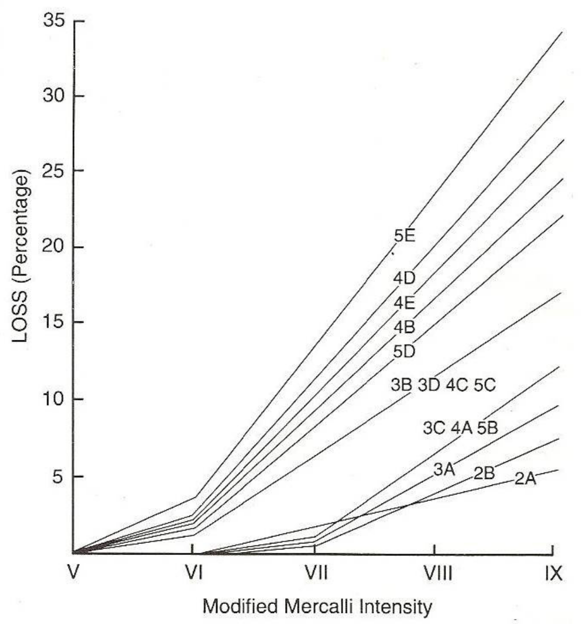
A lake tsunami and seiche occurred following the 1959 M7.3 Hebgen Lake, Montana earthquake. Hebgen Lake is located along the hanging wall of the fault that generated the earthquake. The initial "surge" of water in Hebgen Lake overtopped the Hebgen Lake Dam by about a foot of water (30 cm)(Myers and Hamilton, 1964). Oscillatory waves (seiche) continued for at least 12 hours and had a period of about 15 minutes (Myers and Hamilton, 1964). The dam was overtopped three to four times. The tsunami was the initial surge of water was the lake surface trying to equilibrate after being deformed. The seiche was the waves set up in the lake. Similar tsunami and seiche are expected in Lake Tahoe and Topaz Lake. A tsunami in Owens Lake, following the 1872 Owens Valley, California earthquake (Smoot and others, 2000) and there was a possible seiche in Mono Lake, California from the 1932 Cedar Mountain, Nevada earthquake (Reno Evening Gazette, 12/23/1932).

The potential run-up distance from tsunamis and seiches needs to be modeled and mapped. Based on the potential severity of these waves, signs can be installed that indicate potential inundation and evacuation areas, routes to safe elevations as information and a warning for citizens and visitors. An alternative to high ground is to create vertical evacuation structures closer to the shoreline, that can withstand a tsunami or seiche wave. These can commonly be dual usage structures and blend into the landscape.

Vulnerabilities, Consequences, and Potential Losses from Earthquakes in Douglas County

Earthquake losses and damage

Strong earthquake shaking and ground offsets commonly damage buildings and other structures, especially those that lack seismic resistance or have seismic vulnerabilities. Buildings built before the 1970s may not be designed to resist seismic shaking. Whether they have lateral strength, are tied together as a unit, or are anchored to their foundation is highly variable. Another consideration for earthquake risk is the type of building construction used. Different types of buildings have different chances for successfully surviving earthquakes, figure 10. Buildings that are designed and constructed in compliance with the building codes have a good chance of protecting the occupants, called life safety protection. It is important to note that even though life safety is achieved, there can be considerable damage to a structure that experiences strong earthquake ground motion. Considerations beyond the building code are needed for structures to have limited damage from earthquakes or to continue to be operational through earthquakes. Choosing the level of damage or to maintain operational capability of a building after an earthquake is called performance-based earthquake engineering.



Construction Classes

Building Class	Brief Description of Building Subclasses
1A-1	Wood-frame and stuccoed frame dwellings regardless of area and height
1A-2	Wood-frame and stuccoed frame buildings, other than dwellings not exceeding three stories in height or 3,000 square feet in ground floor area
1A-3	Wood-frame and stuccoed frame structures not exceeding three stories in height regardless of area
1B	Wood-frame and stuccoed frame buildings not qualifying under class 1A
2A	One-story, all metal; floor area less than 20,000 square feet
2B	All metal buildings not under 2A
3A	Steel frame, superior damage control features
3B	Steel frame, ordinary damage control features
3C	Steel frame, intermediate damage control features (between 3A and 3B)
3D	Steel frame, floors and roofs not concrete
4A	Reinforced concrete, superior damage control features
4B	Reinforced concrete, ordinary damage control features
4C	Reinforced concrete, intermediate damage control features (between 4A and 4B)
4D	Reinforced concrete, precast reinforced concrete, lift slab
4E	Reinforced concrete, floors and roofs not concrete
5A	Mixed construction, small buildings and dwellings
5B	Mixed construction, superior damage control features
5C	Mixed construction, ordinary damage control features
5D	Mixed construction, intermediate damage control features
5E	Mixed construction, unreinforced masonry
6	Buildings specifically designed to be earthquake resistant

Figure 10 Loss percent of different building types versus Modified Mercalli Intensity. From National Research Council (1989).

In addition to adopting and enforcing building codes, communities should assess the seismic vulnerability of existing buildings and structures and systematically mitigate structures with the highest earthquake risk. A useful tool for building assessments is the Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154, http://www.fema.gov/library/viewRecord.do?id=3556). This procedure is a rapid review of the sides of a building, ranking on a number of construction questions, and a picture and/or sketch. The result is not certain, but it gives a well-founded ranking of whether a building is vulnerable to earthquakes and it can eliminate some buildings from hazardous categories. To attain a final judgment on a building's construction, the building plans need to be reviewed and/or the building needs to be explored, and the construction type and seismic vulnerability need to be assessed by an engineer. The short list provided by the rapid visual inspection reduces the number of buildings that need this final seismic vulnerability assessment. These assessments are not made lightly because of their importance and the potential consequences to building owners in cost and potential disruption if seismic mitigation is deemed necessary. Old unreinforced masonry buildings are some of the most dangerous during earthquakes, but other building types have seismic vulnerabilities as well, such as non-ductile concrete, pre-1980s concrete tilt-up construction, and soft-story construction. Older residential units and mobile homes are also vulnerable to earthquakes because they may not be tied to their foundations and can fall off during strong shaking, sometimes totally destroying the home.

Fortunately, building codes have been adopted in Douglas County at least since 1983 and many facilities are relatively new and were built to these code standards. Today, the 2006 International Building Code and 2006 Residential Code have been adopted by Douglas County and are administered in an above-the-code fashion. The details of construction practice should be reviewed but this history of code adoption should result in many buildings and facilities in Douglas County having some seismic resistance.

Another important seismic risk that communities should address is nonstructural earthquake hazards. Nonstructural hazards include building infrastructure and the contents people place in buildings. Nonstructural hazards are important to address because they account for many injuries during earthquakes and can comprise a major percentage of the economic loss created by earthquakes. Nonstructural hazards posed by building contents can commonly be mitigated by building occupants or owners. Safety can be gained by relocating or securing dangerous items in areas that are occupied by people, such as bedrooms and work areas. It is important to have safe places in each room that is occupied to protect yourself from falling objects. In some cases, a safety spot will have to be created or simply identify existing safety spots so you can automatically take cover if you feel shaking.

Two tools were used to gain a perspective on the potential earthquake risk in Douglas County, HAZUS modeling and a preliminary estimation on the number of possible unreinforced masonry buildings in the county.

HAZUS Modeling of Scenario Earthquakes

Earthquake scenario modeling allows us to estimate the levels of earthquake damage. Scenarios illustrate the widespread, complex, and interdependent effects that can occur during earthquakes. The specific details of any given earthquake cannot be precisely predicted. The ground motion from each earthquake is unique. Toppozada and others (1988) liken this kind of assessment to predicting with certainty whether a person who is driving under the influence of alcohol will have an accident or not. This kind of prediction isn't possible, but one can say with certainty that the probability of having an accident is significantly higher. Based on past earthquakes, some building types, such as unreinforced masonry buildings, have a higher chance of being damaged during earthquakes. Earthquake damage assessments, such as HAZUS, take these chances into consideration when modeling the potential damage from earthquakes. They are approximations, but very useful approximations.

The FEMA earthquake modeling program HAZUS was used to model eight scenario earthquakes. One background earthquake located just north of Minden and the major faults in Douglas County were used as earthquake sources. The HAZUS earthquake program is a standardized loss estimation program accepted by FEMA and used during earthquake emergencies by Nevada as a disaster assessment tool. The recent version of HAZUS has been underestimating damage costs for some Nevada communities, but this version was utilized for this study because the loss values generated seem reasonable (slightly upgraded estimates may be available for the final version of this report). The HAZUS results are summarized in table 11 and figure 11.

Table 11
Estimated Costs of Earthquakes Occurring along the Major Late Quaternary Faults in Douglas County – HAZUS MH Computer Modeling

Fault	Earthquake Magnitude	Building Damage	Transportation Damage	Utility Damage	Total Cost*
E. Carson V. f	M6.8	$741M	$12M	$21M	$774M
Genoa f	M7.2	$423M	$7.6M	$19M	$450M
Double Spring F. f	M6.8	$314M	$7.2M	$12M	$333M
Mud Lake f	M6.5	$216M	$5.7M	$7M	$229M
W. Tahoe-D.P. f	M7.1	$195M	$4.8M	$7M	$207M
Antelope V. f	M7.1	$140M	$3.5M	$13M	$157M
Smith V. f	M7.1	$127M	$5M	$25M	$157M
E. Antelope V. f	M6.8	$70M	$2.7M	$6M	$79M

*costs for Nevada only

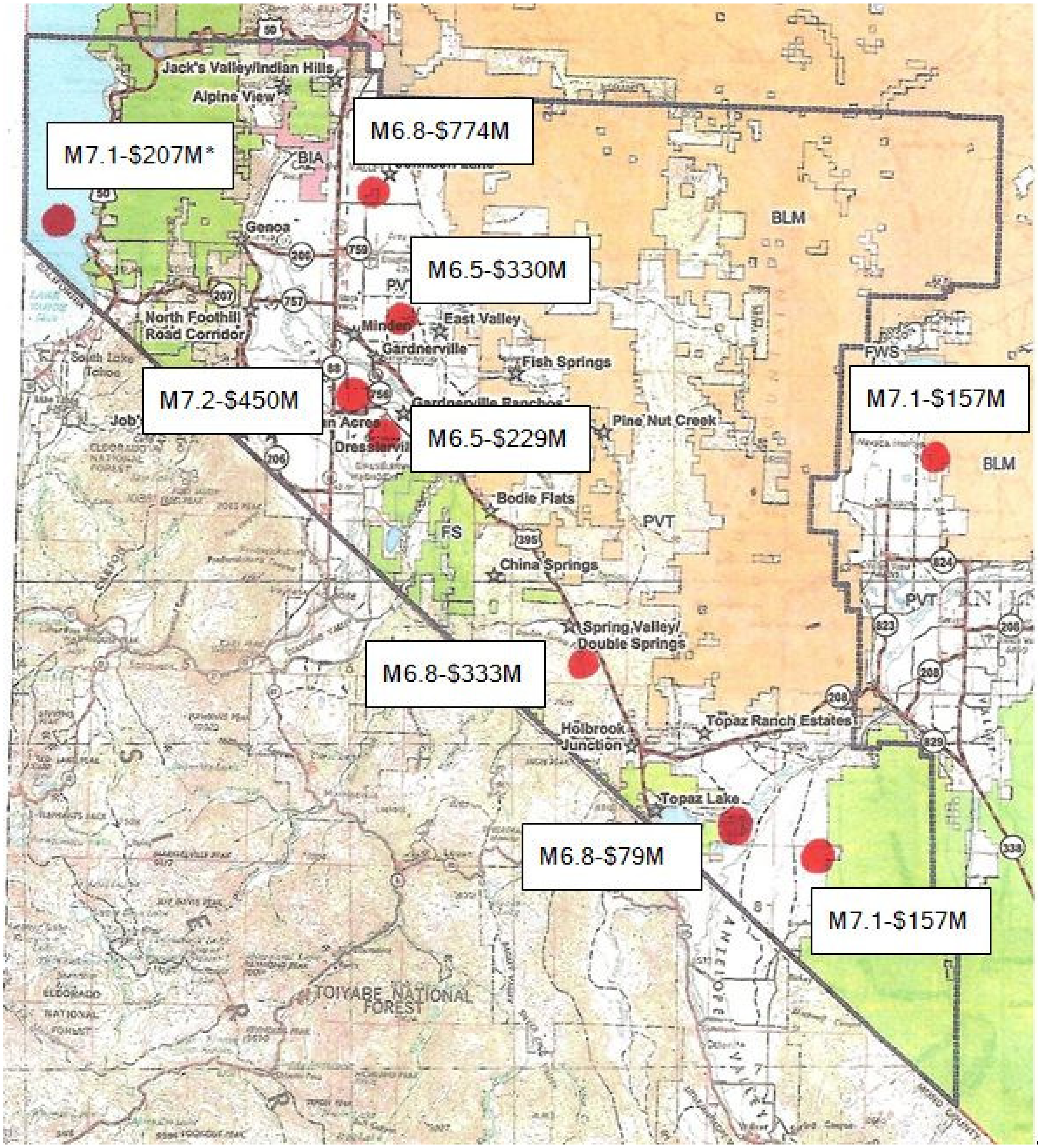


Figure 11 Earthquake planning scenarios run for major faults in Douglas County and a background earthquake just north of Minden. The scenario epicenters are indicated by red dots and labels show the magnitude of the earthquake and the HAZUS estimated dollar loss. The scenario earthquakes are listed in table 7.

The HAZUS results indicate that earthquakes of magnitude 6.5 to 7.2 within Carson Valley will potentially costs and losses from $207 million to $774 million dollars to Nevada. Earthquakes of magnitude 6.8 to 7.1 on the outer parts of the county give cost estimates of $79 million to $207 million. These losses are general approximations and are considered to be within a factor of 10 of the actual values that could occur from an earthquake. For example, a real earthquake in a location with an estimate of $207 million (rounded to $210 million), could cost between $21 million and $2.1 billion.

Nevertheless, the loss estimates indicate earthquakes which could occur within the county would have a devastating effect if Douglas County was unprepared.

Table 12 Preliminary HAZUS Results for the 2013 Statewide Survey (Seelye and others, in prep.)

Minden, Nevada

Epicenter at 119.73°W longitude, 38.97°N latitude

Results of earthquake scenarios using HAZUS, the Federal Emergency Management Agency's loss-estimation model. All numbers are estimates; individual numbers may vary by a factor of 10, depending on the location, depth, and magnitude of the earthquake.

Study Region: **Douglas County**	Earthquake Magnitude				
	5.0	5.5	6.0	6.5	7.0
Number of buildings with extensive to complete damage	5	30	120	380	580
People needing public shelter	0	4	17	57	85
People needing hospital care	0	1	2	8	14
Fatalities	0	0	0	2	3
Total economic loss ($ million)	9	30	74	170	230

Study Region: **All Nevada counties**	Earthquake Magnitude				
	5.0	5.5	6.0	6.5	7.0
Number of buildings with extensive to complete damage	5	36	160	620	2,900
People needing public shelter	0	5	23	93	450
People needing hospital care	0	1	3	12	59
Fatalities	0	0	0	2	8
Total economic loss ($ million)	10	38	110	330	950

Study Region: **Nevada and adjacent states**	Earthquake Magnitude				
	5.0	5.5	6.0	6.5	7.0
Number of buildings with extensive to complete damage	5	37	160	650	3,000
People needing public shelter	0	5	24	98	460
People needing hospital care	0	1	3	13	60
Fatalities	0	0	0	2	13
Total economic loss ($ million)	10	42	120	360	1,000

The preliminary results for Minden are from an "in preparation" statewide community HAZUS earthquake assessment (Seelye and others, in prep.) and are shown in Table 12. This table gives several perspectives of HAZUS results. It shows the impact of different magnitude earthquakes in the same location. It also shows a breakout of the cost of the earthquakes for Douglas County, all Nevada Counties, and Nevada and California together. This table also illustrates that large earthquakes affect multiple jurisdictions and multiple states.

Table 12 indicates that the smaller events, magnitude 5 to 6 cause mostly local effects, and magnitude 6.5 and greater events begin to substantially affect areas outside the county. Magnitude 5 to 6 events have estimated costs to Douglas County of $9 million and $74 million, respectively. A magnitude 6.5 in this position could cause $170 million damage to Douglas County, $330 million to Nevada counties, and $360 million when California is also included. This would be a major regional event. A magnitude 7 earthquake in this location could cause $230 million dollars damage to Douglas County and $770 million dollars outside of Douglas County. Thus, even though the earthquake originated in Douglas County, most of the damage is to the higher population centers in the region. In such an event, Douglas County may have access to less mutual-aid help than usual because the damage is so widespread and the regional demand for mutual aid would be extremely high.

Unreinforced Masonry Buildings

Unreinforced masonry buildings (URM) are among the most dangerous buildings to be in or around during an earthquake. URMs are associated with loss of life and extensive property damage, from moderate or larger earthquakes. When the 2008 magnitude 6 earthquake struck, there were 19 URMs or partial URMs in Wells, Nevada. All these buildings had cracking and minor damage, and 12 of them (63%) had major damage following the earthquake (dePolo, 2011). Earthquake damage to URMs from earthquakes includes parapet failures, collapse of floors, ceilings, and walls, and the partial or total collapse of buildings. Bricks and other debris fall around buildings and can cause injuries to bystanders and occupants trying to escape the building. The unreinforced nature of these structures allows them to break apart and lose cohesion when stressed by earthquake waves. Many unreinforced buildings were built in the late 1800s and early 1900s. The mortar was poor and has weakened with time. Today this older mortar is commonly disintegrated or eroded away entirely if not maintained, making these buildings even more susceptible to damage. In earthquake country such as Nevada, it is also common for older earthquake damage not to be completely repaired if the building hasn't collapsed and many buildings are in a weakened state from prior shaking.

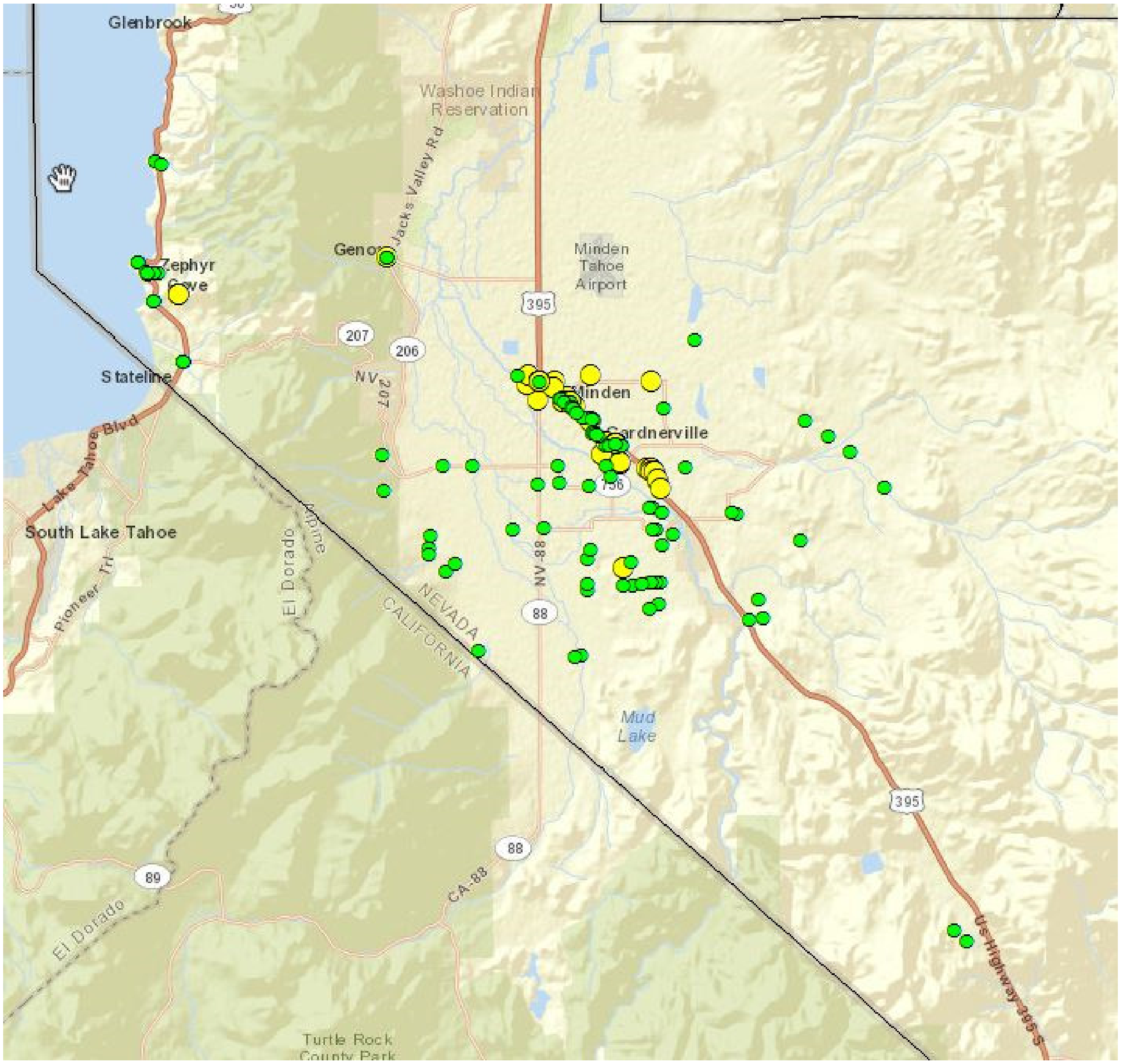
Knowing the number and locations of URMs is the first step towards understanding the magnitude of this hazard in terms of type and usage of buildings, potential economic losses, and for rapid, prioritized emergency response and damage assessments. A preliminary statewide assessment was made based on a selection criteria and extracting potential URMs from county assessor's data and the Nevada Public Works (Price and others, 2012). The study collected information on buildings that were built before 1974 and were constructed of brick, stone, or block masonry. Price and others (2012) caution that there are errors in the database, such as missing

URMs that were not recorded, were incorrectly recorded, or are on Federal or Native American land and buildings that have had their vulnerability altered by seismic retrofit or have been removed. Price and others (2012) concluded there were potentially 23,597 URMs in Nevada, 7,354 buildings are residential and 16,243 buildings are commercial or public. In Douglas County, Price and others (2012) counted up 408 potential URMs, 294 residential and 114 commercial or public buildings. URM homes are of particular concern because of the long occupancy times, but homeowners rarely consider seismic rehabilitation because of cost. Commercial and public buildings may have ornamentation, such as parapets and crowning bond beams, that are falling hazards around URMs even if the building doesn't collapse during an event. The next step is to conduct field inspections to create a complete list of potential URMs for future detailed evaluation.

Figure 12 Unreinforced masonry residence. The home is built on an inhomogeneous rubble-rock foundation, is likely not tied to the foundation, is made of ridged, unyielding brick that will break with strong earthquake forces, and has a topple hazard, the tall chimney. Possible secondary hazards include gas leaks and fire if the gas meter or hoses are damaged or further damaged by aftershocks. Shelter would likely be required for the residents following a major earthquake.

The unreinforced masonry building hazard is a very difficult engineering and social problem. These buildings commonly have a significant historical value and there is a strong desire to maintain their original appearance. If their seismic weakness is not considered, they could kill many people and be lost entirely from an event. The monetary resources needed to rehabilitate URMs are difficult to find and usually are obtained on a building-by-building basis, which is significant but slow progress.

Figure 14



Locations of the possible unreinforced masonry buildings identified by Price and others (2012) in Douglas County.

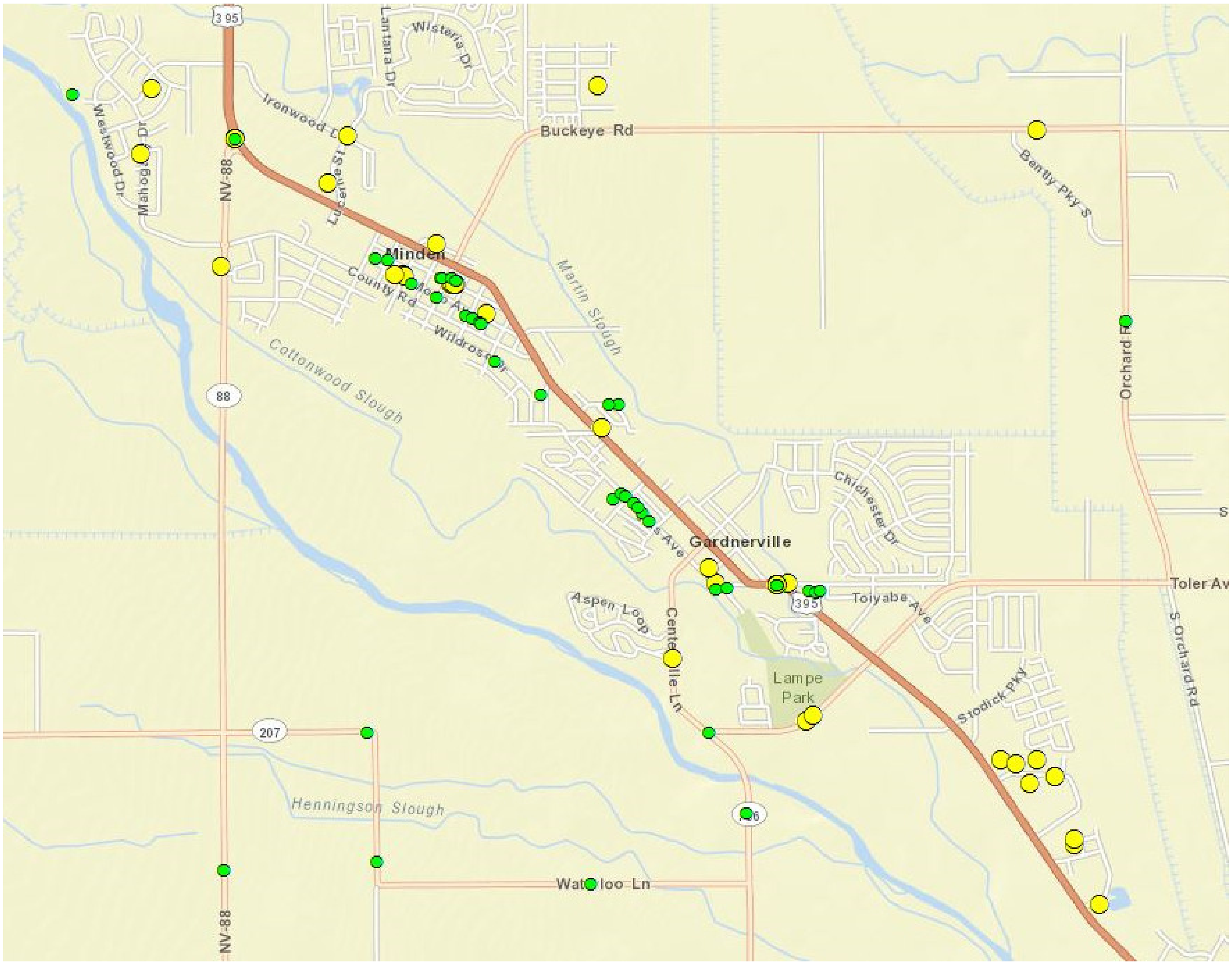


Figure 15 General locations of the unreinforced masonry buildings along the Highway 395 urban corridor in the Minden and Gardnerville area. Many of these buildings are grouped in clusters. Emergency responders should be aware of these areas.

Earthquakes and Douglas County Citizens

Earthquakes are a personal concern as well as being a governmental concern. How an individual survives an earthquake is largely a function of the ability of an individual to react safely to an earthquake and the preparedness and mitigation they have done. Every person in Douglas County should know how to drop, cover, and hold when an earthquake occurs and where the safest place to take cover from falling objects is (safety spots). This would dramatically decrease the amount of injuries and possibly even deaths that occur from the next earthquake in Douglas County.

In the 2012 Great Nevada ShakeOut, 3,863 people signed up for the annual exercise from Douglas County, or just fewer than 6% of the population. Most of these, 3,751 people, were from the schools in Douglas County. Seventy-five people signed up from Native American tribes, 25 people signed up as families, and 12 people signed up from local government. Signing up for and participating in the ShakeOut reinforces the earthquake hazard in lieu of having a damaging earthquake and is designed to engage the participant and offer useful information on how to get prepared for earthquakes. This is why an important action for Douglas County is to increase the participation in the annual Great Nevada ShakeOut, which is usually held in October. This can dramatically increase the ability of the county's citizens to respond to an earthquake and can generate a greater awareness and support by the public for community projects that reduce earthquake risk.

Most people do not fully appreciate the threat posed by earthquakes. This is due to the less frequent occurrence of compared with other hazards. Although less frequent earthquakes are desirable, they still occur from time to time and people are quickly humbled when earthquakes strike. People realize why it is so important to prepare for these potentially deadly events. The key is to take the earthquake threat to heart, always know how to react safely when an earthquake occurs wherever you are, prepare for earthquakes by making rooms safer by eliminating nonstructural hazards, and keep earthquakes in mind when making changes to buildings. The goal is to survive future strong Douglas County earthquakes with few or no injuries and a minimum of economic loss.

Douglas County Earthquake Mitigation Goals and Action Items

The overarching objective of these mitigation goals and actions is to make Douglas County an earthquake resilient county that can experience earthquakes with no loss of life, minimal property damage, and that can rapidly and fully recover from earthquakes. It is incomplete to separate out mitigation, preparedness, and policy issues as they are inextricably intertwined to produce effective earthquake mitigation; therefore all three are included in these goals. Because of the importance of this opportunity to address the earthquake hazards of Douglas County, these goals and actions go beyond the five-year operational life of the mitigation plan. Several of these action items have been extracted or combined for the 2013 mitigation plan.

Goal 1: Adopt and Enforce Current Building Codes and their Seismic Provisions

Action Item 1: Adopt and enforce the current International Building Code and its seismic provisions for new buildings, facilities, and construction in Douglas County. [POLICY]

Action Item 2: Encourage the incorporation of earthquake resistance to mobile home installation guidelines. This will help to avoid overturning, foundation displacement, and the compromise of utilities including water, sewer, gas, and electric [POLICY]

Action Item 3: Evaluate the impact of different site velocity classes to input values for construction in Douglas County. If significant, create earthquake shaking site class maps of the urban be accomplished using Refraction Microtremor measurement of shallow ground velocity measurements and/or velocity-calibrated geologic mapping, and/or slope mapping. The site velocity maps can be used as input for the seismic provisions of the International Building Code, giving more earthquake resistance to buildings in areas that are prone to shake more, such as unconsolidated sediments. [PROJECT]

Goal 2: Assess Earthquake Vulnerabilities of Existing Buildings and Create Strategies to Reduce Earthquake Risks from these Buildings

Action Item 1: Assess the seismic vulnerability of emergency facilities, hospitals, fire and sheriff offices, and lifeline utilities, including the local airport. Recommend any needed actions to reduce seismic vulnerabilities for these facilities. Ideally emergency facilities should survive and be operational following a strong earthquake. [PROJECT]

Action Item 2: Assess the seismic vulnerability and potential nonstructural hazards of schools, county buildings and facilities, high-occupancy buildings, and historical buildings. In addition to having a critical population, schools and public facilities are commonly used as shelters following an earthquake disaster. [PROJECT]

Action Item 3: Promote the proper anchoring of homes and buildings to their foundations, especially structures that were built prior to the adoption of anchorage practices in the building code. [POLICY - SMALL PROJECTS]

Action Item 4: Assess the number of buildings and facilities that are vulnerable to earthquakes and can cause casualties, injuries, or large property losses. The most vulnerable buildings include unreinforced masonry buildings and non-ductile concrete buildings. Examine the buildings identified in NBMG Report 54 (http://www.nbmg.unr.edu/dox/r54.pdf http://www.nbmg.unr.edu/dox/r54.pdf) as possible unreinforced masonry buildings to further identify their building type, and potentially verify or refute their questioned hazardous nature. In addition to the most vulnerable buildings, other types of construction and construction practices that can be vulnerable should be reviewed, including pre-1950 wood-frame houses (may not be tied to their foundations), tilt-up concrete buildings (may have inadequate ties between the walls and the floors and roof), soft-story construction (may lack enough lateral resistance for earthquakes). A tool that should be used in this survey is the Rapid Visual Screening of Buildings for Potential Seismic Hazards (FEMA 154, http://www.fema.gov/library/viewRecord.do?id=3556). Potential economic losses should be estimated to give a perspective of the impact of potential building damage and for benefit cost analyses of seismic rehabilitation. Create a list ranking public and non-public buildings and facilities by earthquake risk, so the highest risk structures can be easily recognized. [PROJECT]

Action Item 5: Compile strategies or techniques for the seismic rehabilitation of public buildings and estimate the mitigation costs. Strategies can include sequencing rehabilitation with maintenance to help lower costs and impact, developing possible funding sources and partnerships, and potential incentives for the seismic rehabilitation of private buildings with high occupancy levels. [PROJECT – POLICY]

Action Item 6: Seismically rehabilitate the highest earthquake risk public building in Douglas County and continue to rehabilitate the next highest priority buildings until all buildings, new and old are seismically resistant. This would be done on a project-by-project basis. [PROJECTS]

Goal 3: Reduce Content and Nonstructural Hazards in Homes, Businesses, and Public Buildings

Action Item 1: Create an awareness and motivation campaign in Douglas County to reduce building content and nonstructural hazards, some of the largest causes of earthquake injuries and costs. Use the county website, the Nevada ShakeOut activity, and public gatherings, such as the county fair, to promote and reinforce the nonstructural earthquake safety message. Encourage hardware stores to stock mitigation supplies for securing contents. Hold "how to" workshops to promote simple mitigation projects. Making sure water heaters are properly secured for shaking is an excellent place to start. [POLICY - SMALL PROJECTS]

Action Item 2: Encourage assistance to folks who might not be able to do nonstructural mitigation themselves. Possible programs include neighbors-helping-neighbors, community mitigation volunteers, or possibly Community Emergency Response Team (CERT) activities. [POLICY]

Action Item 3: Promote an awareness campaign and mitigation activity to properly secure nonstructural items that are of an engineering nature, such as overhead light fixtures. Awards that effectively advertise the safety of buildings that have been mitigated can be given out as an incentive. [POLICY - SMALL PROJECTS]

Goal 4: Encourage the Purchase of Earthquake Insurance

Action Item 1: Encourage the purchase of earthquake insurance to cover vulnerable buildings and to protect major assets from earthquake losses, especially in areas with specific identified hazards, such stronger shaking areas, liquefaction areas, and areas of potential lake tsunami/seiche inundation. Earthquake insurance has to be specifically purchased and is not part of general insurance packages. Consequently, most homes and private buildings in Douglas County currently do not have earthquake insurance. Add information and web links to information and insurance carriers that offer earthquake insurance. Assure important public facilities are carrying appropriate earthquake insurance. [POLICY]

Goal 5: Provide Leadership Encouraging Earthquake Preparedness and Mitigation Activities at All Levels in the County

Action Item 1: Create an earthquake hazard web sub-site for Douglas County that includes information on earthquakes, earthquake preparedness, seismic mitigation, and many helpful internet links. Specific information and guidance for individuals, neighborhoods, businesses, and communities should be included, as well as clear and convincing messages of the earthquake hazard potential of Douglas County to reinforce the this hazard to residents and newcomers. All county residents should know what to do during an earthquake and assist family, friends, customers, and visitors in the aftermath of an event. [POLICY - PROJECT]

Action Item 2: Advertise, participate, and use as a motivational vehicle the Nevada ShakeOut exercise, setting high goals for participation with the supporting strategies to make this work. For example, Douglas County can become the first county in the state to have a 50% participation rate. Encourage County Commissioners and the County Manager to act as public champions for the ShakeOut. [POLICY – SMALL PROJECTS]

Action Item 3: Encourage and support communities and general improvement districts to become prepared for earthquakes, mitigate potential earthquake risks that are unacceptable, and to develop mitigation champions.

Goal 6: Encourage and Plan for Appropriate Land Use to Minimize Earthquake Damage and Losses

Action Item 1: Create earthquake and fault hazard maps at a scale of 1:24,000 for the Douglas County, including an earthquake fault trace map with recommended set-back zones or other mitigation alternatives, a potential earthquake liquefaction hazard map, a landslide hazard map with possible run-out areas, and a lake tsunami/seiche inundation map for the Late Tahoe and Topaz Lake shorelines with potential water run-up areas and water heights. These should be readily available to the public on the county website. [PROJECTS]

Action Item 2: Avoid construction over late Quaternary fault zones. Develop a strategy to avoid building structures for human occupancy and high-value structures across late Quaternary fault traces. For example, fault traces could be identified and a set-back zone of 50 to 60 feet either side of a late Quaternary fault trace could be used as guidelines. Important structures that must cross faults should characterize and mitigate potential surface ruptures. [PROJECT – POLICY]

Action Item 3: Establish guidelines for appropriate design and construction in areas of potential liquefaction, landslides, and lake tsunami/seiche run-up areas. Develop seismic guidelines for construction of buildings and other structures such that damage from liquefaction is acceptable and not life threatening. Develop guidelines for avoidance of potential damage areas from seismically induced landslides and landslide run-out areas in and around communities and areas of habitation or structures. Create guidelines for lake tsunami/seiche run-up areas, including signage for how people should respond to an earthquake in potential tsunami/seiche inundation areas. [PROJECT - POLICY]

Action Item 4: Study the paleoearthquake history of local earthquake faults to better characterize the potential magnitude and occurrence of earthquakes in Douglas County. These studies are scientifically detailed and are expensive, and Federal grants are usually used in Nevada to help support them. A monetary match is usually required for these grants and the development of local funds to use as match would encourage paleoseismic studies in Douglas County. [PROJECTS]

Goal 7: Plan for a Successful Earthquake Disaster Emergency Response and Recovery

Action Item 1: Prepare a detailed Earthquake Disaster Planning Scenario for the county, so that consequences, inter-related incidents, and compounding elements can be recognized and anticipated. Planning scenarios can be used to enhance emergency response and recovery plans and as a tool to help officials and the public visualize the earthquake threat. This visualization aids in evaluating and engaging in effective mitigation. [PROJECT]

Action Item 2: Create a semi-detailed recovery plan to restore the function and quality of life in the county within three years or less following a large earthquake disaster. Successful recoveries have a distinct time variable and recovery is harder to achieve if it is unorganized and goes slowly. The recovery phase of a disaster is also an opportunity to engage in mitigation and there is potential funding for mitigation projects. Recovery needs to begin immediately following the emergency response and needs clear strategies that can be engaged immediately to help protect businesses, community function, and individuals. A good recovery plan will facilitate these activities. [PROJECT]

Table 13 Suggested Prioritization of Actions for Earthquake Resiliency

Rank	Goal & Action	Title	Benefit
1	G5A1/G5A2/G3A1/G4A1	Public Awareness Campaign	reduce eq injuries
2	G2A1	Emergency facility assessment	emerg response
3	G2A2	School and county bldg. assess	safety and ER
4	G1A2	Mobile home guidelines	reduce eq losses
5	G2A3	Encour foundation anchoring	reduce eq losses
6	G2A4	Eq risk bldg assess	assess vulnera
7	G7A1	Eq disast Scenario	motivation & vuln
8	G2A5	Seis rehab tech strategy costs	decision tool
9	G5A3	Encour support comm GIDs	reduce eq risk
10	G1A3	Site velocity eval & map	IB code tool
11	G3A3	Engineering nonstructural mit	reduce eq risk
12	G2A6	Rehab highest risk bldgs.	reduce eq risk
13	G7A2	Eq recovery plan	facilitate recov
14	G6A1	Seismic hazard maps	plan reduce risk
15	G6A2	Eq fault avoidance	reduce eq risk
16	G6A4	Paleoseismic studies	eq hazard charac
17	G6A3	Other eq haz mitigation	reduce eq risk
18	G3A2	Assist w/bldg. content mitigation	increase eq safety
19	G1A1	Adopt IBC – in progress	reduce eq risk

Conclusions

Douglas County has a high level of earthquake hazard. Fortunately there has been an investment in the county in terms of strong building codes and earthquake insurance that will likely have a more-than-one-time benefit. Douglas County is poised to become an earthquake resilient county, but there are many actions that still need to be taken. New construction benefits has earthquake resistance, but the strength of older important buildings needs to be investigated and seismic weaknesses need mitigated over time. Perhaps the most important and time effective action that can be taken is a wholesale education of Douglas County citizens on how to react and protect themselves when an earthquake with strong shaking occurs. The proper response to an earthquake can literally save people's lives. When the next damaging earthquake occurs in Douglas County (or anywhere for that matter), we want people to emerge unharmed. This requires the proper reaction to an earthquake and some thought and action on securing seismically threatening contents in rooms. You want to protect yourself, loved ones, friends, employees, and customers from falling objects.

The effective influence of action in people occurs when there is a clear statement of the hazard and possible solutions, encouraging leadership, support where possible, and an empowerment and motivation of the citizenry to prepare. Regulations and laws should be used sparingly, but the citizenry needs to understand the view of collective loss from a county or state level. Some damage from strong earthquakes is inevitable, but wholesale loss of buildings can literally terminate a community. Thus, some regulations, such as buildings codes, are needed to help protect communities from catastrophic losses. In an area with a high earthquake hazard, these are wise investments for all, and have been a wise investment in Douglas County.

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Appendix

Modified Mercalli Intensity Levels and Descriptions

Intensity I **Not Felt**

Not felt except by a few people under especially favorable circumstances.

Intensity II **Scarcely Felt**

Felt only by a few people at rest, especially in the upper floors of buildings.

Intensity III **Weak Shaking**

Felt quite noticeably indoors, especially on the upper floors of buildings, but many people do not recognize it as an earthquake. Hanging objects swing.

Intensity IV **Moderate, Widely Observed Shaking**

During the day, felt indoors by many, outdoors by few. At night some awakened, especially light sleepers. Dishes, windows, doors disturbed; walls make creaking sound.

Intensity V **Strong Shaking**

Felt by nearly everybody indoors, felt by many outdoors, awakened many if not most. Frightened a few people. Some dishes and windows broken. Overturned vases or small unstable objects.

Intensity VI **Slightly Damaging Shaking**

Felt by all, many frightened and run outdoors. Some alarm among individuals. Awakened all. People move about unsteadily during the event. Damage slight in poorly built buildings. Small amounts of fallen plaster, cracked plaster, broken dishes and glassware in considerable quantities, also some broken windows, fall of knickknacks, books, pictures, some heavy furniture moved and overturned.

Intensity VII **Moderately Damaging Shaking**

Frightened all, general alarm, all run outdoors, some or many find it difficult to stand. Waves in ponds, lakes, running water, water turbid from being stirred up. Suspended objects made to quiver. Some rock falls. Damage considerable in poorly built or weak buildings, adobe buildings, unreinforced masonry buildings, old walls, and spires. Chimneys cracked to a considerable extent. Fall of plaster in large amounts. Numerous windows broken. Loosened brickwork and tiles shaken down. Fall of cornices, bricks and stones dislodged. Damage considerable to concrete irrigation ditches.

Intensity VIII **Heavily Damaging Shaking**

General fright, alarm approaches panic. Trees shaken strongly, branches and trunks broken off. Liquefaction occurs locally accompanied by ejected sand or mud in small amounts. Changes in levels and temperatures of springs. Many rock falls and landslides. Damage slight in well-built structures designed with earthquake resistance, considerable in ordinary substantial buildings, weak structures partially collapsed, racked, and tumbled down. Fall of walls.

Seriously cracked and broken stone walls. Twisting, fall of chimneys, columns, monuments, factory stacks, and towers. Very heavy furniture moved conspicuously or overturned.

Intensity IX **Destructive Shaking**

General panic. Conspicuous cracked ground. Damage considerable in specifically designed structures, great in substantial masonry buildings with some collapse. Buildings wholly shifted off foundations. Well-designed frame structures thrown out-of-plumb and racked. Reservoirs damaged and underground pipes are sometimes broken.

Intensity X **Very Destructive Shaking and Ground Displacement**

Cracked ground, especially when loose and wet. Parallel fissures along canal and stream banks. Landslides considerable along stream banks and steep cliffs. Changed levels in many water wells. Water thrown on the banks of canals, lakes, and rivers. Some well-built structures destroyed. Most masonry structures destroyed along with their foundations. Rails bent slightly. Serious damage to dams, dikes, and embankments.

Intensity XI **Devastating Shaking and Ground Displacement**

Widespread ground disturbance, broad fissures, earth slumps, and land slips in soft, wet, ground. Ejection of large amounts of water charged with sand and mud. Few, if any masonry structures remain standing. Severe damage to wood-framed structures. Great damage to dams, dikes, and embankments. Bridges destroyed by wracking of support piers or pillars. Rails bent greatly. Underground pipes completely out of service.

Intensity XII **Complete Devastation from Shaking and Ground Displacement**

Damage total. Waves seen on ground surface. Objects thrown up in the air. Ground greatly disturbed. Waterways blocked by landslides. Large rock masses loose. Fault displacement of surface with notable horizontal and vertical displacements.

Wildland Fire

Characteristics of Wildland Fire

A wildland fire is a type of fire that spreads through consumption of vegetation. It often begins unnoticed, spreads quickly, and is usually signaled by dense smoke that may be visible from miles around. Wildland fires can be caused by human activities (such as arson or campfires) or by natural events such as lightning. Wildland fires often occur in forests or other areas with sufficient vegetation to sustain combustion and rapid fire spread. This vegetation can occur adjacent to the community such as in a classic interface condition, throughout the community such as in an intermix configuration or on large open space within the interior of a community. However in all cases the wildland fire burns natural vegetation and rapidly spreads and threatens communities and infrastructure.

The following three factors contribute significantly to wildland fire behavior and can be used to identify wildland fire hazard areas.

- **Topography:** As slope increases, the rate of wildland fire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildland fire behavior. However, ridge tops may mark the end of wildland fire spread, since fire spreads more slowly or may even be unable to spread downhill. Within Douglas County, there are areas, especially those along the Sierra Front which frequently experience fire behavior that is not consistent with normal slope effects, in these areas; fire may make extremely rapid and prolonged downhill runs.
- **Fuel:** The type and condition of vegetation plays a significant role in the occurrence and spread of wildland fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the "fuel load"). The ratio of living to dead plant matter is also important. The risk of fire increases significantly during periods of prolonged drought, as the moisture content of both living and dead plant matter decreases. The fuel's continuity, both horizontally and vertically, is also an important factor.
- **Weather:** The most variable factor affecting wildland fire behavior is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildland fire activity. By contrast, cooling and higher humidity often signals reduced wildland fire occurrence and easier containment. In Northern Nevada there is a history of large fires that burn in relatively cool conditions as the winds from an approaching storm systems cause fires to spread rapidly. Some of the most damaging and costly fires in Nevada history have occurred during these types of weather conditions.

The frequency and severity of wildland fires also depends upon other hazards, such as lightning, drought, and infestations. If not promptly suppressed, wildland fires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy structures and infrastructure. In Douglas County wildland fire can have significant impact on agricultural infrastructure such as fences or irrigation ditches. Wildland fire events may require emergency watering/feeding, evacuation, and shelter of livestock.

The indirect effects of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may become hydrophobic and prone to erosion, mud slides or mass wasting. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby increasing flood potential, harming aquatic life, and degrading water quality. Agricultural infrastructure such as irrigation ditches, stock ponds or canals can become impaired by siltation and erosion.

Wildland Fuel Types

Douglas County Nevada is located in the Great Basin on the eastern slopes of the Sierra Nevada. Douglas County has several biotic zones which determine wildland fuel types including:

Mixed conifer forests surrounding the Lake Tahoe Basin and in major drainages in the Sierra Nevada,

Sub-alpine mixed conifer forests at the higher elevations of the Sierra Nevada,

Sagebrush communities in the lower elevations of the Carson Valley and of the valleys in the eastern portions of the county, and

Pinion juniper plant communities particularly in the Pine Nut Mountains and at the mid elevations of the Sierra Nevada.

Each of these biotic zones will produce vegetation that can support large damaging fires that may threaten life and property. The multitude of fuel types creates a difficulty in informing the community about relative fire hazards as dry years may lead to increased fire hazard in the timber fuel types and wet years may cause vegetation growth and increased fire hazard in the sagebrush and cheatgrass fuels, as a result the public hears every year has the potential to be a bad fire year

Fire Ecology

The science of fire ecology is the study of how fire contributes to plant community structure and species composition. A “fire regime” is defined in terms of the average number of years between fires under natural conditions (fire frequency) and the amount of dominant species replacement (fire severity). Natural fire regimes have been affected throughout most of Nevada by twentieth century fire suppression policies. Large areas that formerly burned with high frequency but low intensity (fires more amenable to control, suppression, and rehabilitation) are now characterized by large accumulations of unburned fuels, which once ignited, will burn at higher intensities.

Some plant communities have evolved to burn frequently with low intensity, for example mature Jeffrey pine forests. Under a natural fire regime, low-intensity surface fires reduce fuel loading from grasses and shrubs, suppress regeneration of shade-tolerant white fir seedlings, and leave the adult Jeffrey pine trees unaffected, protected by thick, fire-resistant bark. Forests with frequent fire occurrence often have an open, “park-like” appearance with an understory of grass or low shrubs. Though shaded by large, mature trees, spacing between trees is sufficient to allow sunlight to reach the forest floor and encourage regeneration of shade-intolerant species like Jeffrey pine trees. Pockets of heavy fuels exist in these conditions, but their discontinuous nature reduces the likelihood that a fire will burn with enough intensity to negatively impact mature trees. In the absence of frequent surface fires, accumulated dead-and-down woody fuels and the green “ladder fuels” can carry flames into the coniferous overstory, potentially provoking a catastrophic, stand-destroying crown fire.

Big sagebrush communities are the most common vegetation types in Nevada with an altered fire regime, now characterized by infrequent, high-intensity, catastrophic fires. Sagebrush requires ten to twenty or more years to reestablish on burned areas, and most often these areas provide the conditions for establishment and spread of invasive species before sagebrush reestablishment can occur. Cheatgrass is the most common invasive species to reoccupy sagebrush and pinyon-juniper burned areas in northern Nevada.

Singleleaf pinyon and Utah juniper are the dominant components of a plant community commonly referred to as Pinyon-Juniper (P-J). P-J woodlands were once characterized by a discontinuous distribution on the landscape and a heterogeneous internal fuel structure: a mosaic pattern of shrubs and trees resulting from the canopy openings created by small and frequent wildfires.

Both pinyon and juniper trees have relatively thin bark with continuous branching all the way to the ground. In dense stands, lower tree branches frequently intercept adjacent ladder fuels, e.g. shrubs, herbaceous groundcover, and smaller trees. This situation creates a dangerous fuel condition where ground fires can be carried into tree canopies, which often results in crown fires

Effect of Cheatgrass on Fire Ecology

Cheatgrass is a common, non-native annual grass that aggressively invades disturbed areas, especially burns. Replacement of a native shrub community with a pure stand of cheatgrass increases the susceptibility of an area to repeated rapidly spreading wildfires, especially in mid to late summer when desiccating winds and lightning activity are more prevalent. The annual production, or volume of cheatgrass fuel produced each year, is highly variable and dependent on winter and spring precipitation. Plants can range from only a few inches tall in a dry year to over two feet tall on the very same site in wet years. In a normal or above normal precipitation year, cheatgrass can be considered a high hazard fuel type. In dry years, cheatgrass is generally sparse and low in stature and poses a low fire behavior hazard because it tends to burn with a relatively low intensity. However, in both dry and wet years, dried cheatgrass creates a highly flammable fuel bed that is easily ignited with the propensity to rapidly burn into adjacent fuel types that may be characterized by more severe and hazardous fire behavior. The ecologic risk of a fire spreading from a cheatgrass stand into adjacent, unburned native vegetation is that additional disturbed areas are thereby opened and vulnerable to cheatgrass invasion. Associated losses of natural resource values such as wildlife habitat, soil stability, and watershed functions are additional risks.

Eliminating cheatgrass is an arduous task. Mowing defensible space and fuelbreak areas annually before seed maturity is effective in reducing cheatgrass growth. In areas where livestock may be utilized, implementing early-season intensive grazing up to and during flowering may aid in depleting the seed bank and reduce the annual fuel load (BLM 2003, Davison and Smith 2000, Montana State University 2004). It may take years and intensive treatment efforts to control cheatgrass in a given area, but it is a desirable conservation objective in order to revert the landscape to the natural fire cycle and reduce the occurrence of large, catastrophic wildfires. Community-wide efforts in cooperation with county, state, and federal agencies are necessary for successful cheatgrass reduction treatments.

Wildfire History

Several large wildfires have occurred in the recent history of Douglas County. Between 1992 and 2012, 45,068 acres burned in wildland fires. During this period the largest fire was the TRE fire which burned 7,444 acres, destroying two homes and threatening several hundred. The largest fire recorded in the county was the 16,600-acre Indian Creek II Fire in 1984 that started in California and burned approximately 12,400-acres in Douglas County. Table 5-15 summarizes the large fire history and fire ignitions recorded by year for public lands within Douglas County. The figure illustrates the recorded fire history in the vicinity of Douglas County. Several wildland fires have occurred on private lands within the county. Often these fires are not reported to federal agencies and are therefore, not reflected in the table below.

Summary of Reported Fire History Data 1992-2012		
Year	**Number of Large Fire Ignitions**	**Total Fire Acreage**
1992	0	NA
1993	0	NA
1994	1	7,444
1995	0	NA
1996	2	7,426
1997	1	18
1998	0	NA
1999	0	NA
2000	2	2,314
2001	1	445
2002	3	1,457
2003	0	NA
2004	0	NA
2005	1	580
2006	1	6,213
2007	4	1,101
2008	0	NA
2009	2	97
2010	0	NA
2011	3	5,061
2012	7	12,911
TOTAL	**28**	**48,068**
Source: Fire history and fire acreage is derived from BLM and USFS fire perimeter data and specific to fire acreage within Douglas County.		

Location, Extent, Probability of Future Events

The following information originates from the Nevada Community Wildfire Risk/Hazard Assessment Projects for Douglas County and for the Tahoe Douglas Fire Protection District. Several excerpts from this document are incorporated in this portion of the Mitigation Plan.

The Nevada Fire Safe Council contracted with Resource Concepts, Inc. (RCI) to assemble a project team of experts in the fields of fire behavior and suppression, natural resource, ecology and geographic information systems (GIS) to complete the assessment for each Douglas County community listed in the Federal Register as a community at-risk.

Five primary factors that affect potential fire hazard were evaluated to develop a community hazard assessment score: Community design, construction materials, defensible space, availability and capability of fire suppression resources, and physical conditions such as the vegetative fuel load and topography. Information on fire suppression capabilities and responsibilities for Douglas County communities was obtained through interview with local Fire Chiefs and local agency Fire Management Officers (state and federal). The fire specialists on the RCI Project team assigned an ignition risk ration of low, moderate, or high to each community. That rating was based upon historical ignition patterns, interviews with local fire department personnel, interviews with state and federal agency fire personnel, field visits to each community, and the Fire Specialist's professional judgment based on experience with wildland fire ignitions in Nevada. The Spooner Lake Unit of Lake Tahoe State Park is located in the western portions of both Carson City and Douglas County along US Highway 50 in the southern portion of Lake Tahoe State Park. Because there is no permanent community, very few structures and no features listed in the National Register of Historic Places within the State Park, the Risk/hazard assessment was not completed. However, the Spooner Lake Unit of the State Park is listed as a critical feature potentially at risk.

Existing Bureau of Land Management fuel hazard data for the wildland-urban interface was evaluated and field-verified by the RCI Project team Wildfire Specialists and Natural resource specialists. The risk of catastrophic wildfire is summarized in the following tables:

Community	Interface Classification	Interface Fuel Hazard Conditions	Ignition Risk Rating	Community Hazard Rating
Alpine View	Intermix	High to Extreme	High	Moderate
Bodie Flats	Intermix	High to Extreme	High	Extreme
China Springs	Intermix / Rural	Low to Extreme	High	High
Dresslerville	Classic	Low to Moderate	Low*	Moderate*
East Valley	Intermix	Moderate	Moderate	Low
Fish Springs	Intermix	High	High	High

Gardnerville	Classic	Low	Low	Low
Gardnerville Ranchos	Classic	Low	Low	Low
Genoa	Intermix	Low to Extreme	High	High
Holbrook Junction	Intermix	Moderate to Extreme	High	High
Jacks Valley/Indian Hills	Classic / Intermix	Low to High	High	Moderate
Job's Peak Ranch	Intermix	Moderate to High	High	High*
Johnson Lane	Classic / Intermix	Low to High	Moderate	Moderate
Minden	Classic	Low	Low	Low
North Foothill Road Corridor	Intermix	Low to Extreme	High	High
Pine Nut Creek	Intermix	High	High*	High*
Ruhenstroth	Intermix	Moderate to High	Moderate	Moderate
Sheridan Acres	Intermix	Low to Extreme	High	High
Spring Valley/Double Springs	Intermix	Low to High	High*	High*
Topaz Lake	Intermix	Low to High	High	Moderate
Topaz Ranch Estates	Intermix	Low to Extreme	High	High

Community	***Interface Classification***	***Overall Fuel Density***	***Potential Ignition Risk***	***Fire Hazard Rating***
Cave Rock/Skyland	**Intermix**	**Heavy**	**High**	**High**
Elk Point/Zephyr Heights/Round Hill	**Intermix**	**Heavy**	**High**	**High**

Glenbrook	Intermix	Heavy	High	High
Kingsbury	Intermix	Heavy	High	High
Logan Shoals	Intermix	Heavy	High	High
Stateline	Interface/Intermix	Medium	Moderate	Moderate
Chimney Rock	Intermix	Heavy	High	Extreme

Areas with elevated hazard ratings are attributed to inadequate defensible space, combustible building materials, steep slopes, and moderate to extreme fuel hazards, often in either volatile cheatgrass, pinion-juniper or Jeffrey pine/bitterbrush fuel types.

Areas with moderate hazard ratings are attributed to either reduced fuel hazards or adequate implementation of defensible space, which has partially mitigated the potential for a destructive wildfire in these communities.

Low hazard ratings are attributed to a combination of irrigated agricultural lands, adequate defensible space, and fire-resistant construction materials have mitigated the primary risks and hazards associated with wildfire in these areas.

The County Commission has actively worked to increase wildfire response capabilities in the County through installation of static water tanks and additional firefighting personnel. The Tahoe Douglas Fire District has implemented an aggressive fuels management program that includes a seasonal firefighting crew, a chipping program and fuels consultation with landowners. Future efforts to mitigate this hazard should incorporate the concepts of the Cohesive Strategy, which has been developed by a number of cooperators at the national level. This strategy calls for a three pronged approach to reduce the risk of wildfire; Resilient Landscapes, fire adapted communities and adequate suppression response. Applying the concepts of the Cohesive Strategy will require fuels management activities throughout the county, including the use of prescribed fire. It will also require full implementation of the International Wildland Urban Interface Code, including the provisions which require ignition resistant construction in the wildland urban interface.

The County Commission must consider necessary modification to existing Master Plan, Open Space Plan and County Building Code (Title 20) to reduce risk due to wildfire. *Please see tables below for types and numbers of existing structures in hazard areas. Please see map in appendix B for visual reference of types and number of future structures in hazard area.*

Values At-Risk from Wildfire

Douglas County Nevada is primarily a rural county with several towns with urban characteristics. Thus the county has limited areas that are classic wildland urban interface where wildland fuels abut a community that has suburban characteristics, such as dense housing, irrigated lawns and landscaping and paved drives and roads. The county has many areas characterized as intermix. The intermix is characterized by widely spaced structures where wildland fuels surround individual structures and the presence of adjacent structures has little influence on the fire behavior. This difference in interface types was then used to determine the values at-risk from catastrophic wildfire.

To determine the values at-risk, a GIS shapefile of all parcels with structures present was obtained from the Douglas County GIS. Then an analysis by Chief Officers of Tahoe Douglas FPD and East Fork FPD was conducted where they used aerial photography and personal knowledge to identify those communities that had a classic wildland urban interface. Developed parcels outside of the classic urban interface communities where then considered intermix parcels and are by definition at-risk from catastrophic wildfire. Structures within the classic urban interface boundaries are at reduced risk with increasing distance from the urban interface boundary. To account for this all structures within 400 feet of the interface boundary were considered at-risk, and all structures greater than 400 feet from the interface boundary were considered to be at low risk and excluded from the calculation of values at-risk.

The floor area of structures at-risk from catastrophic fire where then multiplied by the reconstruction cost for of residential and commercial buildings for the Lake Tahoe Basin or Carson Valley. The following table shows the floor area at-risk from catastrophic fire in Douglas County.

	Classic Interface Communities	
	Residential Floor Area	**Commercial Floor Area**
Tahoe	3,003,678	41,704
Valley	14,861,274	73,712
Total	17,864,952	115,416
	Intermix Communities	
	Residential	**Commercial**
Tahoe	11,316,986	28,339
Valley	34,263,123	452,748
Total	45,580,109	481,087

Wildfire Mitigation Projects

Wildland fire risk mitigation must include reducing fuels in the wildland adjacent to structures and communities, creating defensible space adjacent to structures and building or retrofitting structures with ignition resistant building materials and features.

Reducing fuels in the wildland involves interrupting the horizontal and vertical continuity of surface and aerial fuels. As discussed above, there are three primary wildland fuel types in Douglas County, mixed conifer forests, pinyon-juniper woodland and big sagebrush plant communities. The fuel type present in any given area will determine the type of treatment and treatment intervals, however all treatments are designed to obtain the basic objective of interrupting fuel continuity so that flame lengths do not exceed four feet during 90th percentile fire weather. Additionally, projects are designed to provide room for firefighters to actively engage and suppress the fire in the wildland urban interface. These projects are collectively known as community wildfire protection projects and they are published within the Community Wildfire Protection Plans for the Tahoe Douglas FPD and East Fork FPD. Currently the Tahoe Douglas FPD, in partnership with the U.S. Forest Service and State of Nevada, is actively working to implement the projects identified in the community wildfire protection plan for the district. The Tahoe Douglas FPD is now using the experience gained over the past four years of managing fuels reduction projects to update the community wildfire protection plans. This update will be completed in the fall of 2013. In the balance of the county the Bureau of Land Management and U.S. Forest Service are actively involved in implementing the projects identified in the Nevada Community Wildfire Risk / Hazard Assessment Project – Douglas County.

Creating defensible space generally involves removing fuels within 100 feet of a structure so that fire will not likely directly impinge on the structure or t heat will not cause failure of building elements such as windows or siding. Homeowners or building owners are responsible for implementing defensible space on their developed parcels. Thus the challenge for fire agencies is to educate homeowners about how to create effective defensible space and then to motivate them to take action. To this end the University of Nevada – Reno Cooperative Extension has created the Living with Fire Program and accompanying educational materials. These materials have been developed for each of basic fuel types in Douglas County with recommendations tailored to the Tahoe Basin and Carson Valley. These materials provide clear instructions to property owners wishing to create defensible space. The Tahoe Douglas FPD also has an active defensible space inspection program. Property owners can call the Tahoe Douglas FPD and obtain a defensible space inspection and get site specific advice about creating defensible space. Additionally the Tahoe Douglas FPD conducts blanket inspections one of one quarter of all of the residential parcels in the district on a yearly basis. The results of the curbside inspections are then mailed to the property owner along with information on how to comply with defensible space requirements. The Tahoe Douglas FPD is also active in obtaining grant funding for defensible space implementation and in providing homeowners with free residential chipping services. When grants are available, homeowners can obtain up to 50 percent of the cost of an initial defensible treatment. This program motivates homeowners to take action and subsidizes what can be the very high cost of the initial treatment of a parcel. Homeowners can also call the Tahoe Douglas FPD and schedule free residential chipping services. The Tahoe Douglas FPD will chip slash from cut trees and brush and haul the chip from the parcel for any homeowner in the fire district. Finally, the State of Nevada has adopted the defensible space requirements in the International Wildland Urban Interface Code (2009 Ed.). Currently the fire districts are actively working to educate property owners prior to enforcement of the WUI Code.

An important component of preventing damage to structures during a wildfire is the construction features of the home itself. Ignition resistant construction enables the structure to resist burning ember penetration, heat energy and direct flame impingement. The use of wood roof coverings is prohibited by County Code. Within the Tahoe Douglas Fire District the use of shingle siding is also restricted. Adoption of the ignition resistant construction section of the International Wildland Urban Interface Code. Additionally all windows must be double pained. Mitigation projects to implement the requirements of ignition resistant requirements of the Wildland Urban Interface Code would include programs to replace wood shake roofs, replace standard vents with ember resistant vents, enclose eaves, and replace combustible siding with ignition resistant siding.

Staff/Personnel Resources	Department/Agency
Forester with capability to model fire behavior and design fuels management projects	Tahoe Douglas FPD
Wildland Firefighting Crew with capability to thin forest fuels and plan and implement prescribed fire projects.	Tahoe Douglas FPD
Public Information Officer (s)	Fire Districts

Financial Resources for Hazard Mitigation

Financial Resources	Effect on Hazard Mitigation
Local	
Tahoe Douglas Fire District –Fire Safe Community Tax	Provides funding for fuels management mitigation activities. Can be used to match state and federal grants.
State	
Nevada Division of Forestry State Fire Assistance Grants	Provides funding for fuels management mitigation activities and related public education
Federal	
Southern Nevada Public Lands Management Act	Provides funding for fuels management mitigation activities and related public education
USFS and BLM Grant Programs including National Fire Plan and Non-Federal Lands Grants	Provides funding for fuels management mitigation activities and related public education

Flood

5.3.3.1 Nature

Flooding is the accumulation of water where there usually is none or the overflow of excess water from a stream, river, lake, reservoir, or coastal body of water onto adjacent floodplains. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected.

Nationwide, floods result in more deaths than any other natural hazard. Physical damage from floods includes the following:

- Inundation of structures, causing water damage to structural elements and contents.
- Erosion or scouring of stream banks, roadway embankments, foundations, footings for bridge piers, and other features.
- Impact damage to structures, roads, bridges, culverts, and other features from high-velocity flow and from debris carried by floodwaters. Such debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping or backwater effects.
- Destruction of crops, erosion of topsoil, and deposition of debris and sediment on croplands.
- Release of sewage and hazardous or toxic materials as wastewater treatment plants are inundated, storage tanks are damaged, and pipelines are severed.

Floods also cause economic losses through closure of businesses and government facilities; disrupt communications; disrupt the provision of utilities such as water and sewer service; result in excessive expenditures for emergency response; and generally disrupt the normal function of a community.

Nevada is the driest state in the Union, with an average annual precipitation of only about nine and one half inches, although there are areas in Douglas County that average above forty inches (CWSD). Douglas County is unique in the fact that many different types of flooding occurs within its boundaries. The major flood types that may occur in Douglas County include:

- Alluvial Flooding (Zone AO): Alluvial fans occur mainly in dry mountainous regions, are deposits of rock and soil that have eroded from mountainsides and accumulated on valley floors in a fan-shaped pattern. The deposits are narrow and steep at the head of the fan, broadening as they spread out onto the valley floor.
- Channels along fans are not well defined and flow paths are unpredictable. As rain runs off steep valley walls, it gains velocity, carrying large boulders and other debris. When the debris fills the runoff channels of the fan, floodwaters spill out, spreading laterally and cutting new channels. The process is then repeated, resulting in shifting channels and combined erosion and flooding problems over a large area (Wright 2008).
- Ponding (Zone AO and AH): Ponding occurs when water has no available outlet. Ponding floodwaters are typified by low or no velocities and a depth. In areas where rivers exceed floodwater storage capacity excess water will begin to pond. Ponding is common in the Carson Valley adjacent to the Carson River and away from the Carson and Pinenut Mountain Ranges.

Elevating the finished floors of structures and providing an outlet for floodwaters are effective ways of mitigating the damage ponding waters can cause.

2) Riverine Flooding (Zone A and AE): Stream channels are adjusted to carry the normal discharge of water from upstream and from tributaries. Most of the time, the water level remains within the confines of the stream banks, but periodically the flow of water is beyond the capacity of the channel to hold, and the water spills over the banks causing (riverine) flooding (Easterbrook 1999). Riverine flooding is more devastating to a community than alluvial flooding or ponding. Riverine flooding can inundate hundreds of square miles and the floodwaters could take several weeks to recede. In addition, riverine flooding may cause disruptions in utility services and may close large portions of the local transportation network. Douglas County is affected by riverine flooding under the following three scenarios:

(4) Flash floods caused by summer thunderstorms;

(5) Floods caused by rapid snowmelt; and

(6) Floods caused by frontal rains and frontal rains on snow or frozen grounds.

Flash floods result from intense rainfall in localized areas during thunderstorms, usually during the months of June to November. These floods, while intense, tend to be localized because the storms usually cover a small area. Washes along the eastern boundary of Douglas County abutting the Pinenut Mountains are the area most likely to be affected by summer flash flooding. Floods from rapid snowmelt tend to occur between March and June, and can cover a large area but tend to flood areas close to the main river channel. Floods resulting from rain on snow or frozen ground tend to occur between November and April and have caused some of the greatest regional historical floods.

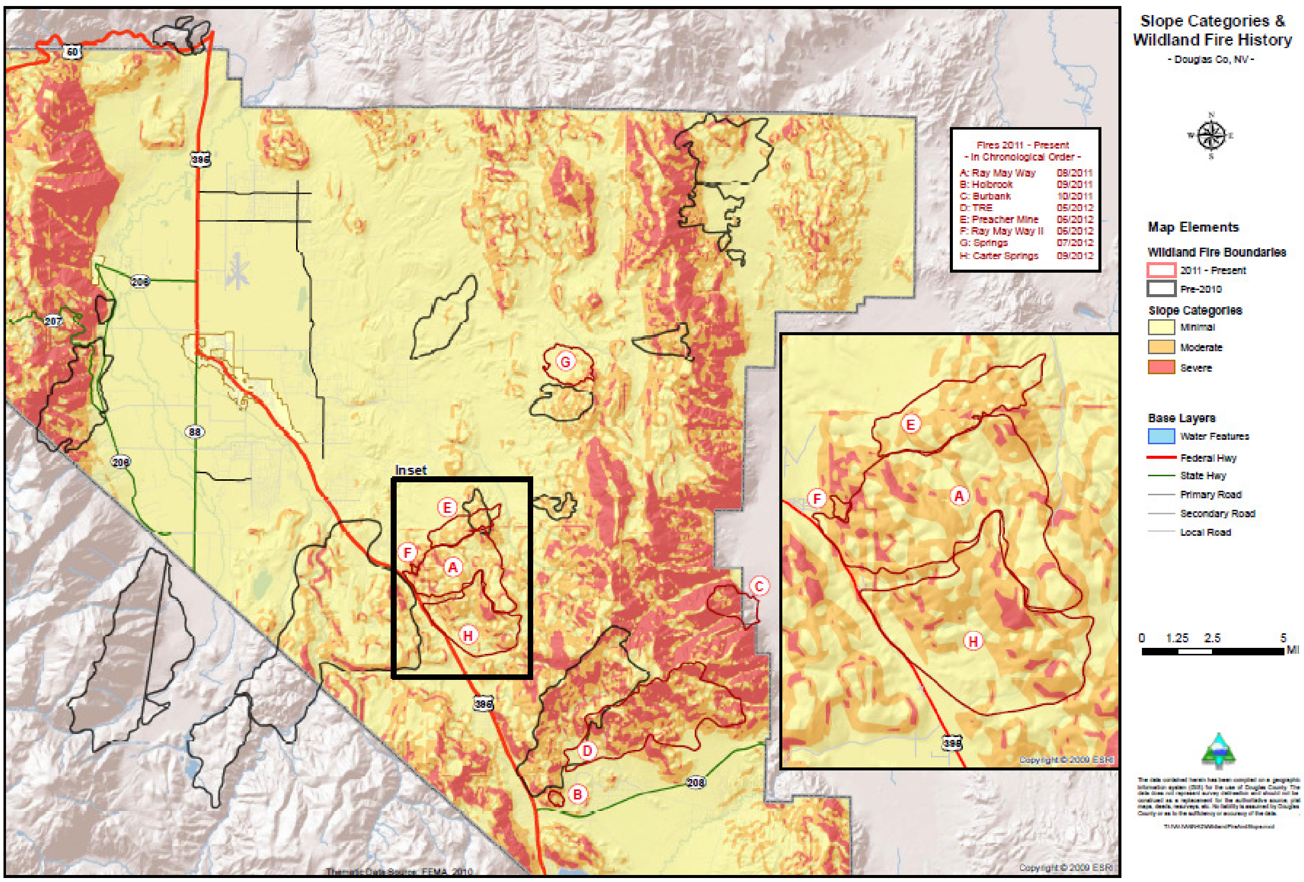
In Douglas County, the primary cause of riverine flooding is winter rainstorms saturating and melting the Sierra snow pack at elevations between 4,500 and 8,000 fee or higher. Though most winter storms bring snow to elevations above 6,000 feet, a pattern of warm storms (known as the Pineapple Express or Pineapple Connection because they come from the warm pacific islands) occasionally dumps rain at higher elevations. Winter floods can occur any time between November and April in successive years, or not occur at all for many years.

5.3.3.2 Affects of Wildland Fires on Floods

Wildfire is a disturbance that can change the characteristics of a watershed such that the subsequent hydrologic response to the normal precipitation is often a sudden and dramatic increase in water discharge. Wildfires alter the live and dead vegetation in a watershed by: (1) decreasing the canopy interception, which increases the percentage of rainfall available for runoff; (2) decreasing the water normally lost as evapotranspiration, which increases the base flow; (3) consuming ground cover, litter, duff, and debris, which increases runoff velocities and reduces interception and storage (Moody and Martin 2001).

Significant wildland fires may affect the root systems of vegetation and trees,. The soils (ground) in the burned area can become unstable and subject to movement (earth flows) which can cause damage to structures and road ways that are in its' path. The most recent evidence of this occurrence was during a storm event near the Ray May Way wildland fire (2012) where severe damage to root systems of trees and vegetation allowed for wet saturated unstable ground to move downhill blocking Highway 395. The Wildland fire and slope map on the following page shows recent fires in Douglas County. The map also identifies the slopes in these areas and the concern of deforestation on these slopes.

The reseeding of areas affected by a wildland fires should be considered a priority in order to get rooting of the grasses in place which will help restabilize the soil and reduce potential earth flow events. This reseeding will reduce the amount of peak discharge during rain events by allowing more precipitation to infiltrate the ground and it will slow the rate of flow downstream.

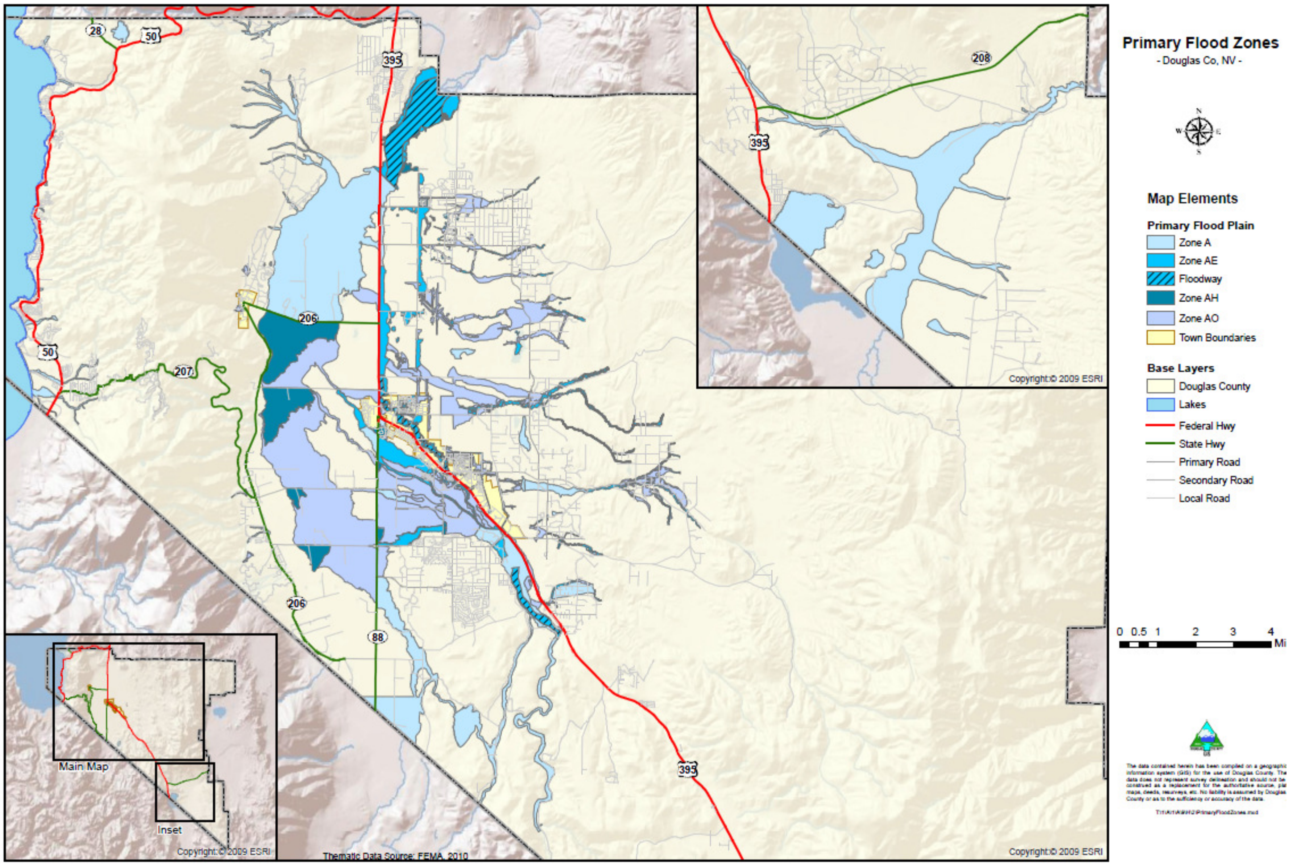


5.3.3.3 History, Location, Extent and Probability of Future Events

The Carson River begins in the Sierra Nevada in California south of Lake Tahoe, and consists of two forks, the West Fork Carson River and the East Fork Carson River. These Tributaries flow northward into Nevada before joining to form the main-stem Carson River in Carson valley. The west Fork Carson River enters Nevada west of Mud Lake and several miles west of U.S. 395. It continues in a northerly to northwesterly direction along the western side of Carson valley and is joined by several small streams from the Carson Range to the west and joins the East Fork. The East Fork enters Nevada approximately 5 miles east and south of the West Fork in a deep, narrow canyon incised into volcanic bedrock. It flows northerly and enters the southern end of Carson Valley a few miles east of the West Fork. The East Fork then turns northwestward, flows to the west of the towns of Minden and Gardnerville, and joins the West Fork southeast of Genoa, near the western side of the valley (See The Primary Flood Zones Map on the following page for 2010 floodplain boundaries in Douglas County).

From near Genoa, the main-stem Carson River flows northeasterly through the northern part of Carson Valley, crosses under U.S. 395 at Cradlebaugh Bridge, and exits the valley at its northeast corner. The river then flows northerly along a deep, bedrock canyon near Empire, just south of U.S. 50. After exiting the deep but short bedrock canyon a little west of Dayton, the Carson River continues in a northeasterly direction for several miles, traversing the broad, alluvial Carson Plains before entering a relatively confined bedrock-bounded channel in the northern end of the Pine Nut Mountains at the east end of the Carson Plains. As it enters the northern Pine Nut Mountains, the river turns nearly due west and flows a total distance of about 12 air miles before exiting the mountains at Fort Churchill. Downstream, the Carson River passes under Weeks Bridge on U.S. 95 Alt, and enters Lahontan Reservoir a few more miles to the east. Downstream from Lahontan Reservoir, the river flows northeastward to its terminus at Carson Sink. The Carson River Basin in Nevada and California encompasses about 3,966 square miles, of which about 3,360 square miles are in Nevada (CWSD).

Table A in Appendix XXX shows a brief description of some of the larger floods that have been documented along the Truckee, Carson and Walker Rivers and their tributaries. Much of the material in this section is from USDA Nevada River Basin survey Staff (1969, 1973) and Goodwin (1977).



5.3.3.4 Emergency Response

The following table from the Carson River Watershed's Regional Floodplain Management Plan shows that the Carson River is able to transport flows up to around 10,000 cfs before transportation is affected and first responders would need to mobilize.

Level (ft)	Approximate cfs	Potential Flood Impacts
19.0	38000	Incredible flood with damage previously unknown from Carson Valley to Fort Churchill including Empire and Dayton areas. USGS estimated 100 yr flood...
17.0	29600	Record flooding. All towns cut off...bridges and roads destroyed.
16.0	25800	Near record flooding with massive destruction throughout reach. Most towns isolated with transportation nearly impossible.
15.0	22200	Major flood disaster with widespread destruction throughout reach from Genoa to Weeks. Transportation extremely difficult.
13.5	17400	Flood disaster throughout reach. Transportation very difficult. Large number of structures affected and infrastructure damage (roads, bridges, power, water).
12.0	13300	Extensive flooding with major damage. Most roads in valley areas flooded making transportation difficult. Massive erosion with large agricultural losses and cattle drownings.
11.0	10900	Major flooding. Many roads and highways flooded. Transportation becoming difficult...US Hwy 395 closes. Massive bank erosion with the ability to wash away buildings...cars...roads. River channel begins to move around laterally.
10.5	9800	Moderate flooding through reach. Damage to roads, bridges, crops, .irrigation systems and buildings in lower areas. Transportation begins to be affected.
10.0	8800	Flood stage. Minor to moderate lowland flooding with several homes having flood problems in Genoa, Carson Valley, Stewart, and Dayton. Minor to moderate damage to agriculture.
9.5	7800	Minor flood impacts in lower portions of reach.
9.0	6900	Minor lowland flooding through reach in lower flood prone areas.
8.5	6000	Minimal lowland flooding through reach.
8.0	5200	Monitoring stage. Flood threat and localized overbank flows begin in lowest areas.

Source: NOAA National Weather Service, Advanced Hydrologic Prediction Service: Reno: Carson River near Carson City

5.3.3.5 Mitigation

Mitigating flood hazard is not possible by a single action or policy. The County has identified several actions and strategies to mitigate flood hazards. The following list includes items which may be pursued by the County to mitigate flood damage. These items will be evaluated as funding is identified.

1) Flood Hazard Mapping
2) RISK Mapping
3) Regional Retention Basins
4) Structural Mitigation
5) Passive Mitigation
6) Designated Emergency Routes
7) County Floodplain Ordinance
8) Public Information

5.3.3.5.1 Flood Hazard Mapping

Douglas County participates in the National Flood Insurance Program (NFIP). Participation in the NFIP requires the county to adopt and enforce minimum regulations with regard to floodplain development. A major part in enforcing floodplain development is to have floodplains identified, the primary tool for floodplain mapping are FEMA's National Flood Insurance Rate Maps (FIRMS).

Douglas County entered into the National Flood Insurance Program on January 4, 1975 under the Emergency Program and then on March 28, 1980 under the regular program. The first Flood Insurance Rate Maps for Douglas County were dated March 28, 1980. The most recent FIRM's are dated January 20, 2010. The County is covered by 37 published FIRM panels. According to the State of Nevada Community Assistance Visit (CAV) findings from February 2012, there are currently 1,077 flood insurance policies in Douglas County totaling $287,798,100 in coverage. There have been 117 losses in Douglas County totaling $2,943,995 in paid losses.

The FIRMS that are effective in Douglas County are the 2008 editions which have been found to be inaccurate. September 17, 2009, Douglas County filed suit against FEMA in U.S. District Court alleging that FEMA's data and analyses were scientifically or technically incorrect, which is the sole statutory basis of an appeal. County officials were notified by the Scientific Resolution Panel on July 18, 2012 that based on the submitted scientific and technical information by Douglas County and FEMA, the panel has determined that FEMA's data does not satisfy National Flood Insurance Program mapping standards defined in FEMA's Guidelines and Specifications for Flood Hazard Mapping Partners and must be revisited. FEMA has subsequently stated that although the 2008 FIRMS are known to contain errors they are the "best available information" and the County still regulates to these maps. This has placed thousands of residences into floodplains where flood hazards do not actually exist. One of the major priorities for the County is to restudy and remap the flood hazards in the areas where the maps are known to be incorrect. There are other areas of the County where flood risk has not been studied or the studies are old and need to be redone.

The Carson River Water Subconservancy District is actively mapping and studying the entire Carson River Watershed. There are many "approximate floodplains" (Zone A) along the Carson River. This study will eliminate many of the approximate floodplain locations and provide more accurate floodplain elevations for the County to use for regulations.

5.3.3.5.2 <u>Risk Mapping, Assessment, and Planning (MAP)</u>

FEMA has recently developed a new program called Risk MAP. The goal of this program is to work closely with communities to better understand local flood risk, mitigation efforts, and spark watershed –wide discussions on flood awareness. Historically, FEMA has dealt with flood mapping and issues on a county-by-county basis. The Risk MAP process allows FEMA to focus on flood issues on a watershed- wide basis, with local input.

Risk MAP Charter:

In 2012, Carson Water Subconservancy District (CWSD), FEMA, State of Nevada, Alpine County, Douglas County, Carson City, Lyon County, Churchill County, and other federal agencies began signatories to the Risk MAP Charter (Charter) for the Carson River Watershed. The Charter represents a good-faith effort by all parties to share data, communicate findings, and plan mitigation activities to protect communities within the watershed from flood risks. The Charter does not legally bind nor preclude communities from participating in FEMA's National Flood Insurance Rate Map (FIRM) appeal process. The Charter does:

- Detail the long-term flood hazard mapping vision for the watershed;
- Describe the desired mapping, assessment, planning information, and planning products;
- Describe the assistance that CWSD and FEMA will provide;
- Summarize local flooding concerns and indicates areas where floodplain changes are expected; and
- Describe the roles and responsibilities of the CWSD, FEMA, and other signatory partners.

This is the first Charter to be adopted in FEMA Region Nine.

Risk MAP Discovery:

FEMA has recently developed a new program called Risk MAP. The goal of this program is to work closely with communities to better understand local flood risk, mitigation efforts, and spark watershed –wide discussions on flood awareness. Historically, FEMA has dealt with flood mapping and issues on a county-by-county basis. The Risk MAP process allows FEMA to focus on flood issues on a watershed- wide basis, with local input.

5.3.3.5.3 Structural Mitigation

These measures are "structural" because they involve construction of man-made structures to control water flows. They can be grouped under four measures:

- Channel and Drainage Modifications
- Diversions
- Dams and Levees
- Regional Detention Basins

Most structural projects can have the following shortcomings:

- They can be too expensive for one community or agency to afford.
- They disturb the land and disrupt natural flows, often destroying habitats.
- They require regular maintenance, which if neglected, can have disastrous consequences.
- They are built to a certain flood protection level that can be exceeded by larger floods, causing extensive damage.

- They can create a false sense of security, as people protected by a project often believe that no flood can ever reach them.

(Flood Hazard Mitigation, 1999)

5.3.3.5.3.1 Channel and Drainage Modifications

Channel modifications can include a number of alterations to the natural channel. Channels may be lined, widened, deepened, or relocated. Douglas County places an emphasis on maintaining natural drainage channels. Miles of concrete lined channels are not desired in the County. In many locations in the County channels that were previously modified are being restored to their natural state (Glenbrook, Burke Creek, and areas of the Carson River). A channel will always find equilibrium. Making a channel wider in one are will cause slower moving waters and sediment deposition, lining a channel will increase flow velocities causing erosion in higher discharges downstream. Channel modifications may be considered in local areas of flooding, but overall the natural channel of a drainage system should be left in a natural state if possible.

5.3.3.5.3.2 Diversions

A diversion is simply a new channel that sends floodwater to a different location, thereby reducing flooding along an existing watercourse. Diversions can be surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel. During flood flows, the stream spills over to the diversion channel or tunnel which carries the excess water to the receiving lake or river. Diversions are limited by topography; they won't work everywhere. Unless the receiving water body is relatively close to the flood prone stream and the land in between is low and vacant, the cost of creating a diversion can be prohibitive. Where topography and land use are not favorable, a more expensive tunnel is needed. (Flood Hazard Mitigation, 1999)

Diversions are already used extensively for irrigation and less extensively for flood control in Douglas County. Diversions should be studied to see if they present a viable option for flood mitigation locally.

5.3.3.5.3.3 Dams and Levees

There has only been one major dam constructed on the Carson River in Douglas County. The Douglas Power Dam (known locally as Ruhenstroth or Broken Dam) lies at a narrow construction of the East Fork of the Carson River, about ½ mile upstream of the southeastern end of the Carson Valley. Constructed in 1912, the dam provided electrical power first to a gristmill along nearby Indian Creek, and later to Garnerville. This dam stood until the December 1937 floods heavily damaged the east retaining wall. Little additional damage occurred until the New Year's floods of 1997 destroyed much of the remaining eastern half of the dam. Due to hazards posed by the remains of this dam, it was removed in October 1997. (Nevada Bureau of Mines and Geology 1998).

Dams are effective tools in controlling flood waters. Dams also provide water storage, power generation, and recreational actives. Damming flow, particularly upstream of Douglas County would provide flood relief to every community downstream. Dams are no longer the preferred method to control floods. Dams can be very expensive to construct and maintain, they alter the natural ecosystems of the affected area, they take along time to permit, and are often met with local oppositions.

Many dams have been removed as communities try to improve river habitat, restore fish migrations, or remove hazardous dams that are crumbling or no longer serve a useful purpose. In 2008, about 60 dams were removed, according to the advocacy group American Rivers. That adds substantially to the more than 300 dams that have been removed since 1999, and about 790 dams removed in the last 100 years, according to the group's tally.

5.3.3.5.3.4 Regional Detention Basins

A detention basin is a storm water management facility that is designed to protect against flooding, downstream erosion, and sedimentation by detaining the large peak flows generated by storms and then releasing them at a controlled rate that will not negatively impact areas downstream. The release rate is limited to the downstream capacity with consideration given to inflows occurring below the detention basin. Often detention basins are designed to detain the 100 year or 500 year return period storm. In Douglas County the current standard design storm for detention is only 25 years. While most detention ponds are designed to drain within 6-12 hours after a storm event, others basins which are called "Extended Detention Basins" are designed to drain within a longer time period typically of 24-48 hours or even up to 7 days which tends to result in improved water quality because the longer period allows for a larger amount of suspended solids to settle out. Douglas County standard is for a detention basin to drain within 48 hours.

Detention basins are a very effective means of controlling flooding and sedimentation. By reducing and controlling the rate of flow through a downstream system the flooding hazard is removed. They can also be very effective at removing suspended solids from runoff because the solids have time to drop out which reduces sedimentation.

Detention Basins provide one of the most cost effective means of flood control. Land is often less expensive than improvements. One detention basin can remove more properties from the flood plain than multiple other means of flood control and will cost much less than the many other improvements that would be required if the detention basin were not installed.

Detention Basins can offer many options for aesthetically pleasing facilities. Often residents near detention basins don't even know they are there or in the case of multi-usage facilities think only of the basin as its other use, such as a park.

Things to consider in creating detention basins:

- The Nevada State Engineer must review detention basins which require dams having embankments greater than 20 feet in height or impounding over 20 acre-feet of water.
- Dams and levees require certification and periodic recertification by FEMA.
- Below-grade detention basins are preferred to above grade facilities.
- Basins should be sited on publicly-owned lands whenever possible.
- Basins should be required to properly function under all debris and sedimentation conditions.

- All detention basins should include emergency spillways.
- A minimum of 1 foot of freeboard should be required above the emergency spillway design water surface elevation.
- Basins should be self-regulating (passive).
- Embankment protection should be considered for each basin. Protection should include protection from failure due to overtopping.
- Detention basins should include access for equipment and workers to perform maintenance.

Douglas County has identified preliminary sites for regional detention basins in the east valley to eliminate some of the peak flooding caused by rain over the Pinenut Mountains. These basins would reduce the area prone to flooding, improve water quality, and allow additional infiltration of ground water. Obtaining funding for additional studies and construction of regional detention basins is very appealing to the County.

5.3.3.5.4 Passive Mitigation

Passive flood mitigation includes items which reduce flood risk without actually controlling flood waters. Passive flood mitigation includes keeping floodplains in their natural state and purchasing repetitive loss properties. The County has several programs to preserve open space and preserve natural floodplains as described below:

- Transfer Development Rights Program - Douglas County established its Transfer Development Rights (TDR) program in 1996 with the adoption of the Consolidated Development Code but the first TDR and resulting conservation easement did not occur until 2002. Under the County's TDR program, willing sellers can transfer development rights to designated receiving areas in the Carson Valley. Property owners are entitled to a bonus of 7 units per 19 acres for each sending parcel that contains at least 50% of the parcel within the 100 year floodplain. Since 2002, the TDR program has resulted in 4,003 acres of conservation easements. Many of these easements include special flood hazard areas.

- Division of Agricultural Land for Conservation Purposes – Douglas County adopted additional measures to protect open space and natural floodplains with the adoption of the Ranch Heritage and agricultural 2-acre land division regulations in 2008.

- Repetitive loss properties are defined by FEMA as:

A residential property that is covered under an NFIP flood insurance policy and:

(a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or

(b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

A current change in federal definition has removed all repetitive loss properties in Douglas County though historically, there have been five repetitive loss properties in the County (one has been mitigated). Most of the properties are located in the Town of Genoa. Many communities will purchase repetitive loss properties and turn the property into an unbuildable easement. By removing the property from the floodplain the potential of future loss is removed. Additionally, the flow obstruction is removed and floodplain capacity is restored to predevelopment conditions.

5.3.3.5.5 Designated Emergency Routes

The County has identified several roads as emergency access routes. These routes are the major ingress/egress ways to larger County population centers and are critical for residences to evacuate or emergency personal to enter the population center. A map showing the designated emergency routs can be found on the following sheets.

The County has a requirement for all new development to provide a minimum 12-foot wide dry lane during a 100-year runoff event. Many of the County's emergency access routes were constructed before this requirement was in place. As a result many of the designated emergency access routes become flooded during the 100-year runoff event. Upgrading these access routes to current county standards is a priority for the County.

5.3.3.5.6 County Floodplain Ordinance

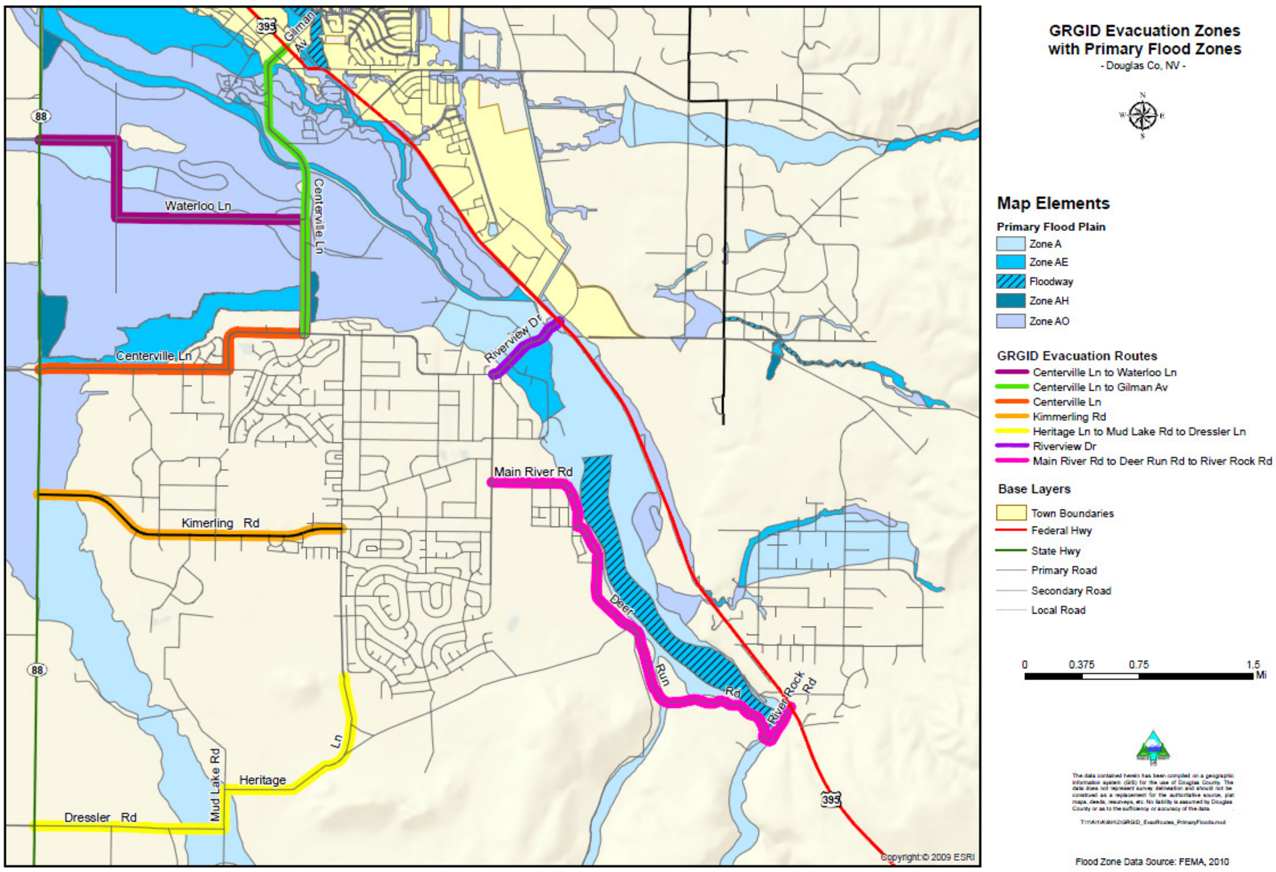
Title 20 of the County Code serves as the County floodplain ordinance. To participate the in the NFIP the County must enforce minimum standards for development in a FEMA designated floodplain. These standards include how high above a 100-year base flood elevation you must construct the bottom floor of a building (residential or commercial) and how much impact the development can have on the increase in floodwater elevation.

Douglas County Code requires standards that are above those required by the NFIP. The NFIP allows for developments to set a finished floor elevation of a building at the base flood elevation. The County requires that all finished floors be elevated at a minimum of 1-foot above the base flood elevation. In addition, the NFIP has no development requirements for buildings out of the 100-year floodplain, but within the 500-year floodplain. Within the 500-year floodplain in the County all buildings must be elevated 1-foot above the highest adjacent grade of the building pad. NFIP allows a development to increase the high water mark of a 100-year flood by 1-foot, County Code has a more stringent requirement allowing only a 0.5-foot rise.

5.3.3.5.7 Public Information

Providing information to the public is a critical item in mitigating flood damage. The County has several locations where floodplain information is provided to the public including the Douglas County

Library, Douglas County website, and the public counter at 1594 Esmeralda Avenue room 202. Additional public information may be provided by billboards or public service announcements on TV or radio.



5.3.3.8 Summary

The Douglas County Board of Commissioners must be made aware of the need for enforcement of the master plan (using the floodplain studies) for future development, public awareness to include the flood insurance program information and an active mitigation program. The greatest flood threat to Douglas County's population exists in the Gardnerville Ranchos area due to the fact that these residential structures are pre NFIP. Current master plan code does not allow building of new structures in this floodplain. *Please see tables below for types and numbers of existing structures in hazard areas. Please see map in appendix B for visual reference of future structures in hazard area. (There are four separate maps which cover entire county)*

References:

Carson Water Subconservancy District (CWSD), Carson River Watershed Regional Floodplain Management Plan, 2008

Wright, James M. "Types of Floods and Floodplains," Chapter 2 in Floodplain Management Principals & Current Practices 2008.

Eastbrook, Don J. "Fluvial Processes" Chapter 5 in Surface Processes and Landforms, Prentice Hall, 1999.

Moody, John A. and Martin, Deborah A., "Post-fire rainfall intensity-peak discharge relations for three mountainous watersheds in the western USA" USGS 2001

Flood Hazard Mitigation – A Plan For South Carolina Agencies, 1999

The 1997 New Years Floods of Western Nevada, Nevada Bureau of Mines and Geology, Special Publication 23, 1998

Year	Flooding Location	Comments	Estimated Losses
December 1852	Carson Valley	Two days of heavy snowfall followed by four days of warm rain. Little damage occurred because settlements were located away from the low areas. It is likely flooding occurred along other western Nevada rivers at this time.	No Figures available
December 1861 January 1862	Carson and Truckee River Basins	Two days of heavy snow before Christmas, followed by extreme cold temperatures freezing the snow. From Christmas Day until December 27, a warm rain fell. It was reported that Carson Valley became a lake. At that time, most of the settlements were located out of the valley along the eastern slope of the Sierra Nevada, so little damage was reported.	No Figures available
December 1867 January 1868	Carson and Truckee River Basins	On December 20, an unseasonably warm rainstorm fell on snow accumulations in the Sierra Nevada. This storm became more intense on December 24 and ended on Christmas Day. After a period of clear weather, a second intense rainstorm began on December 30 and continued through January 2, 1868. The Carson Valley again became a lake. This flooding exceeded the 1861 flood crest. All bridges in the Carson Valley crossing the East Fork and West Fork Carson River as well as the main-stem, were swept away, including William Cradelbaugh's toll bridge, the first bridge over the Carson River in Carson Valley.	No Figures available
March 1907	Walker, Carson and Truckee River Basins	A series of snow storms began on March 16, turning to rain and continuing until March 20. The Truckee River severely damaged the Electric Light Bridge. In Carson Valley, all of the bridges of the East Fork and West Fork Carson River as well as the main-stem Carson River were Either destroyed or seriously damaged. Among the bridges destroyed on the Carson River were the Cradlebaugh bridges on the Gardnerville-Carson city Road (U.S 395, and the McTarnahan bridge on the toll-road on the south end of Prison Hill. . .	No Figures available

Year	Flooding Location	Comments	Estimated Losses
March 1928	Walker, Carson and Truckee River Basins	A snowstorm began March 23 and soon turned to a rainstorm below the 8,000-foot elevation. On March 26 Temperatures dropped. In the Carson Valley, both forks of the Carson River and the main-stem Carson River overflowed their banks, but little damage was caused.	No Figures available
December 1937	Carson and Truckee River Basins	Rain began on the evening of December 9, and continued until the afternoon of December 11, melting most of the snow pack at the higher elevations. After a short break, the rain restarted and continued until December 13. On the East Fork Carson River, the Douglas Power (Ruhenstroth) Dam was severely damaged. Flooding began in the south end of Carson Valley on December 10. In the Gardnerville area, the flood crested at 10.300 cfs late in the afternoon of December 11 at the USGS stream gage on the East Fork Carson River near Gardnerville. On the West Fork Carson River, parts SR 37 present day SR 88. Were flooded to the depth of 14 inches. On the Carson River, Cradlebaugh Bridge was under about 18 inches of water, and the main highway between Carson City and Gardnerville was closed and not reopened until December 13.	No Figures available
November December 1950	Walker, Carson and Truckee River Basins.	A sequence of rapid moving storms and unseasonably high temperatures melted most of the early snow pack in the Sierra. During a period from November 13 to December 8, total precipitation ranged from about 5 inches at the foot of the Sierra Nevada in Nevada to about 30 inches at the crest in California. On the East Fork Carson River near Gardnerville, the flood crested on November 21, at 12,100 cfs. At the north end of Carson Valley, the peak discharge near Carson City was 15,500 cfs on November 22.	The estimate of damages in the three river basins was $4.4 Million ($27.6 million in 1997 dollars) (U.S. Geological Survey, 1954);

Year	Flooding Location	Comments	Estimated Losses
December 1955	Truckee, Carson and Walker River Basins	During December 21 to 24, an intense storm of unseasonably high temperatures melted part of the snow pack in the Northern Sierra Nevada. Precipitation at the headwaters of the principal river basins averaged from 10 to 13 inches. On the East Fork of the Carson River near Gardnerville, the flood crested at 17,600 cfs on December 23. On the West Fork Carson River at Woodfords, California, the flood crested on December 23 at 4,810 cfs. In the Carson Valley, over 16,000 acres were flooded (about the same acreage flooded in New Year's flood 1997) and many families were forced to move out when their homes were isolated and flooded. The largest structure destroyed in Carson Valley was Lutheran Bridge, which collapsed. At the north end of Carson Valley, the flood crested near Carson City on December 24 at 30,000 cfs, setting a record that stood until the New Year's flood 1997.	The estimate of damages in the three river basins was $3,992,000 ($22,327,000 in 1997 dollars) (U.S. Geological Survey 1963b). One life was lost.
January February 1963	Truckee, Walker and Carson River Basins	As late as January 27, western Nevada was having one of its worst winter droughts. An intense storm of unseasonably high temperatures started late January 28 and continued through February 1. Precipitation varied from 5 to more than 13 inches. The freezing level was above 8,000 feet during most of the storm and as high as 11,000 feet at times. On February 1, the flood crested at 13,360 cfs on the East Fork Carson River near Gardnerville, and at 4,890 cfs on the West Fork Carson river at Woodfords (USGS Survey, 1966 a).	Damage in the three river basins was estimated at $3,248,000 ($15,130,000 in 1997 in dollars) (U.S. Geological Survey 1966a).

Year	Flooding Location	Comments	Estimated Losses
December 1964	Truckee and Carson River Basins	This flood resulted from a storm of unseasonably high temperature and rain melting part of the snow pack. During December 21-23, warm air mass raised temperatures, increased wind velocities and caused torrential rains, as much as 16 inches in the mountain areas. This flood was similar to the December 1955 flood. On December 23, the East Fork Carson river near Gardnerville crested at 8,230 cfs and the West Fork Carson River at Woodfords crested at 3,100 cfs. In Carson Valley, 13,500 acres of pasture, hay and grain were flooded. The flood crested on the Carson River near Carson City on Christmas Day at 8,740 cfs (USGS Survey 1971).	The estimate of damages in these two river basins was $2,236,000 ($10,111,000 in 1997 dollars) (U.S. Geological Survey, 1966b).
February 1986	Truckee and Carson River Basins	A light rain began February 12 becoming heavy on February 15, diminishing on February 18. On February 19, the East Fork Carson River near Gardnerville crested at 7,380 cfs, and the West Fork Carson River at Woodfords crested at 551 cfs (Pupacko and others, 1988). Flooding in Carson Valley caused the closing of Cradlebaugh Bridge on U.S. 395 over the Carson River on February 17.	Damage resulting from this flood was estimated at $12,700,000 ($17,760,000 in 1997 dollars) (Donna Garcia, U.S. Army Corps of Engineers, verbal commun., 1997)
December 1996 January 1997	Walker, Carson and Truckee River Basins	This flood resulted from several moderate to heavy snowstorms during December 1996, followed by three subtropical, heavy rainstorms from the Pacific. The third storm melted most of the snow pack in the Sierra Nevada below 7,000 feet and produced heavy rainfall up to 10,000 feet.	Estimated initial damage (Interagency Hazard mitigation Team for FEMA-1153-DR-NV) $21,310,567. .
August 2012	Preacher/Ray May Fire area watersheds	This flash flood resulted from thunderstorm rain on wildfire footprints. The debris covered and closed U.S. Highway 395.	Estimated initial damage: $92,000.00 (Nevada Department of Transportation).

Based on historical events, flooding is a high probability in the Carson Valley (Douglas County).

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Appendix C

Planning Team Meetings

- ***September 2012***

During the kick-off meeting at Douglas County Emergency Operations Center, the Committee discussed the objectives of the DMA 2000, the hazard mitigation planning process, the public outreach process, and the steps involved in updating the HMP and achieving the County's goals. The planning process was discussed, including the purpose of the plan and the previous plans tasks, goals and objectives and new goals and objectives were considered. The 12 potential hazards from the original HMP (as shown in Section 5.2), were reviewed and modifications to the hazards list were discussed. A hazard identification table was completed for the update. The exercise identified the specific hazards that the Planning Committee wanted to address in the HMP. A Hazard Profiling Worksheet was then completed by the Planning Committee, which used group averaging to prioritize the hazards into high, medium and low categories. See Appendix E for agenda, list of attendees and handouts.

- ***October 2012***

Briefed the Planning Committee on progress made to date. A review of the completed Hazard Profiling worksheets took place, along with confirmation of hazard ranking. Sub-committee groups for the highest ranking hazards were established and given assignments. Progress report dates were also established. See Appendix E for agenda, list of attendees and meeting handouts.

- ***February 2013***

Presentations of work performed thus far on the top five identified hazards were given by each sub-committee leader. Discussion of lower raking hazards took place, along with future actions on those hazards. Project identification and priority were briefly discussed as well. The committee ended the meeting by reviewing the plan update schedule and discussing future meetings and procedural matters. See Appendix E for agenda, a list of attendees and meeting handouts.

- ***July 11, 2013***

A brief review of the rough draft HMP document took place, along with the review of the identified goals and actions. STAPLE+E worksheets were distributed and explained for prioritization of the identified goals and action items. Each member was asked to complete the STAPLE+E forms and submit them back for scoring. The upcoming HMP public presentations were discussed, along with the recently revised HMP update timeline. See Appendix E for agenda, a list of attendees and meeting handouts.

- ***July 25, 2013***

Another review of the rough draft HMP document took place. Results of the STAPLE+E worksheet were thoroughly reviewed and discussed. Some goals and actions were re-prioritized based on importance. See Appendix E for agenda, a list of attendees and meeting handouts.

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Appendix D

Public Information

Stakeholders Letter

Douglas County Emergency Management

Administered Under Inter-Local Agreement By The East Fork Fire and Paramedic Districts

P.O. Box 218
Minden, Nevada 89423
(775) 782-9040 FAX (775) 782-9043

July 26, 2012

RE: Hazard Mitigation Plan Revision Working Group

Douglas County Emergency Management is currently soliciting individuals who would be interested in becoming a member of a working group tasked with the revision of the Douglas County Hazard Mitigation Plan. Under current federal guidelines, counties and/or agencies residing in those counties wishing to apply for federal hazard mitigation grants must have a current and approved Hazard Mitigation Plan. The current plan, adopted by the Douglas County Board of County Commissioners in 2008 is due to expire on December 31, 2013. The plan is good for a five year period.

Douglas County Emergency Management was successful in receiving a $138,000 Hazard Mitigation Plan Revision Grant this year. Our desire is to involve as many interests as possible in the planning process, which will address natural hazard potential within Douglas County. This will include flooding, earthquakes, wildland fire, weather events, etc… We would like to invite you or your designee to be a part of the process as it is critical that we attempt to represent as many local agencies as possible. Identifying potential hazards becomes the first step towards applying for federal grant assistance and must be identified within an approved Hazard Mitigation Plan.

The revision process will be time consuming and task oriented, so your participation will require some effort. Those accepting the invitation to participate will not only have to represent their specific jurisdictions, but all others as well, even those without representatives on the working group. Our goal will be to prepare a revised plan which is as comprehensive as possible.

On August 9, 2012, the Nevada Hazard Mitigation Planning Committee will be meeting in Minden, at the East Fork Fire and Paramedic District Office, beginning at 9:45 AM.

An agenda is attached for your reference. Our desire would be to introduce our working group to the state committee during the public comment portion of the meeting. The agenda includes information specific about Douglas County and would serve as a primer for all working group members, so your attendance would be encouraged.

Please advise if you are willing to serve on this important committee prior to August 3, 2012. You can either advise via phone to Erin Surane at 783-6436 or via email to esurane@eastforkfire.org or tcarlini@eastforkfire.org.

An initial working group meeting will be scheduled towards the end of August where a comprehensive work schedule and objectives will be distributed.

Thank you in advance for your consideration to participate in this very important project.

Sincerely,

Tod F. Carlini, District Fire Chief

Bordering Communities Letter

Douglas County Emergency Management
Administered Under Inter-Local Agreement By The East Fork Fire and Paramedic Districts

P.O. Box 218
Minden, Nevada 89423
(775) 782-9040 FAX (775) 782-9043

August 21, 2012

Douglas County has launched a planning effort to update the *Douglas County Hazard Mitigation Plan* to assess risks posed by natural and manmade disasters and identify ways to reduce those risks. This plan is required under the Federal Disaster Mitigation Act of 2000 as a pre-requisite for receiving certain forms of Federal disaster assistance.

Douglas County shares common borders with your jurisdiction/organization and we may share some mutual corresponding risks, such as fire, flood, earthquake, dam failure, transportation, hazardous materials, and other hazards. Migration measures will focus on prevention, property and natural resource protection, public education and awareness, enhanced emergency services, and improved management practices for structural projects.

The public, including local, state and Federal entities is invited to participate in this planning process. The Workgroup will be holding its inaugural meeting on September 5, 2012 at 9:00am in the East Fork Fire and Paramedic District Office/EOC Meeting Room, 1694 County Road, Minden, Nevada. You are welcome to attend this meeting or you may contact me directly at (775) 782-9048, email tcarlini@eastforkfire.org or submit written comments to the Workgroup at the address below.

Douglas County Emergency Management
P.O. Box 218
Minden, Nevada 89423
Attention: Hazard Mitigation Plan Revision Workgroup

Your concerns and hazard mitigation strategy input would be both helpful and welcome.

Sincerely,

Tod F. Carlini, District Fire Chief/Emergency Management Director

cc: Karen Johnson, NV Division of Emergency Management

Press Release

Douglas County Emergency Management To Host Public Presentation On Hazard Mitigation Plan Update

Douglas County Emergency Management, as provided by the East Fork Fire and Paramedic Districts, will be hosting two public presentations on the Douglas County Hazard Mitigation Plan Update. The first meeting will be held on July 29, 2013 at the East Fork Fire and Paramedic District Office, 1694 County Rd, Minden and will begin at 7:00 pm. The second public presentation will be held at the Tahoe Douglas Fire Station 3 at 193 Elks Point Rd, Zephyr Cove on August 1, 2013 and will begin at 7:00 pm. Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000, local governments are required to develop a hazard mitigation plan as a condition for receiving certain types of emergency and non-emergency disaster assistance, including funding for mitigation projects and emergency response. The plan must be approved by the Federal Emergency Management Agency and adopted by the Board of County Commissioners. The Douglas County Board of Commissioners adopted the last plan five years ago. Hazard Mitigation Plans must be updated every five years, hence the reason for the current update effort.

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Mitigation activities may be implemented prior to, during, or after an incident. Hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. It is important to understand how much of the community can be affected by specific hazards and what the impacts would be on important community assets. The public presentations will afford attendees an opportunity to provide comment on the proposed updates and to better understand the Hazard Mitigation Planning Process. Over the past few months, several individuals with subject matter expertise have been reviewing and updated specific sections of the current plan.

The top five hazards identified in the Douglas County Plan include flooding, earthquakes, wildland fires, drought, and severe weather events. District Fire Chief and Douglas County Emergency Manager, Tod Carlini, is encouraging the public to attend. Carlini noted that "the Hazard Mitigation Planning Update process is yet one more way that we hope to make Douglas County a more disaster resilient community". Following the public presentation process and a review by the Douglas County Local Emergency Planning Committee (LEPC), the plan will be prepared in a final form and sent to the Nevada Department of Emergency Management, followed by a review by the Federal Emergency Management Agency (FEMA). Once approved by FEMA, the plan will be presented to the Douglas County Board of Commissioners for adoption, hopefully at the October 17, 2013 Board meeting. Individuals with questions regarding this plan update may also contact the East Fork Fire and Paramedic Districts Office at 775-782-9040.

Public Presentation Sign-In Sheet

July 29, 2013

Douglas County Emergency Operations Center

Douglas County Hazard Mitigation Plan Public Presentation
July 29, 2013

Emergency Operations Center
1694 County Rd.
Minden, NV 89423

Name	Organization	Mailing Address	Phone	Email
Nancy McDermid	D.C.	—	2677968	nmcdermid@co.douglas.nv.us
Dawna Meyer			265-0443	rosiced@charter.net
MARSHALL GOLDY	NONE		265-0267	marshallgoldy@frontier.com
Gareth Craner			782-7975	mgordogator@frontier.com
Ellen Perkins	NONE		782-2929	eljperkins@aol.com

Public Presentation Sign-In Sheet

August 1, 2013

Tahoe-Douglas Fire Station

Douglas County Hazard Mitigation Plan Public Presentation
August 1, 2013

Tahoe-Douglas Fire Protection District
193 Elks Point Rd
Zephyr Cove

Name	Organization	Mailing Address	Phone	Email
Greg Felton	TDFPD Board Stateline resident	PO Box 2130 Stateline NV 89449	775 588 3121	GregoryRFelton @yahoo.com

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Appendix E

Meeting Agendas & Handouts

Meeting No. 1 Agenda

Douglas County Hazard Mitigation Plan Update
Planning Committee Agenda
September 2012 – 9:00 AM
Douglas County Emergency Operations Center

AGENDA

1. Welcome and opening remarks

   Tod F. Carlini, District Fire Chief
   Steve Mokrohisky, County Manager
   Lee Bonner, Chairman, Douglas County Commission

2. Introductions of Working Group Members

3. Introduction and Presentation by Nevada Division of Emergency Management on Hazard Mitigation Planning
   Elizabeth Ashby and/or Karen Johnson
   Process
   Funding

4. Distribution of Working Group Member Binders and Textbooks and discussion of procedural matters and participation documentation

5. Plan revision process discussion and presentation

6. Break

7. GIS Capabilities Presentation
   Eric Schmitt, GIS Manager

8. General overview of the current Hazard Mitigation Plan

9. Group Exercise: Hazard Mitigation Profile

10. Discussion regarding adding additional areas of expertise to the working group as actual group members or technical experts

11. Discussion regarding the establishment of a meeting schedule and the establishment of future sub-committees, use of technical expertise and consultation, and necessary documentation

12. Questions and Comments

Meeting No. 1 Sign in Sheet

Douglas County Hazard Mitigation Plan Update Kick-off Meeting
September 5, 2012 0900

Emergency Operations Center
1694 County Rd.
Minden, NV 89423

Name	Organization	Mailing Address	Phone	Email
Karen Johnson	DEM		687-0373	kjohnson@dps.state.nv.us
Mark Novak	TDFD		586-1576	mnovak@tahoefire[illegible]
Steve Mokrohisky	Do. County		782-9821	smokrohisky@co.douglas.nv.us
Mike Vollmer	TRPA		588-4547	mvollmer@trpa.org
Josh Poulson	ToG		782-7134	jpoulson@co.douglas.nv
Eric Schmidt	DC GIS		782-9045	eschmidt@co.douglas.nv.us
Erik Nilssen	DC Com Dev		x 9063	enilssen@co.douglas.nv.us
Tom Dallaire	Town G'ville		x 7134	tdallaire@co.douglas.nv.us
John Pickett	Tahoe Douglas FPD		775-220-7675	jpickett@tahoefire.com
Steve Eisele	EFFPD		782-9041	seisele@eastforkfire.org
Bob Spellberg	GBGID		265-2048	gbgid@aol.com
Candace H. Stowell	DC Commun. Dev		782-6200	cstowell@co.douglas.nv.us
Keith Ruben	R.O. Anderson Eng.			
Tod Carlini	DCEM			
Erin Surane	DCEM			

Toni Braga DCEM

Meeting No. 1 Handouts

General Information

DEFINITIONS

Hazard Mitigation is any sustained action taken to eliminate or reduce long term risk to human life, property and the environment posed by a hazard.

Hazard Mitigation Planning is the process of making any sustained plan or course of action taken to reduce or eliminate long-term risk to people and property from both natural and technological hazards and their effects. The planning process includes establishing goals and recommendations for mitigation strategies.

Hazard Mitigation may occur during any phase of a threat, emergency or disaster. Mitigation can and should take place during the preparedness (before), response (during), and recovery (after) phases.

The process of hazard mitigation involves evaluating the hazard's impact and identification and implementation of actions to minimize the impact.

Unreinforced Masonry (URM)**:** Buildings constructed prior to 1973. These structures may be of stone, brick or concrete block bearing wall materials that contain no reinforcing rods.

PLANNING EFFORT

Douglas County Emergency Management

Douglas County Emergency Management is the lead agency and chair in coordinating the efforts of the Hazard Mitigation Planning Committee.

Purpose of the Plan

The purpose of this plan is to integrate Hazard Mitigation strategies into the activities and programs of the County, and to the extent practical, into the activities of private sector organizations.

The plan identifies and evaluates specific Douglas County Hazard Mitigation strategies to be considered by the county and their agencies and offers a support document, as well as planning support, for those strategies developed by its political subdivisions, agencies, special districts and organizations.

It is understood that the mitigation strategies adopted in this plan will be recommendations only, and they must be approved and funded in order to be implemented as official Hazard Mitigation Strategies.

Reviewing Hazard Mitigation Planning Committee By-Laws

Members from the Planning Committee agree to meet on a bi-monthly basis to identify hazard priorities, develop a risk assessment and review, identify and implement Douglas County hazard mitigation strategy recommendations.

The Planning Committee agrees to make and pass policy recommendations by a vote of a simple majority of those members present at the meeting.

Any single Planning Committee member may petition the Planning Committee as a whole to request an adoption of/or amendment to the plan or process. No action will be taken until the next subsequent meeting of the Planning Committee.

The Planning Committee may form sub-committees to review and to develop those hazard mitigation strategy recommendations identified and to be reviewed by the Planning Committee as a whole.

The Planning Committee will identify hazard mitigation strategies from existing recommendations contained in plans and documents, the local political subdivisions, and from the input of regional jurisdictions and the input of private citizens and private organization sector.

The Planning Committee will facilitate county wide and community input through the following methods:

Press Release Announcements

Reviewing Hazard Mitigation Planning Tasks

Coordinate multi-hazard mitigation planning tasks and activities with Douglas County Emergency Management to develop a multi-jurisdictional mitigation plan and support the EM oversight of the planning process.

Assist in carrying out the goals of the Douglas County Hazard Mitigation Plan in compliance with FEMA DMA 2000 Hazard Mitigation Act.

Prioritize Risks for implementing mitigation strategies.

Select designated Critical Facilities and ascertain risk exposure analysis for those facilities.

Select highest and best mitigation recommendations and develop those recommendations for further action by Douglas County.

Review mitigation planning drafts, recommendations and updates.

Develop and implement long and short term goals.

Integrate the plan with all phases of Comprehensive Emergency Management Planning.

Provide for the implementation of committee decisions.

Encourage, coordinate and provide a methodology for the implementation of public input.

Name:______________________________ Date: ____________

Agency:______________________________

Hazard Profiling Worksheet

Legend: 1 = lowest; 5 = highest

Hazard Type	Magnitude	Duration	Economic	Area Affected	Frequency	Degree of Vulnerability	State & Community Priorities	Total
Natural								
Avalanche								
Drought								
Earthquakes								
Epidemic								
Expansive Soils								
Extreme heat								
Flood (Includes dam failure, canal failure, and mudslides)								
Hail & thunderstorm								
Infestations								
Land subisdence & ground failure								
Severe Winter Storm								
Severe Windstorm								
Tornado								
Tsunami/seiche								
Volcano								
Wildfire								
Human-caused								
Hazmat								
Terrorism/WMD								

State of NV Categorization of Hazards

Very High Risk	High Risk	Medium Risk	Low Risk	Very Low Risk
Earthquake	Flood	Epidemic	Drought	Avalanche
Terrorism/WMD	Wildfire	Severe winter storm	Hazardous materials event	Expansive soils
			Severe windstorm	Extreme heat
			Tsunami/seiche	Land subsidence and ground failure
				Hail and thunderstorm
				Infestation
				Tornado
				Volcano

These criteria will be used to categorize the identified hazards into high, medium and low risk hazards.

Criterion One: Magnitude

Magnitude refers to the physical and economic impact of the event. Magnitude factors are represented by:

- Size of event
- Life threatening nature of the event
- Economic impact of the event
- Threat to property
  - Public Sector
  - Private Sector
  - Business and Manufacturing
  - Tourism
  - Agriculture

Value:

Very Low	Handled by community
Low	Handled at city/town level
Medium	Handled at county level
High	State must be involved
Very High	Federal declaration needed

Criterion Two: Duration

Duration refers to the length of time the disaster affects the State and its citizens. Some disaster incidents have far-reaching impact beyond the actual event occurrence such as the September 11, 2001 event. Duration factors include the following:

- Length of physical duration during emergency phase
- Length of threat to life and property
- Length of physical duration during recovery phase
- Length of time affecting individual citizens and community recovery
- Length of time affecting economic recovery, tax base, business and manufacturing recovery, tourism, threat to tax base and threat to employment

Value:

Very Low	Critical facilities and/or services lost for 1 to 3 days
Low	Critical facilities and/or services lost for 4 to 7 days
Medium	Critical facilities and/or services lost for 8 to 14 days
High	Critical facilities and/or services lost for 15 to 20 days
Very High	Critical facilities and/or services lost for more than 20 days

Criterion Three: Economic Impact

Distribution of the event refers to the depth of the effects among all sectors of the community and State, including both the geographic area affected as well as distribution of damage and recovery of the economy, health and welfare, and the State/community infrastructure. Distribution factors include the following:

How widespread across the state are the effects of the disaster?
Are all sectors of the community affected equally or disproportionately?
How will the distribution of the effects prolong recovery from the disaster event?

Value:

Very Low	Community –Only the immediate community or part of a town/city is affected
Low	City/Town – entire town/city is affected
Medium	County – effects are felt at the county level
High	State – the entire state will be affected by the event
Very High	Federal effects are felt nationwide (e.g. Hurricane Katrina-sized)

Criterion Four: Area Affected

Area affected refers to how much area is physically threatened and potentially impaired by a disaster risk. Area affected factors include of the following:

Geographic area affected by primary event
Geographic, physical, and economic areas affected by primary risk and potential secondary effects.

Value:

Very Low	Community
Low	City/Town
Medium	County
High	State
Very High	Federal

Criterion Five: Frequency

The frequency of the risk refers to the historic and predicted rate of recurrence of a hazardous event (generally expressed in years, such as the 100 year flood).

Value:

Very Low	Occurs less than once in 1,000 years
Low	Occurs less than once in 100 to once in 1,000 years
Medium	Occurs less than once in 10 to once in 100 years
High	Occurs less than once in 5 to once in 10 years
Very High	Occurs more frequently than once in 5 years

Criterion Six: Degree of Vulnerability

The degree of vulnerability refers to how susceptible the population, community infrastructure and state resources are to the effects of the risk. Vulnerability factors include the following:

History of the impact of similar events
Mitigation steps taken to lessen impact
Community and State preparedness to respond to and recover from the event

Value:

Very Low	1 to 5% of property in affected area severely damaged
Low	6 to 10% of property in affected area severely damaged
Medium	11 to 25% of property in affected area severely damaged
High	26 to 35% of property in affected area severely damaged
Very High	36 to 50% of property in affected area severely damaged

Criterion Seven: State and Community Priorities

State and community priorities refer to the importance placed on a particular risk by the citizens and their elected officials. Priorities factors consist of the following:

Long term economic impact on portions of the State or community
Willingness of the State or community to prepare for and respond to a particular risk
More widespread concerns over one particular risk than other risks
Cultural significance of the threat associated with a risk.
Potential for long term community or cultural disruption presented by the hazard
Matrix Prioritization of Hazards Results

Value:

Very Low	Advisory
Low	Considered for further planning in the future
Medium	Prompt action necessary
High	Immediate action necessary
Very High	Utmost immediacy

Vulnerability Ratings

High Risk Hazard: Event has most likely occurred in the past and/or is likely to occur in the future. Of substantial magnitude, with loss and financial impact to the State considered beyond the State's available resources and ability to respond.

Moderate Risk Hazard: Event has most likely occurred in the past and/or is likely to occur in the future. Of moderate magnitude, may be considered beyond the State's available resources and ability to respond.

Low Risk Hazard: Event has a very low occurrence rating and not likely to cause major damage to property or loss of lives in the future. Not likely to exceed the State's available resources or ability to respond.

No Substantial Risk Category: Event would be considered a State/local emergency incident within the jurisdiction's response capability and needing no additional resources to respond.

Special Risk Category: A hazard with an identified mitigation plan or lead agency that provides the expertise to provide mitigation strategies.

Meeting No. 2 Agenda

Douglas County Hazard Mitigation Plan Update
Planning Committee Agenda
September 2012 – 9:00 AM
Douglas County Emergency Operations Center

AGENDA

1. Committee Membership
2. Review of Hazard Profiling Worksheets and confirmation of hazard ranking

   Determine whether to include man-made hazards

3. Develop sub-committees, assignments and define process
4. Establish progress reporting dates
5. Sub-committee breakout sessions and establish target deadlines
6. Discussion of future meetings
7. Questions and Comments

Meeting No. 2 Sign in Sheet

Hazard Mitigation Plan Update Committee
October 10, 2012

Emergency Operations Center
1694 County Rd.
Minden, NV 89423

Name	Organization	Mailing Address	Phone	Email
Erik Nilsson	D.C.		775 782 0965	enilsson@co.douglas.nv.us
Stephanie Hicks	ROAnderson		215-5042	shicks@roanderson.com
Mike Vollmer	TRPA		775 539-5268	mvollmer@trpa.org
Nate Leising	C.V. Ag Assoc.		775-720-2799	[illegible]
Tom Dallaire	Town of Gardnerville		775 782 7134 [illegible]	[illegible]@co.douglas.nv.us
John Pickett	TDFPD		775-220-7675	JPickett@tahoefire.com
Mark Novak	TDFPD		775-450-6141	mnovak@tahoefire.com
Greg Hill	Town of Minden		775 221 8350	ghilltom@frontier.com
[illegible] A. Stowell	D.C.-CD		782-6200	cstowell@co.douglas.nv.us
Eric Schmidt	DC GIS		782-9045	eschmidt@co.douglas.nv.us
Tod Carlini	DCEM			
Erin Surane	DCEM			
Steve Eisele	DCEM			
Bob Spellberg	GRGID		265-2048	GRGID@GRGID.com

Meeting No. 2 Handouts

Hazard Mitigation Plan Update
Proposed Sub Committee Assignments

Based on the outcome of our Douglas County Hazard Profiling Exercise, we have identified three very high risk hazards and two high risk hazards. The balances of hazards identified are either medium, low, or very low risks.

I would like to propose that we concentrate on the very high and high hazards as an initial approach. We will also need to begin working on the demographic information for the update and risk mapping. In order to accomplish our task, we will need to break our committee up into sub committees, generally by matching up areas of committee member expertise with one of the five hazards. Some individuals may be asked to serve on more than one sub-committee.

The following sub-committees proposed are:

Earthquake

Members

Tod Carlini (Lead)
Steve Eisele
Erin Surane

Technical Expertise

Craig Depolo, Nevada Bureau of Mines and Geology
Gary Johnson, Nevada Bureau of Mines and Geology

Floods

Members

Erik Nilssen (Lead)
Tom Dallaire
Kevin Ikehara
Greg Hill
Josh Poulson
Bob Spellberg
Candice Stowell

Technical Expertise

Luke Opperman, Risk Mapping – Division of Water Resources
Edwin James, Water Sub-Conservancy
Kim Davis, Flood Plan Manager
Stephanie Hicks, RO Anderson Engineering

Wildland Fire

Members

Mark Novak (Lead)
John Pickett
Steve Eisele
Mike Vollmer

Reference: Nevada Wildland Fire Assessment 2006 – Douglas County/Lake Tahoe Basin

Drought

Members

Nate Liesing (Lead)
Erik Nilssen
Tom Dallaire

Technical Expertise

Edwin James, Water Sub-Conservancy
Douglas County Agricultural Community
Gary Stone, Federal Water Master

Severe Storm

Members

Tod Carlini (Lead)
Gary Cullen
Nate Leising

Technical Expertise
U.S. Weather Service - Reno

Demographics and Risk Mapping

Candice Stowell
Eric Schmidt

Meeting No. 3 Agenda

Douglas County Hazard Mitigation Plan Update
Planning Committee Agenda
February 2013 – 9:00 AM
Douglas County Emergency Operations Center

AGENDA

1. Committee roll call

2. Sub-Committee assigned plan section updates

    1) Flood- Erik Nilssen
    2) Drought- Nate Leising
    3) Earthquake- Tod Carlini
    4) Wildland Fire- Mark Novak
    5) Severe Storm- Tod Carlini
    6) GIS- Eric Schmidt
    7) Demographics- Candace Stowell

3. Discussion on remaining hazards and future actions

4. Discussion on project identification and priority

5. Review plan update schedule

6. Future meetings

7. Procedural matters and questions

Meeting No. 3 Sign in Sheet

Douglas County Hazard Mitigation Plan Update Committee Meeting
February 13, 2013
Emergency Operations Center
1694 County Rd.
Minden, NV 89423

Name	Organization
Candace H. Stowell	Douglas County - Community Dev. Dept
Erik Nilssen	D.C. Community Development
Josh Poulson	Town of Gardnerville
Mike Vollmer	TRPA
Tom Dallaire	Town of Gardnerville
Stephanie Hicks	RO Anderson Engineering - DCSD
Karen Johnson	NDEM
Craig dePolo	Nevada Bureau of Mines & Geology
Mark Wurtz	TDFPD
John Pickett	" "
Erin Surane	DCEM
Tod Carlini	DCEM
Nate Leising	Private
Eric Schmidt	DC GIS
Bob Spellberg	GRGID

Meeting No. 4 Agenda

Douglas County Hazard Mitigation Plan Update
Working Group Agenda
July 11, 2013 – 9:00 AM
East Fork Fire and Paramedic District Office

AGENDA

1. Review of HMP rough draft document
2. Review of HMP goals and action items
3. Review of STAPLE + E prioritization of goals and action items
4. Discussion on upcoming HMP public presentations
5. Review of HMP update timeline
6. Discussion on time cards
7. Procedural matters and questions

Meeting No. 4 Sign in Sheet

Douglas County HMP Planning Committee Meeting
July 11, 2013

Emergency Operations Center
1694 County Rd.
Minden, NV 89423

Name	Organization	Phone	Email
Stephanie Hicks	RO Anderson for DCSD	215-5042	shicks@roanderson.com
Jennifer Davidson	TOM	782 5976	jdavidson@co.douglas.nv.us
Gary Cullen	DCSD	782-8140	gcullen@dcsd.k12.nv.us
Craig dePolo	NBMG	322-7485	eq_dude@sbcglobal.net
Erik Nilssen	DC	782-9067	enilssen@co.douglas.nv.us
Tom Dallaire	TOG	782 7134	tdallaire@co.douglas.nv.us
Mark Novak	TDFPD	586-1576	mnovak@tahoefire.com
Dave Drew	EM		
Elizabeth Ashby	NDEM	687-0314	eashby@dps.state.nv.us
Karen Johnson	NDEM	687-0373	kljohnson@dps.state.nv.us
Steve Eisele	DCEM		
Erin Surane	DCEM		

Meeting No. 4 Handouts

Below is the STAPLE+E evaluation criteria developed by FEMA. Each of the Potential Actions will be scored by using rankings of one for lowest and three for highest priority, acceptance, feasibility etc.

Please review these criteria and at least begin to consider the scoring of the Potential Actions.

Table 8-4. STAPLE+E Evaluation Criteria for Mitigation Actions

Evaluation Category	Discussion "It is important to consider…"	Considerations
Social	The public Support for the overall mitigation strategy and specific mitigation actions	Community acceptance; adversely affects population
Technical	If the mitigation action is technically feasible and if it is the whole or partial solution	Technical feasibility; Long-term solutions; Secondary impacts
Administrative	If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary	Staffing: Funding allocation; Maintenance/operations
Political	What the community and its members feel about issues related to the environment, economic development, safety, and emergency management	Political support; Local champion; Public support
Legal	Whether the community has the legal authority to implement the action, or whether the community must pass new regulations	Local, State, and Federal authority; Potential legal challenge
Economic	If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete a FEMA Benefit Cost Analysis	Benefit/cost of action; Contributes to other economic goals; Outside funding required; FEMA Benefit Cost Analysis
Environmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community	Effect on local flora and fauna; Consistent with community environmental goals; Consistent with local, State and Federal laws

STAPLE + E Evaluation Table

	S		T			A			P			L			E				E					PT
	(Social)		(Technical)			(Administrative)			(Political)			(Legal)			(Economic)				(Environmental)					
Considerations → / Mitigation Actions ↓	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Native Habitat	Consistent with Local / Federal Laws	Priority Total
1.A																								
1.B																								
1.C																								
1.D																								
1.E																								
1.F																								
2.A																								
2.B																								
2.C																								
2.D																								

STAPLE + E Evaluation Table

	S		T			A			P			L			E				E					PT
	(Social)		(Technical)			(Administrative)			(Political)			(Legal)			(Economic)				(Environmental)					
Considerations → Mitigation Actions ↓	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Native Habitat	Consistent with Local / Federal Laws	Priority Total
2.E																								
2.F																								
2.G																								
3.A																								
3.B																								
3.C																								
3.D																								
3.E																								
3.F																								
3.G																								

STAPLE + E Evaluation Table

	S		T			A			P			L			E				E					PT
	(Social)		(Technical)			(Administrative)			(Political)			(Legal)			(Economic)				(Environmental)					
Considerations ⇨ Mitigation Actions ⇩	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Native Habitat	Consistent with Local / Federal Laws	Priority Total
4.A																								
4.B																								
4.C																								
5.A																								
5.B																								
5.C																								
5.D																								
5.E																								
5.F																								
5.G																								
5.H																								

STAPLE + E Evaluation Table

	S (Social)		T (Technical)			A (Administrative)			P (Political)			L (Legal)			E (Economic)				E (Environmental)					PT
Considerations → Mitigation Actions ↓	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Native Habitat	Consistent with Local / Federal Laws	Priority Total
5.I																								
5.J																								
5.K																								
5.L																								
5.M																								
6.A																								
6.B																								
7.A																								
7.B																								
7.C																								
7.D																								

STAPLE + E Evaluation Table

	S		T			A			P			L			E				E					PT
	(Social)		(Technical)			(Administrative)			(Political)			(Legal)			(Economic)				(Environmental)					
Considerations → / Mitigation Actions ↓	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Native Habitat	Consistent with Local / Federal Laws	Priority Total
7.E																								
7.F																								
7.G																								
7.H																								

1 – Low Priority

5 – High Priority

Meeting No. 5 Agenda

Douglas County Hazard Mitigation Plan Update
Working Group Agenda
July 25, 2013 – 9:00 AM
East Fork Fire and Paramedic District Office

AGENDA

1. Review of HMP rough draft document

2. Review and approve STAPLE+E and mitigation goals and potential actions

Meeting No. 5 Sign in Sheet

Douglas County HMP Planning Committee
July 25, 2013

Emergency Operations Center
1694 County Rd.
Minden, NV 89423

Name	Organization	Mailing Address	Phone	Email
Karen Johnson	NDEM		775 687 0374	Kjohnson@dpsstate.nv.us
Erik Nilssen	Douglas County		775 782 9063	[illegible]
Erin Surane	DCEM			
Dave Drew	NDEM			
Todd Carlini	DCEM			
Eric Schmidt	GIS			
John Pickett	TDFPD/Forestry			
Jennifer Davidson	TDM			

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Appendix F
Plan Maintenance Documents

Sample Press Release for Annual Maintenance Meeting

Douglas County, Nevada is meeting to review and maintain its Hazard Mitigation Plan to assess risks posed by natural disasters and identify ways to reduce those risks. This plan is required under the Federal Disaster Mitigation Act of 2000 as a prerequisite for receiving certain forms of Federal disaster assistance. The plan can be found on the Douglas County Emergency Management website at www.douglascountynv.gov.

Public comments and participation are welcomed. For additional information or to request to participate, or to submit comments, please contact Tod Carlini, Douglas County Emergency Manager, at (775) 782-9040 or tcarlini@eastforkfire.org.

Annual Review Questionnaire

PLAN SECTION	QUESTIONS	YES	NO	COMMENTS
PLANNING PROCESS	Are there internal or external organizations and agencies that have been invaluable to the planning process or to mitigation action?			
	Are there procedures (e.g., meeting announcement, plan updates) that can be done more efficiently?			
	Has the Steering committee undertaken any public outreach activities regarding the HMP or implementation of mitigation actions?			
HAZARD PROFILES	Has a natural and/or human-caused disaster occurred in this reporting period?			
	Are there natural and/or human-caused hazards that have not bee addressed in this HMP and should be?			
	Are additional maps or new hazards studies available? If so, what have they revealed?			
VULNERABILITY ANALYSIS	Do any new critical facilities or infrastructure need to be added to the asset lists?			
	Have there been changes in development patterns that could influence the effects of hazards or create additional risks?			
MITIGATION STRATEGY	Are there different or additional resources (financial, technical, and human) that are now available for mitigation planning?			
	Are the goals still applicable?			
	Should new mitigation actions be added to a community's Mitigation Action Plan?			
	Do existing mitigation actions listed in a community's Mitigation Action Plan need to be reprioritized?			
	Are the mitigation actions listed in a community's Mitigation Action Plan appropriate for available resources?			

Mitigation Action Progress Report

Page 1 of 3

Progress Report Period:______________________ to ______________________

(date) (date)

Project Title:______________________ Project ID#______________

Responsible Agency:

Address:______________________

City:______________________

Contact Person:______________________

Phone # (s): ______________________ email address:______________________

List Supporting Agencies and Contacts:

____

____

Total Project Cost: ______________________

Anticipated Cost Overrun/Underrun: ______________________

Date of Project Approval: ______________ Start date of the project: ______________

Anticipated completion date: ______________________

Description of the Project (include a description of each phase, if applicable, and the time frame for completing each phase): ______________________

____

____

Milestones	Complete	Projected Date of Completion

Plan Goal(s) Address

Goal: ______________________________

Indicator of Success: ______________________________

____

____

____

Project Status

☐ Project on schedule

☐ Project completed

☐ Project delayed*

*explain ______________________________

____

☐ Project Cancelled

Project Cost Status

☐ Cost unchanged

☐ Cost overrun*

*explain ______________________________

____

☐ Cost underrun*

*explain ______________________________

____

Summary of progress on project for this report:

A. what was accomplished during this reporting period?

____

____

____

B. What obstacles, problems, or delays did you encounter, if any?

____

____

____

C. How was each problem resolved?

____

____

____

Next Steps: What are the next step(s) to be accomplished over the next reporting period?

Other Comments:

Appendix G

Previous Plan Goals & Actions

Overview of the Mitigation Goals, Objectives, and Potential Actions (2006)

Listed below are the County's specific hazard mitigation goals and objectives as well as related potential actions. For each goal, one or more objectives have been identified that provide strategies to attain the goal. Where appropriate, the County has identified a range of specific actions to achieve the objective and goal.

Goal Number and Description	Action Number	Action Description	Sub Action Description	Sub Action Status
Goal 1 **Promote disaster-resistant development**	**Objective 1.A**	Ensure that the County's planning tools to be consistent with the hazard information identified in the HMP.	**Action 1.A.1** Update the Douglas County Master Plan, Open Space and Agricultural Lands Preservation Implementation Plan and County Title 20 to be consistent with the hazard area maps and implementation strategies developed in the HMP.	Master Plan etc. updated in2011. Continued in HMP revision in Action 1.A.
	Objective 1.B	Pursue available grant funding to implement mitigation measures.	**Action 1.B.1** Apply for PDM and HMGP grants to fund mitigation actions identified in this HMP.	Applications submitted for highway 395 in process and 88.TDFPD fuels reduction grants received. Continued in HMP revision, actions 5.F, 7.C, 7.D, 7.E, 7.F.
			Action 1.B.2 Research State and Local entities with resources to leverage new and existing funding (University of Nevada Reno Cooperative Extension, Carson River Water Subconservancy District, and Tahoe Regional Planning Agency).	Application submitted for Highway 395 (in process) and 88. Partnered with NDOT and Subconservancy. Study completed by NCRWS (info coming) action continued in HMP revision actions 2.D, 5.F.

Goal 2 **Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters.**	**Objective 2.A**	Educate County officials, department heads and emergency response personnel about the Hazard Mitigation Plan.	**Action 2.A.1** Develop and provide presentation and/or information about the hazard mitigation program and this plan for distribution during meetings.	Presentations in LEPC, CERT, EOP presentations to public, HMP revision process, living with fire, wildfire awareness week. Actions continued in HMP revisions as actions 1.B, 1.E, 2.A, 2.G.
	Objective 2.B	Improve upon existing capabilities to warn the public of emergency situations to include the education of the public about the warning systems.	**Action 2.B.1** Develop emergency evacuation programs for neighborhoods in flood prone areas and wildland fire areas by increasing the public awareness about the evacuation programs.	EOP describes evacuation procedures 2011. TDFPD evacuation drills. Maps added to HMP revision. Continue public education in HMP revisions action 2.A.
			Action 2.B.2 Add rain gages to existing warning systems.	Hasn't been completed due to budget. Carry forward to revised HMP action 5.A.
	Objective 2.C	Educate the public to increase their awareness of hazards, emergency response, and recovery.	**Action 2.C.1** Establish a budget and identify funding sources for mitigation outreach to include all the identified hazards (flood, earthquake, wildland fire, severe weather, avalanche and landslides).	TDFPD complete for wildland fire, Subconservancy provides, HMP update public meetings, continued in HMP revisions actions 2.D, 7.C, 7.D, 7.E, 7.F.

Goal 2 **Build and support local capacity to enable the public to prepare for, respond to, and recover from disasters.** **Continued**	**Objective 2.C** **Continued**	Educate the public to increase their awareness of hazards, emergency response, and recovery. Continued	**Action 2.C.2** Work with school districts to develop a public outreach campaign that teaches children how to avoid danger and behave during an emergency.	Shake-out, fire drills, earthquake drills monthly. DC website alerting and preparedness information. Continued in HMP revisions actions 1.E, 2.E.
			Action 2.C.3 Support the efforts and education of people with disabilities to prepare for disasters.	Not specifically targeted, covered in previous. Not continued in update.
			Action 2.C.4 Distribute appropriate public information about hazard mitigation programs and projects at County-sponsored events	Covered in other action items, continued in HMP revision actions 2.G, 3.E, 7.B.
Goal 3 **Reduce the possibility of damage and losses due to Natural Hazards**	**Objective 3.A**	Protect existing assets, as well as any future development, from the effects of an avalanche.	**Action 3.A.1** Develop and adopt a development ordinance that may stipulate building and landscaping requirements in the avalanche prone area.	No action. Delete from HMP revision because of low risk.

Goal 3 **Reduce the possibility of damage and losses due to Natural Hazards** **Continued**	**Objective 3.B**	Protect existing assets, as well as any future development, from the effects of an earthquake.	**Action 3.B.1** Survey the public buildings to determine the need for structural retrofit of critical facilities.	No action. Carried forward to HMP revision in action 3.A.
			Action 3.B.2 Survey the public buildings to determine the need for non-structural retrofit of critical facilities.	No action. Carried forward to HMP revision in action 3.A.
			Action 3.B.3 Work with Nevada Earthquake Safety Council in the compliance of the Nevada Earthquake Mitigation plan goals and objectives.	Addressed in revision process for HMP in action 3.C.
			Action 3.B.4 Procure equipment such as emergency backup generators, which provide continuity of operations to critical public utilities and infrastructure.	Several county facilities, fire districts, towns, retrofit water systems, GID facilities, security augmentation, EOC.
	Objective 3.C	Protect existing assets, as well as any future development, from the effects of a flood.	**Action 3.C.1** Continue to strictly enforce the County's building code Title 20, the Open Space Plan and the Master Development Plan.	Ongoing, continued in HMP revision in actions 1.A, 1.F, 3.D, 5.B, 5.L, 7.A, 7.C, 7.H.

Goal 3 **Reduce the possibility of damage and losses due to Natural Hazards** **Continued**			**Action 3.C.2** Support the efforts of the Carson Valley Water Sub conservancy District in issues within the County's jurisdiction regarding development in the Carson River Basin.	Cooperative agreements with adjoining political subdivisions continued in HMP revision as action 5.L.
			Action 3.C.3 Acquire Repetitive Loss Properties within the County.	Acquired 1 of 4 buildings, continued in HMP revision action 5.M.
	Objective 3.D	Protect existing assets, as well as any future development, from the effects of a landslide.	**Action 3.D.1** Develop and adopt a development ordinance that may stipulate building and landscaping requirements in the landslide prone area.	No action. Delete from HMP revision because of low risk.
	Objective 3.E	Protect existing assets, as well as any future development, from the effects of severe weather.	**Action 3.E.1** Install/maintain lightning detection systems and rods for public outdoor venues and critical facilities.	No action. Not carried forward to HMP revision because of low risk.
			Action 3.E.2 Develop an annual free curb-side dead tree and branch removal pick-up program to protect structures from a thunderstorm/lightning/wind event.	Towns have curbside green waste disposal program, continued to HMP revision action 7.D.

Goal 3 **Reduce the possibility of damage and losses due to Natural Hazards** **Continued**	**Objective 3.E** **Continued**	Protect existing assets, as well as any future development, from the effects of severe weather.	**Action 3.E.3** Continue to enforce and update the Building Code provisions pertaining to construction relative to snow and wind resistance.	Ongoing, included in HMP revision action 1.A, 1.F, 3.D, 7.L.
			Action 3.E.4 Procure equipment such as emergency backup generators, which provide continuity of operations to critical public utilities and infrastructure.	Same as above action 3.B.4.
	Objective 3.F	Protect existing assets, as well as new development, from wildland fires.	**Action 3.F.1** Review, update and enforce the Master Plan, Open Space plan and building codes related to defensible space requirements for new development.	Ongoing, included in HMP revision actions 7.A, 7.C, 7.H.
			Action 3.F.2 Develop a curb-side dead tree and weed removal pick-up program.	Commercial and public green waste facilities, TDFPD curbside chipping program, towns have programs for removal of hazardous trees continued in HMP revision as action 7.D.

Goal 3 **Reduce the possibility of damage and losses due to Natural Hazards** **Continued**			**Action 3.F.3** Work with Nevada Division of Forestry, Nevada Division of State Lands, Bureau of Land Management and US Forest Service to conduct fuel reduction project on state and federal property surrounding each community.	TDFPD fuels modification programs on private lands, state park development at Tahoe, federal agencies' fuels modification programs. Ongoing to HMP revision action 7.E.