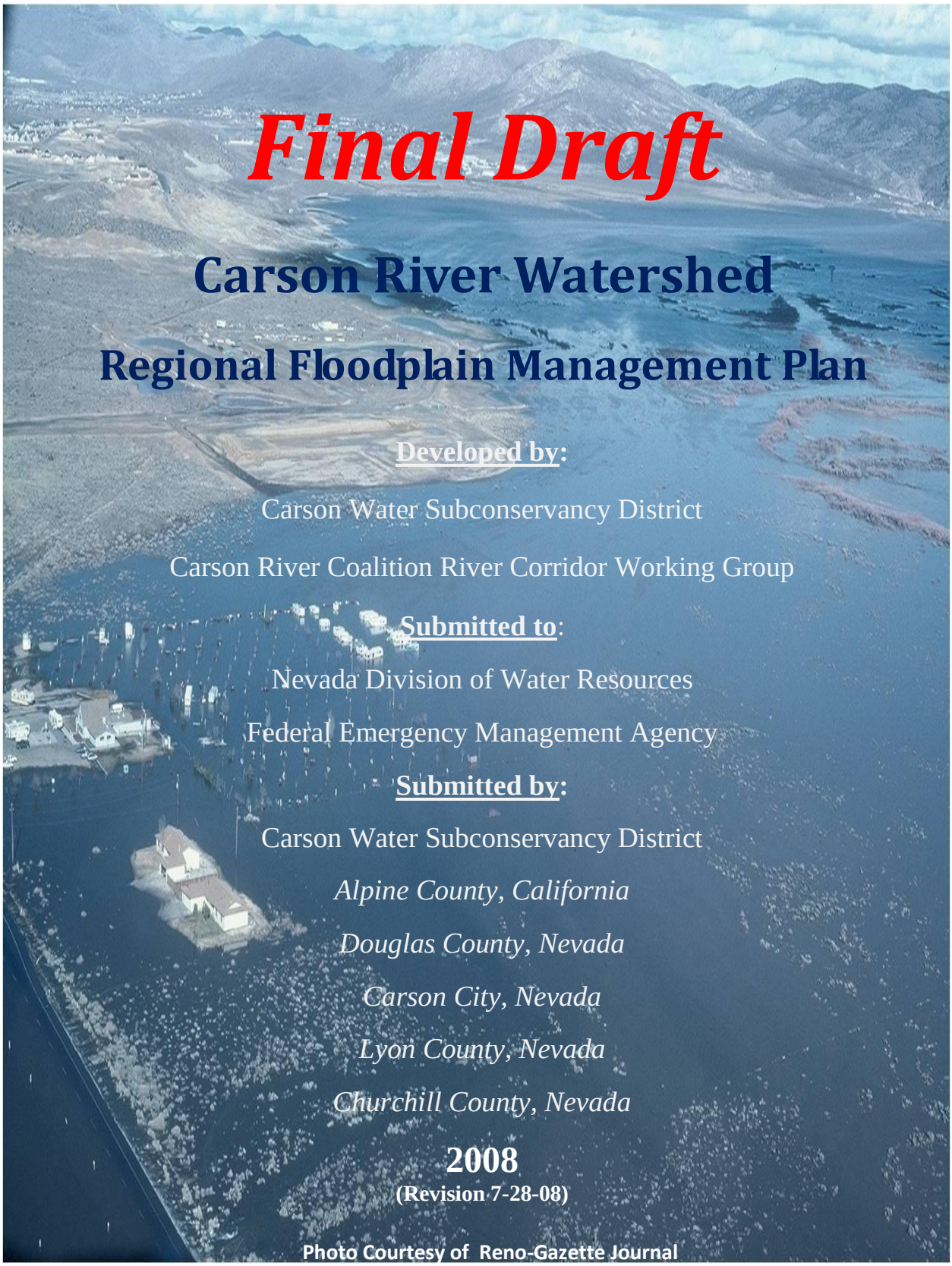

Final Draft

Carson River Watershed

Regional Floodplain Management Plan

Developed by:

Carson Water Subconservancy District

Carson River Coalition River Corridor Working Group

Submitted to:

Nevada Division of Water Resources

Federal Emergency Management Agency

Submitted by:

Carson Water Subconservancy District

Alpine County, California

Douglas County, Nevada

Carson City, Nevada

Lyon County, Nevada

Churchill County, Nevada

2008

(Revision 7-28-08)

Photo Courtesy of Reno-Gazette Journal

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PREFACE

Flooding in the Carson River Watershed is a natural process that occurs on a regular basis. It is also one of the most devastating and costly natural events that our communities face. The Carson River is unique in that we have no flood control structures and have extremely limited upstream storage capability. However, we have the best flood control mechanisms available - open floodplain lands. These lands not only provide public safety during flooding events by storing and slowing floodwaters, but also help protect our natural resources such as drinking water and wildlife habitat. Future predictions as related to climate change include the high potential for an increase in storm intensities that could directly increase peak flows and increase the likelihood of "rain on snow" events. There are uncertainties associated with all of these predictions, but it is imperative that we plan properly and implement good floodplain management strategies.

The actions of one community have the potential to impact downstream communities, making flooding a watershed-wide challenge. The main goal of this planning process is to develop strategies for floodplain management that can be applied regionally as well as locally. Included are suggested actions that encourage communities within the Carson River Watershed to recognize the value and critical functions provided by floodplain lands for public safety and reduction of costly flood damages. The suggested actions also address the need for accurate data, reduction of negative impacts from existing infrastructure, and outreach and education. This plan is intended to be a starting point and a living document that guides the implementation of the suggested actions.

Abbreviations

amsl	above mean sea level
ASFPM	Association of State Floodplain Managers
BFE	Base Flood Elevation
cfs	cubic feet per second
CLOMR	Conditional Letter of Map Revision
CRC	Carson River Coalition
CRS	Community Rating System
CWSD	Carson Water Subconservancy District
dFIRM	Digitized Flood Insurance Rate Map
ERM	Elevation Reference Mark
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
LOMR	Letter of Map Revision
NBMG	Nevada Bureau of Mines and Geology
NDEP	Nevada Division of Environmental Protection
NDWR	Nevada Division of Water Resources
NFIP	National Flood Insurance Program
NGO	Non-Government Organization
NPS	Non-point Source Pollution
NAVD	North American Vertical Datum
SFHA	Special Flood Hazard Area
TWT	Tall Whitetop
UNCE	University of Nevada Cooperative Extension
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

Executive Summary

"Rivers were here long before man, and for untold ages every stream has periodically exercised its right to expand when carrying more than normal flow. Man's error has not been the neglect of flood control measures, but his refusal to recognize the right of rivers to their floodplain."

(Engineering News-Record 1937)

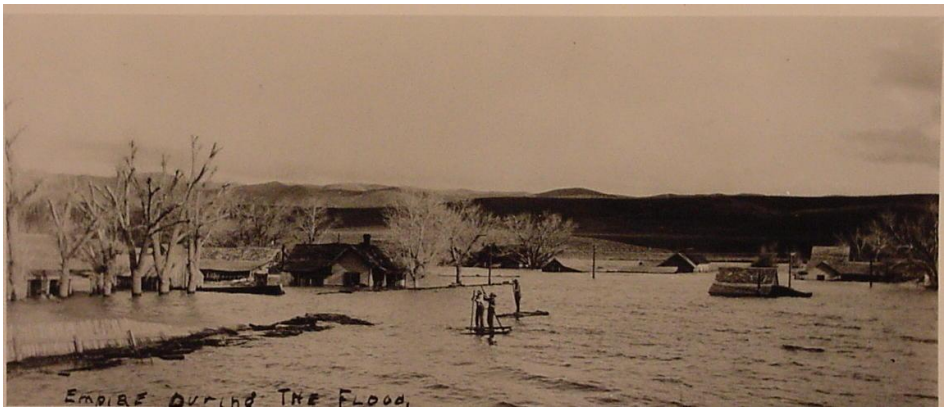
According to the Federal Emergency Management Agency (FEMA) floods have caused a greater loss of life and property, and have devastated more families and communities across the United States than all other natural hazards combined. Past efforts to reduce flood losses usually relied on trying to control floodwaters with costly flood control infrastructure, instead of encouraging people to avoid flood hazard areas. Despite the expenditure of billions of tax dollars to construct flood control structures such as dams, levees, and stream channelization, flood losses continue to rise. In addition, this structural approach frequently has adverse impacts on the natural resources and ecological integrity of our rivers and floodplains. Today, people and communities across the United States have come to recognize that protecting the natural resources and functions of floodplains, has proven to be effective in reducing flood losses. ***FEMA now encourages and provides incentives to communities to adopt and implement programs that preserve the integrity of floodplain resources and functions.***

Ranch Land to Subdivision (Photo Courtesy of The Nature Conservancy)

The Carson River Watershed (watershed) is experiencing development pressures at an unprecedented rate. Much of the development is aimed at areas within the floodplains, river corridor and on alluvial fans. Former open-range and agricultural lands are being converted to subdivisions, some of them right to the river's edge. This practice places these homes in a dangerous position with the potential for significant damage or destruction due to channel migration risks. Development in low-lying valley bottom floodplains, especially when large amounts of fill is used, increases the risk of flooding to adjacent and downstream properties because it changes the flooding routes, elevates flood stage, and reduces the storage capacity of the floodplains.

History shows repeated incidents of flooding with 33 documented flooding events in the watershed since 1852, on an average of every five years. At least 17 of these events have caused major flooding and extensive damage. Since the upper watershed is not regulated to provide flood control and there is

extremely limited reservoir storage capability, large flows occur downstream. During a major flood event Carson and Dayton Valleys are inundated and over-bank flows can reach a depth of many feet. Continued development within critical floodplain areas and the river corridor will intensify future flooding events and cause areas to flood that were not previously prone to flooding. While raising building pads, foundations and first floors above the 100 year flood level may appear to protect the inhabitants, it can actually reduce the area that the floodwaters can occupy on the floodplain, meaning that the water will need to go somewhere else, possibly flooding areas that did not flood before. It is also predicted that the western states will experience more extreme events of flooding, making it even more important to plan well now.



Historic Flooding on Carson River – 1903 Empire Flood
(Photo courtesy of the Nevada Historical Society)

We are very fortunate in this Watershed that we still have open floodplain lands that can slow down and temporarily store floodwaters .

Currently, the watershed is fortunate to have many stewards of floodplain lands. Long time ranchers and other landowners that have been on their properties for decades and generations have experienced first-hand the power of the river and uncertainties of the channel's stability during flooding events. It is interesting to note that their homes are not built in the low-lying areas on their properties or next to the river channel. Most of these homes have never experienced flooding impacts even during the major events - yet. These stewards know and intimately understand many of the concepts presented in this plan. However, we are experiencing an influx of people from outside of this area who are not necessarily aware of the flooding hazards and the complex river system.

Stakeholders from throughout the watershed are recognizing the critical need to protect these natural resources. By working together we add protection and strength for all stakeholders. Consistency in our planning and programs benefits us all and provides local and tribal governments with additional resources and support to address issues such as litigation and development pressure.

The purpose of this Plan is to create a long-term vision and strategies for floodplain management to reduce flood damage impacts. The plan objectives include the following:

- Manage economic development without sacrificing floodplain and river form and function;
- Ensure public safety upstream and downstream;
- Protect property rights while conserving our natural resources;
- Protect and improve wildlife habitat and water quality,

- Provide river continuity (un-impeded flow conditions) and connectivity (connection of river to its floodplain; and
- Promote conservation of lands within the river corridor.

The floodplain management strategies were developed through input from floodplain administrators from each county, county staff, planning commissions, advisory boards, a rapid evaluation of the river system, and input received from the general public during the public process. The strategies have been divided into the following components:

- Protection of Natural Floodplain Function and Values. Keeping lands in a more natural state, where possible, within the river corridor and other special flood hazard areas, will allow the river to access its floodplain and provide natural, no cost, flood protection. This approach is often referred to as the "Living River" concept and has numerous benefits such as:

    - Connects river with its floodplain
    - Minimizes disruption and alteration of river and riparian habitat
    - Conveys variable flows and restores habitat in floodplain
    - Balances sediment input with sediment transport
    - Provides fish and wildlife habitat
    - Enhances water quality and supply
    - Maintains aesthetic and recreational qualities
    - Keeps structures out of unstable, unsafe areas near valley bottom channels
    - Generally enhances the human environment

    Agricultural and ranch lands are consistent with a living river approach and most appropriate for critical floodplain lands. Providing ways to protect and sustain these lands is a top priority.

- Higher Regulatory Standards. FEMA recommends that local governments go beyond the minimum regulatory standards. Typically, engineering practices, as well as community enforcement, has limited its concern to the study of impacts to the immediate area adjacent to a proposed development or reach. Cumulative impacts to downstream communities and loss of floodwater storage volume are not typically included with this approach. Through the enhancement of ordinances this concern can be addressed. This Plan recommends that local governments go beyond the minimum requirements and provide additional protection to their residents and to the natural resources.

- Flood Data Information and Maintenance. Technical information used for the analysis of flood risks and risk reduction needs to be managed in a manner that is consistent throughout the watershed, is readily accessible, and allows for new or updated information to be easily integrated. These data include flood risk studies, hazard mapping, updating of FIRMs, elevation reference marks, and photo-monitoring.

- Channel Migration and Bank Erosion Monitoring. The flooding history of the Carson River indicates that floods have been altering channel alignments and stability every five to twenty-five years since the turn of the 20th century. Land near an incised channel is an extremely dangerous place for any development. Yet channel migration is part of the healing process of channel evolution by which rivers gain space for flooding and riparian vegetation to again provide

multiple functions and benefits. Long-term tracking of channel migration, establishing building setbacks in hazardous areas, and utilizing bio-engineering techniques in combination with other proven methods are included in the suggested actions.

- Floodplain and Flood Hazard Outreach and Education. Outreach and education is a critical and low-cost tool that can be used to raise awareness of the importance of floodplains, increase public safety, and reduce flood risks. A watershed wide outreach program could assist local governments with programs and reinforce the flood hazard message in a consistent format.

- Reduction of Infrastructure Impacts. There are opportunities throughout the watershed for the enhancement and/or design and maintenance of roads, culverts, grade controls, and bridges to accommodate floodwaters better, protect floodplains, and decrease harmful erosion.

Regional Approach and Plan Adoption

The intent of this plan is to provide strategies that can be applied regionally as well as on a local level. The benefits of addressing this issue with a regional approach include the following:

- Enhanced public safety by reducing flooding risk to all communities
- Reduced flood damage costs to all communities
- Enhanced awareness of flooding issues throughout watershed
- Provides watershed-wide consistency and resources to local floodplain programs
- Provides support to local floodplain administrators
- Receives Community Rating System credit
- Lowered community flood insurance rates
- Increased funding leverage and opportunities

This Plan was developed through a collaborative effort guided by the Carson Waters Subconservancy District (CWSD) and the Carson River Coalition (CRC) River Corridor Working Group (working group). Details about the planning process can be found in Section 6. Although this Plan has been developed on a watershed or regional basis, it must be adopted by each of the counties along the Carson River. ***Adoption of this plan means: We agree on a regional approach and will work together to implement the suggested actions.***

With careful consideration, planning and ongoing cooperation the Carson River and its floodplains can be aesthetic and functional assets that reflect our communities' pride and ingenuity. If we ignore the importance of natural floodplain function, we face increased flood losses, economic impacts from flood damages, plus deteriorating water quality, supply, and habitat. It is less costly to plan well now. The consequences of unplanned floodplain loss through collective individual actions would be permanent.

This Plan is intended to be a "living document" that may be amended or revised as conditions change. This Plan addresses the Federal Emergency Management Agency (FEMA) requirements for floodplain management planning and outlines potential credit for the National Flood Insurance Program (NFIP) Community Rating System (CRS). The Plan is also consistent with the State of Nevada Multi-Hazard Mitigation Plan in that State strategies for flood mitigation include avoiding future damages by acquisition of land within the floodway and guiding future development away from floodplains.

1.0 Introduction and Background

The Carson River Watershed (watershed) is the land in Nevada and California that captures, stores and releases rain and snowmelt to the Carson River (Figure 1.0-1). It is located east of the Sierra Nevada range and is characterized by partly filled alluvial valleys ranging in elevation from 3,000 to 6, 000 feet above mean sea level (amsl). The valleys are surrounded by mountains ranging in elevation from 6,000 to 11,000 amsl. The area is seismically active with a complex series of faults spanning a large area of Western Nevada. The Genoa Fault Zone is one of the most active faults in the region.

The watershed consists of approximately 3,965 square miles, with 606 square miles located in California. The Carson River flows approximately 184 from its headwaters in Alpine County to the terminus at the Carson Sink in Churchill County, Nevada. The upper watershed in the Sierra Nevada is described by long, very cold winters and by short, moderate to warm summers. It typically receives more than 40 inches of precipitation per year, usually as snowfall. The climate of the middle and lower watershed is described as semi-arid to arid. The average annual precipitation at elevations of 4,500 to 9,000 feet is about eight to twenty inches. In lower elevations of less than 4,500 feet the average annual precipitation is four to eight inches. Habitats within the watershed range from dry, salt desert scrublands to lush mountain meadows, forest and aspen groves. Detailed information on watershed characteristics and history can be found in the Stewardship Plan (CWSD 2007) and is available at www.cwsd.org.

West Fork Carson River in Alpine County, California

Newlands Irrigation Project Infrastructure – Churchill County, Nevada

Population centers in the watershed include the Minden/Gardnerville area in Douglas County, Carson City, Dayton in Lyon County and Fallon in Churchill County. The physical setting of the watershed has somewhat influenced the occurrence and size of population centers. Localized urban and residential areas (often located along or near the river) are separated by larger areas of ranchlands and farmlands.

The watershed encompasses some of the most rapidly growing areas in the State of Nevada and in the Nation. Table 1.0-1 provides information on the populations of the counties and the projected changes to 2010.

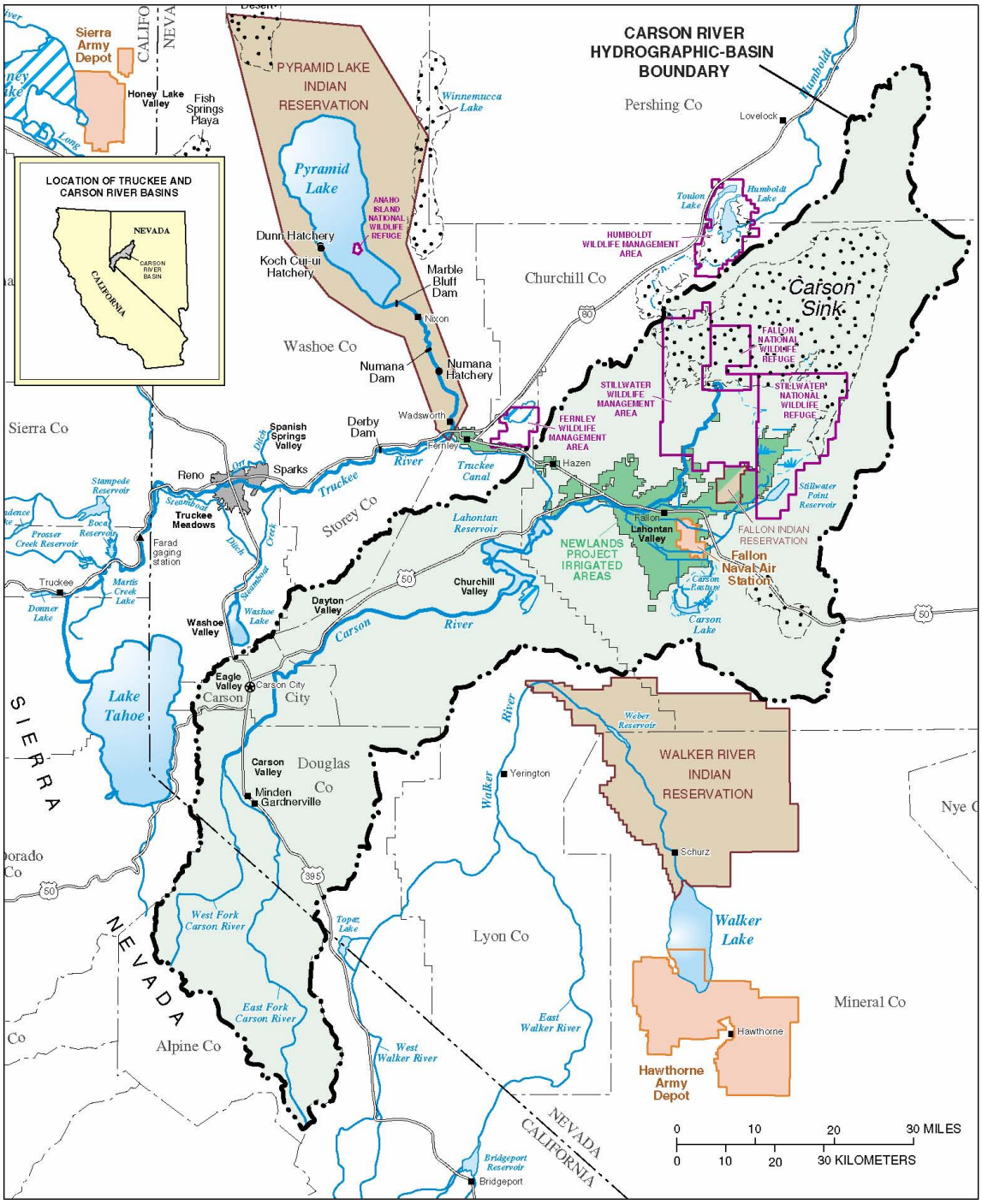


Figure 1.0-1: Overview of Carson River Watershed

Table 1.0-1: Population Change from 1990 to 2000 and Projected Change to 2010

County	Population		Population Change 1990 to 2000		Projected Change 2000 to 2010	
	1990	2000	Number	%	Increase	%
Alpine	1,113	1,113	0	0	84	7.50
Douglas	27,637	41,259	13,622	49	18,122	44
Carson City	40,443	52,457	12,014	30	10,895	21
Lyon	20,001	34,501	14,500	72	14,840	43
Storey	2,526	3,399	873	35	989	29
Churchill	17,938	23,982	6,044	34	10,737	45
Total	109,658	156,711	47,053	43%	55,667	36%

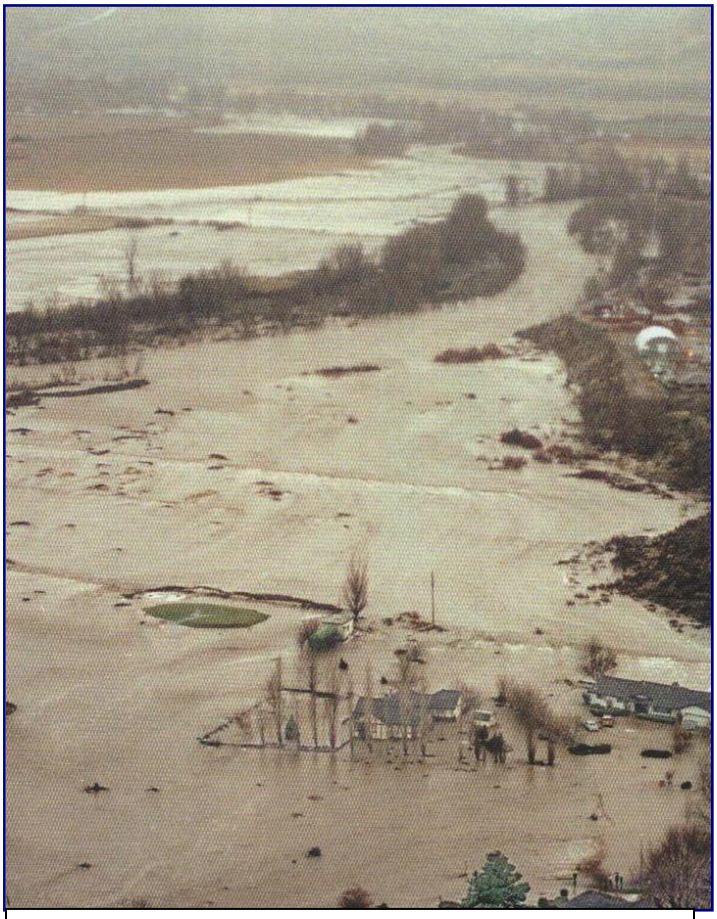
Source: Nevada Natural Resources Status Report

1.1 Economic Impacts

Devastation from flooding events, such as the 1997 New Years Flood, causes significant economic impact to property owners, communities, state and federal agencies. The following paragraphs provide damage estimates from the 1997 flood event. Total estimated damages for all of the counties combined in the watershed were significantly less than that experienced in Washoe County alone (see Table 1.1-2). This difference is due to the amount of development that has occurred on floodplain lands and adjacent to the river.

The Truckee River Watershed in the Truckee Meadows is highly developed and the floodplain encroached upon. The 2008 estimate for mitigating floodplain encroachment is estimated at $1 billion. Along the Carson River there are still many areas that have not been developed that retain functioning floodplains, thereby lessening the economic impact when the flooding events occur. The economic impacts of the 1997 New Years Flood (NBMG 1998; Alpine County Auditor) provides a good comparison of the costs associated with floodplains that have been encroached upon and can no longer provide its natural services to the degree necessary to prevent excessive flooding damages and those that still retain functioning floodplains.

These costs are FEMA's estimated damages from the 1997 event they are not the actual paid out costs. The actual costs associated with the flood would be impossible to accurately calculate.



Area along Carson River at Genoa, Nevada – 1997 Flood Event (Photo courtesy of Reno Gazette Journal)

Alpine County: According to the Alpine County Auditor's Office, Alpine County received reimbursements from FEMA for flood damages occurring during the 1997 flood event in the amount of $331,372. Much of the reported damage was to roads adjacent to the river system.

Douglas County: The 1997 flood caused extensive damage to homes and levees through the Carson Valley. Over 75 homes in the Minden and Gardnerville received flood damage. The estimate for repair to the homes and businesses was about $1.5 million. Repairs costs for levee and irrigation systems totaled $4.5 million, and damage to the county and city infrastructure totaled $440,000. Residents of the Carson Valley were isolated for several days due to damage and flooding on Highway 395 and State Route 88. Repairs to roads, highways and bridges totaled $2.12 million. Other flood damages included $4.26 million to farmland, $200,000 to golf courses, and $70,000 to U.S. Forest Service facilities. Total estimated damages to Douglas County amounted to approximately $13.1.

Carson City: A combination of riverine and alluvial fan flooding caused extensive damage in the Carson City and Eagle Valley area. Damages included about 3.14 million to county infrastructure; $500,000 to businesses and homes; $840,000 to state highways and structures; $310,000 to farmland, and $320,000 to USFS facilities. Debris cleanup and repair of to irrigation systems were about $194,000. Total estimated damages to Carson City amounted to over $5.3 million.

Lyon County: Damage occurred throughout Lyon County as a result of the New Years Flood. Much of the damage was in Yerington, where nearly 500 homes were extensively damaged. In Dayton (along the Carson River) 23 homes were damaged for a total of about $300,000. Dayton Utilities had about $120,000 in damages, and the repair work along the Carson River was estimated at $265,000 by the U.S. Army Corps of Engineers (USACE). Damages to roads throughout Lyon County totaled $170,000. Damage to agricultural land and irrigation systems, river banks, plus debris removal was estimated at about $8.4 million for the Smith, Mason and Dayton Valleys. Also, a total of $785,000 in county services was required to fight the flood. Total estimated damages to Lyon County amounted to about $10 million.

Churchill County: Damage to public buildings, utilities, and roads totaled about $30,000. Damages to private structures and properties were estimated at about $315,000, of which $267,000 was to Truckee-Carson Irrigation District facilities. Total estimated damages to Churchill County amounted to about $345,000.

In comparison to the counties along the Carson River, Washoe County received the greatest amount of damage due to the high concentration of businesses and homes that have been built along the Truckee River in the Reno/Sparks area. The total estimated loss to Washoe County is in excess of $686 million. However, it should be noted that the intensity of the 1997 storm in the Truckee River Watershed was slightly higher.

Floodplain Management is a tool for avoiding or decreasing high costs and damages associated with flooding events.

The following table shows flood damages from the 1997 New Years Flood for the counties within the watershed contrasted with Washoe County.

Table 1.1-2: 1997 New Years Flood Damage Estimates: Carson vs. Truckee Rivers*

County	Estimates of Flood Damages
Alpine County, California[1]	$331,372
Douglas County, Nevada[2]	$13,100,000
Carson City, Nevada[2]	$5,300,000
Lyon County, Nevada[2]	$10,000,000
Churchill County, Nevada[2]	$345,000
Total Estimates for Counties along Carson River	**$29,076,372**
Total Estimate for Washoe County	**$686,000,000**

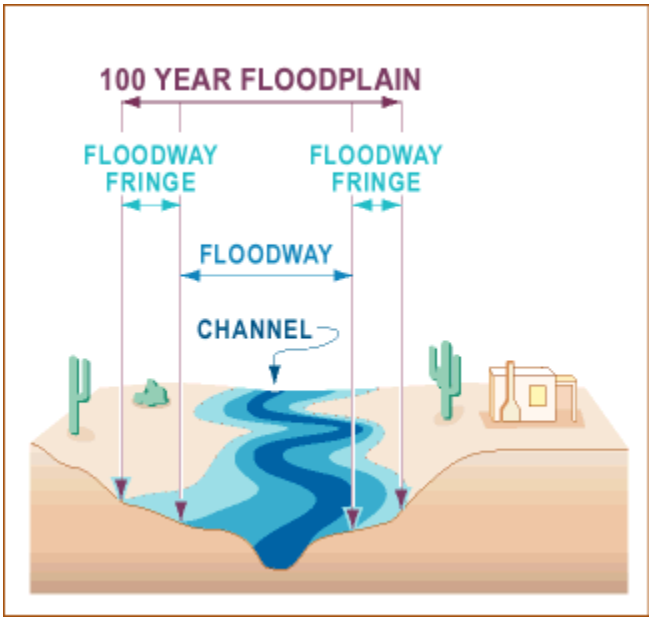
Source: 1-Alpine County Auditor's Office; 2- NBMG 1998;

*Cost estimates include entire counties not just the Carson River Watershed and do not represent the actual paid out costs associated with the 1997 flood event.

2.0 Floodplain 101

The intent of this section is to provide information on what floodplains are and how they function naturally, plus background on FEMA and the National Flood Insurance Program (NFIP).

The level area bordering a river channel is known as the floodplain. The formation of the floodplain is tied to the river. The river channel meanders through the landscape and over time shapes the surface geology of the landscape and deposits sand, silt, and other material. These deposits are referred to as alluvium. The level areas bordering the river channel containing the deposits are known as floodplains. As the river cuts downward it may leave terraces. These landforms are part of the larger river corridor and are extremely important to floodplain ecosystem function.



The floodway is a critical component of the floodplain, relative to maintaining the flood carrying capacity of the river. The floodway is defined as that area of the river plus adjacent floodplain land that must be protected in order to allow the discharge of the base flood without increasing flood heights. FEMA requires communities to prohibit development within floodways that would cause an increase in flood heights.

Floodplains perform certain natural and beneficial functions. FEMA describes three types of "natural and beneficial functions" that warrant protecting floodplains in their natural state (FEMA 2002).

1. Floodplains in their natural state have an important positive impact on flooding. Flood waters can spread over a large area in floodplains that have not been encroached upon. This reduces flood velocities and provides flood storage to reduce peak flows downstream. Natural floodplains reduce wind and wave impacts, and their vegetation stabilizes soils during flooding. Protected floodplains reduce the energy of a flood and therefore reduce damage to adjacent properties and areas downstream.

FEMA encourages state, local, and private programs and projects that preserve or restore the natural state of floodplains.

2. Floodplains in their natural state provide "ancillary beneficial functions" beyond flood reduction. Water quality is improved in areas where natural vegetative cover acts as a filter for runoff and overbank flows. Natural floodplains moderate water temperature, reducing the possibility of damaging impacts to plants and animals.

3. Floodplains can act as recharge areas for groundwater, reduce the frequency of low flow events, and increase minimum flow rates of riverine systems. They provide habitat for

diverse species of flora and fauna, some of which can live nowhere else. They are particularly important as breeding and feeding areas for birds and other wildlife.

Floodplain Economic Value is Not Often Considered. Services provided by floodplain lands, such as providing public safety, improvements in water quality, flood water retention and providing wildlife habitat, are economic goods even if they are not explicitly bought and sold like other commodities (Lichtenberg 1994). Economically efficient floodplain management should take into account the costs and benefits of these natural goods and services, often referred to as ***ecosystem services***, in a more thorough and comprehensive way than they have been in the past.

Development within floodplains often occurs without consideration of the effects on floodplain function. The loss of natural floodplain function not only impedes flood storage, but also increases erosion, and reduces the mitigating effects that vegetated areas have on the pollution of waterways. Impermeable surfaces such as buildings and pavement replace vegetative cover, creating runoff from water that would have infiltrated in a natural floodplain. The lack of naturally functioning floodplains has a significant impact on water quality. Diffuse "nonpoint sources" (NPS) of pollution, such as lawn fertilizers, leached materials from waste disposal, sediment from excessive erosion, and chemicals from automobiles, just to name a few, present a threat to water quality. Natural floodplains and vegetated buffers along waterways can help significantly to mitigate NPS pollution.

Land use that allows and encourages native vegetation to flourish is highly suitable for floodplains. Well-placed parks, trails or other recreational areas that include native vegetation are often ideal for flood storage capacity. They support the natural and beneficial functions that protect water quality and sustain wildlife habitat. Agricultural lands also provide open space that can maintain flood storage capacity.

A 100-year flood does not occur only once every hundred years; it can occur anytime.

Floodplains are frequently defined in terms of the likelihood of being flooded in a given year. Floods are classified according to their frequency and depth. For instance, there are 10-year, 25-year, 50-year, 100-year, and 500-year floods. A 100-year flood is less frequent than a 10-year flood but is deeper and far more destructive. The 100-year flood is commonly referred to as the "base flood". The 100-year floodplain (or base flood) and the floodway make up the special flood hazard area (SFHA). Buildings located within the SFHA are required to have flood insurance as a condition of receiving a federally backed mortgage loan or a home equity loan. Given that most mortgages have a 30 year repayment period, there is a 26% chance that the building located within a higher risk flood area will experience flooding during the life of the loan. The following table shows the statistical chances of flooding over different periods of time.

Table 2.0-1: Statistical Chances of Being Flooded During a 30-Year Mortgage

Period of Time	10-yr Flood	25-yr Flood	50-yr Flood	100-yr Flood
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Source: Morgan 2003

The occurrence of a flood does not affect the probability of a flood to occur again in the same or next year. Flood frequency values adjust either up or down as more data is collected and the flood frequency is recalculated. Bank full discharge is predicted to occur for most alluvial streams, like the Carson River, on average, once every 1.5 years (Leopold 1994). Out-of-bank flooding occurs, on average, once every 2.3 years with a 40% chance of occurring in a given year. Inappropriate development on vulnerable floodplain lands can cause an increase in the risk and frequency of flood-related damages to property and infrastructure even from relatively minor floods like the most recent 2006 New Years Flood.

Floodplain planning and management provides many public safety, ecosystem, and economic benefits. By encouraging wise land use decisions along the river corridor and in critical floodplain areas, floodplain management can save lives, reduce property and livestock losses, improve ecosystems, and provide open space. Controlling development within the floodplain can significantly reduce future flood risk to people and property. Reconnecting the river to its floodplain reduces destructive peak flood flows in channels, increases groundwater recharge, improves water quality plus fish and wildlife habitat, and protects cultural and historical resources. All of these benefits contribute to an enhancement of our quality of life. Floodplain management should be multi-objective. Programs and projects, while providing for public safety, should also maximize opportunities for agricultural conservation and ecosystem protection and restoration.

Floodplain Management should be multi-objective- providing public safety and opportunities for agricultural conservation and ecosystem protection.

2.1 Federal Emergency Management Agency

In the 1960's, Congress became concerned with problems related to the traditional ways of dealing with floods and flood damage. The construction of structural projects were not reducing the flood hazards and the costs of federal disaster assistance was increasing, and private industry could not provide affordable flood insurance. In response to these challenges Congress passed the National Flood Insurance Act in 1968 to correct some of the shortcomings of the traditional flood control and relief programs (FEMA 2005). This Act created the National Flood Insurance Program (NFIP).

The NFIP provides a financial mechanism to respond to flood disasters by making flood insurance available to the private property owner. The NFIP encourages communities to enact and enforce minimum federal floodplain regulations in order for residents to qualify for the flood insurance. Communities can receive flood insurance premium discounts by adopting regulations that exceed the minimum standards.

The Community Rating System (CRS) is part of the NFIP. It is designed to encourage communities to implement floodplain management programs that go above and beyond the minimum NFIP requirements. This is done by scoring the community's activities according to formulas that measure the impact on flood losses and flood insurance rating. The scoring is based on 18 activities organized under four series as shown below.

CRS Activities

300 Public Information Activities
- 310 Elevation Certificates
- 320 Map Information
- 330 Outreach Projects
- 340 Hazard Disclosure
- 350 Flood Protection Information
- 360 Flood Protection Assistance

400 Mapping and Regulatory Activities
- 410 Additional Flood Date
- 420 Open Space Preservation
- 430 Higher Regulatory Standards
- 440 Flood Data Maintenance
- 450 Stormwater Management

500 Flood Damage Reduction Activities
- 510 Floodplain Management Planning
- 520 Acquisition and Relocation
- 530 Flood Protection
- 540 Drainage System Maintenance

600 Flood Preparedness Activities
- 610 Flood Warning Program
- 620 Levee Safety
- 630 Dam Safety

Communities can lower their individual flood insurance costs by up to 45%, a substantial savings to homeowners, by implementing good floodplain management programs.

Flood insurance rates are based on the community's CRS classification. The community is assigned a classification based on the CRS score. There are 10 classes, 1 through 10, with a Class 1 community receiving the greatest flood insurance premium reduction. ***A Class 1 community can have up to 45% reduction in individual insurance rates which can be a substantial savings to home owners.*** Table 2.0-2 provides a breakdown of the CRS credit points, classification and premium reductions.

Table 2.1-1: Community Rating System Classification and Flood Insurance Premium Reductions

		Premium Reduction	
Credit Points	**Class**	**SFHA**	**Non-SFHA**
4,500 and above	1	45%	10%
4,000 – 4,999	2	40%	10%
3,500 – 3,999	3	35%	10%
3,000 – 3,499	4	30%	10%
2,500 – 2,999	5	25%	10%
2,000 – 2,499	6	20%	10%
1,500 – 1,999	7	15%	5%
1,000 – 1,499	8	10%	5%
500 - 999	9	5%	5%
0 - 499	10	0	0

Note: SFHA – special flood hazard area

The current status of CRS classification for the counties within the Carson River Watershed is the following:

County	Classification
Douglas County	6
Carson City	8
Lyon County	10*
Churchill County	10*
Alpine County – not classified	

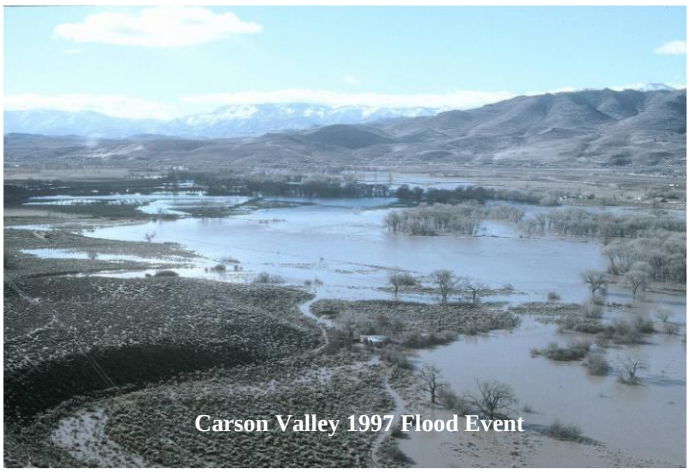
*Participates in the NFIP but does not currently participate in the CRS program.

Activities, such as floodplain management planning, are eligible for credit under the CRS.

This Plan has been designed to address activities eligible to receive credit with the CRS program.

3.0 Flood History and Risk Assessment

History shows repeated incidents of flooding with 33 documented events since 1852. Of the 33, at least 17 involved major river flooding. Most flooding events in the watershed are the result of heavy rain on accumulated snow pack that causes rapid melting. Since the upper watershed is not regulated to provide flood control, large flows can occur downstream. Appendix A contains information on the documented events with estimated flood levels and experienced impacts.



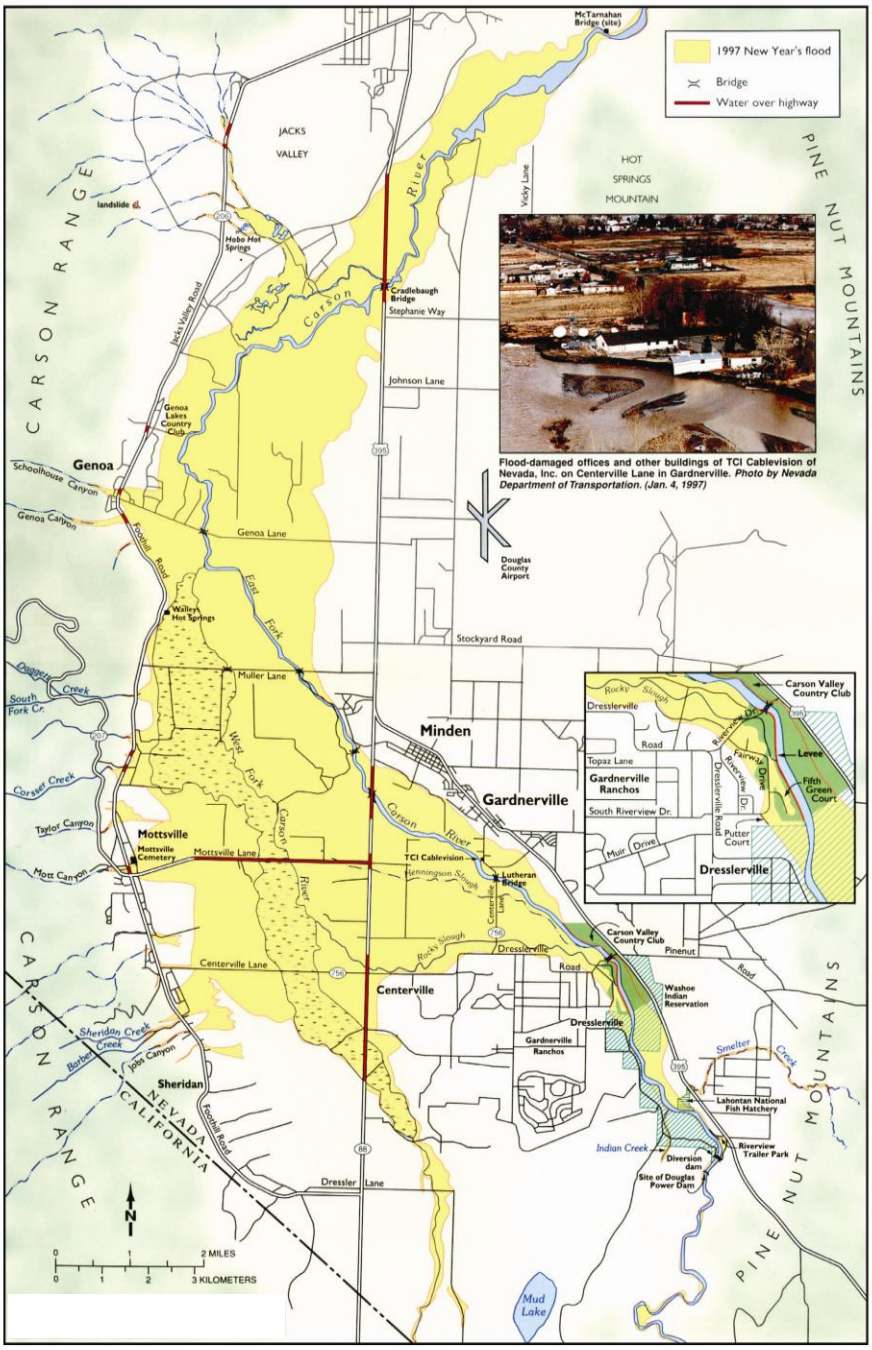
Carson Valley 1997 Flood Event

Often in historical accounts of flooding events the Carson Valley is described as a large lake. For example, in 1861 the valley was inundated; sawmill, buildings, and bridges were swept away. However, little damage was incurred since at that time most of the settlements were not along the river but rather along the Eastern Sierra slope. In 1907, with an estimated flow of 4,000 cfs, all bridges over the East and West Forks and main stem Carson River were destroyed or severely damaged. Agricultural lands and irrigation structures were severely impacted and residents living near the river or in low land areas were forced to evacuate to higher ground. The flood of 1937, considered to range from a 5- to 50- year event, severely damaged the Douglas Power (Ruhenstroth) Dam on the East Fork and parts of State Route 88 were flooded to a depth of 14 inches. Highway 395, the only highway from Carson City to Minden, was under about 18 inches of water. More than 16,000 acres were flooded in Carson Valley in 1955 with many families forced to move out when their homes were isolated and flooded.

The most significant recorded flooding event in the watershed, to date, occurred on New Year's 1997 when flows of up to 22,800 cfs ravaged Carson, Eagle and Dayton Valleys. Figure 3.0-1 shows the extent of flooding in the Carson Valley. During this event Carson Valley became a lake with depths over three feet in places. Highway 395 through the valley was under water, eliminating travel from Carson City to Minden for approximately one week. Floodwaters spread over Dayton Valley causing damage to farms, ranches, and homes, as well as the Dayton State Park. New Year's 2006 brought another reminder that flooding is a regular occurrence on the Carson River. This estimated 10-25 year event caused significant damage to irrigation structures, buildings, and homes. Some residents and natural resource managers reported that areas that had not flooded during past events experienced flooding during this relatively small event. It is suspected that an increase of floodplain development may be changing the flood routes and increasing velocities, thereby causing flooding in areas that were previously considered to be safe.

The U.S. Geological Survey (USGS) developed a website,"Flood Chronology of the Carson River Basin," that provides in-depth flooding information. The website can be found at http://nevada.usgs.gov/crfld. Appendix A contains a table with information from the website about all of the documented flooding events in the watershed from 1852 to 2006.

Figure 3.0-1: Carson Valley 1997 Flood Extent Map (source NBMG 1997)



The NOAA National Weather Service website (http://ahps2.wrh.noaa.gov) provides information on flood levels and associated potential flood impacts. Table 3.0-1 provides risk assessment information for the Carson River near Carson City. Data is also available from the website for the West Fork Carson River at Woodfords and East Fork Carson River at Gardnerville.

Table 3.0-1: Potential Flood Impacts Related to Flood Stage for Carson River near Carson City

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

As can be seen from the above table even 10,000 cfs can cause significant flooding. If future conditions result in more frequent and more intense flooding events, ***a flood greater than the 22,000 cfs, experienced in 1997, is not unrealistic***.

3.1 Types of Flood Hazards

Flooding, whether localized or basin-wide, is a common occurrence in the watershed. Three main types of flooding that occur are described by USGS (2006) as the following:

Main Channel (Riverine Flooding): Main-channel floods result from rain on the mountain snowpack which contributes to rapid snowmelt. As flows in the Carson River increase due to the rapid snowmelt, the channel overflows and floods adjacent areas or floodplains.

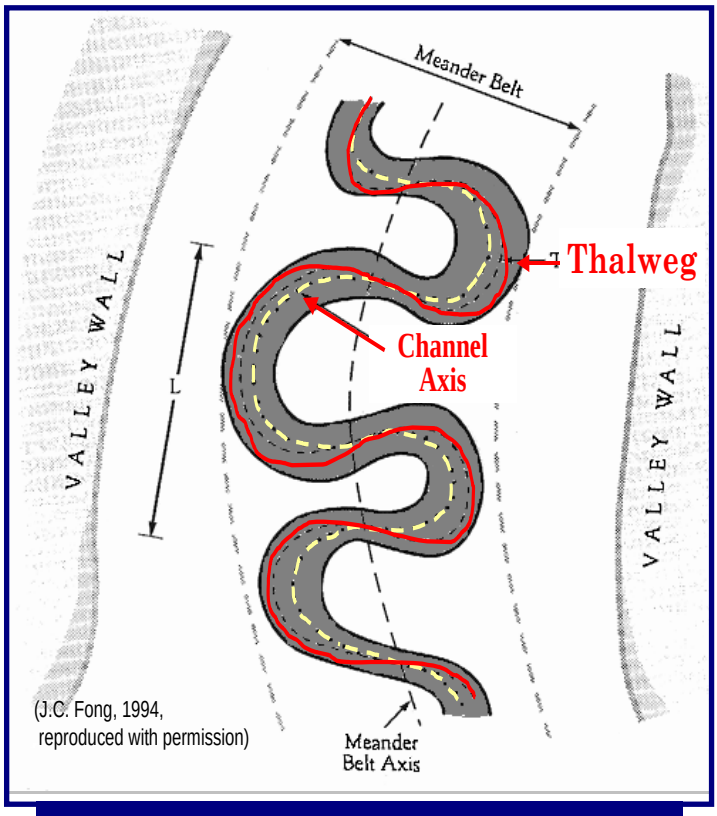
Alluvial Fan Flooding: Also known as flash flooding, alluvial fan flooding results from intense rainfall during summer thunderstorms on alluvial fan surfaces (gently sloping, fan-shaped landforms common just

below mountain canyons). Flash flooding is characterized by high-velocity flows, sediment and bedload transport, erosion and deposition, and unpredictable flow paths. The risks from this type of flooding increases as development continues on alluvial fans.

Debris Flows: Debris flows are the result of water from intense rainfall or rapid snowmelt mixing with sediment and bedload to become a slurry similar to wet concrete. In steep canyon (for example, the east slope of the Carson Range), debris flows can reach high velocities, transport large boulders, and cause catastrophic damage from impact or burial.

Channel Stability and Migration Risks

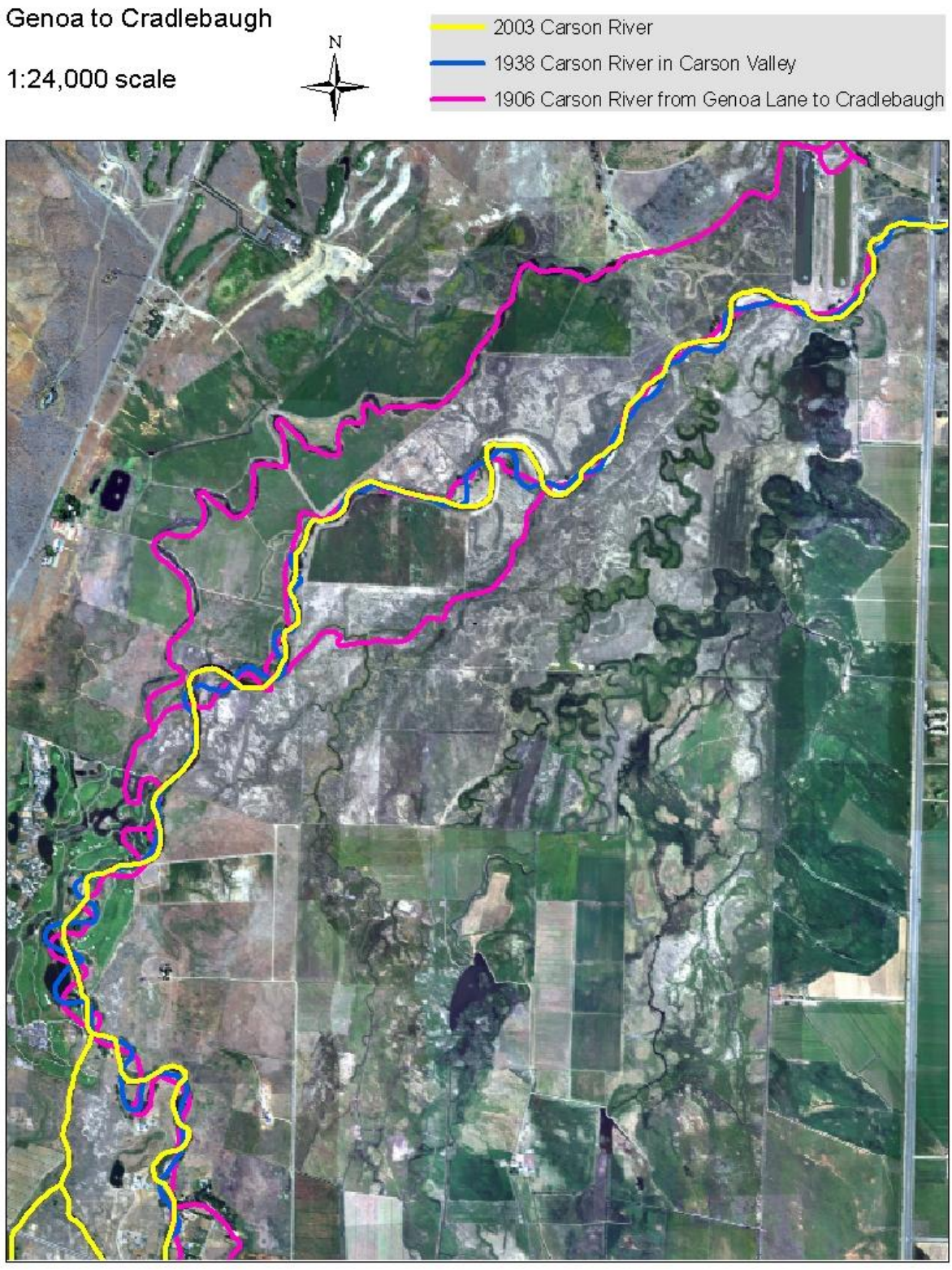
According to a fluvial geomorphic assessment of the Carson River that was conducted in 1996 (Inter-Fluve 1996), the stability of the Carson River is poor. This instability dates back to the first extensive uses of the river by industrialized settlers for irrigation, logging and mining activities. The assessment states that the combination of these uses and the geographic setting, which regularly delivers large magnitude floods, results in a river instability that appears to have been the prevailing condition for many decades. The flooding history of the Carson River indicates that floods have been altering channel alignments and stability every five to twenty-five years since the turn of the 20th century. As an example, Figure 3.1-1 shows the channel movement that has occurred in Carson Valley from 1907 to 2003.



Single channel rivers on valley floors will reestablish meanders even if they are straightened or their channels are incised into the floodplain (Mount 1995).

Over the last 150 years, the river has actually dug itself deeper into the valley floor in places. The channel bottom is about 6-10 feet lower than it was when the valley was settled in the 1850's. Technically, the Carson River channel is "incised" or "down cut" in many places, especially on the valley floors. The river channel has responded in this way because of the cumulative effects of activities, such as logging, mining, urbanization, and channel straightening over time.

Figure 3.1-1: Channel Movement from 1907 to 2003 (Courtesy of Randy Pahl and Jean Stone, NDEP)



Land near an incised channel is a dangerous place for development. Because the floodwaters of an incised river are trapped within a gully, the high velocity flood flows are concentrated rather than being dispersed over a floodplain. The deep confined flows have more power than shallow dispersed flows, and the result can often be severe bank erosion. Conversely, deposition (agradation) of sediment and bedload can fill the channel during a flood and the river can jump out of the incised channel.

Channel migration risks are at least twofold in Carson River valleys. Incised rivers are known to widen their gullies, and valley bottom rivers tend to meander. During floods, the river will erode the outer banks of bends, and these bends will also migrate downstream. The area at greatest risk for development can be estimated by studying the landforms and soils on the valley floor. Careful channel measurements and analysis of the amount of sediment and bedload being transported are other important inputs. Scientists also search for clues about the extent of river meandering that occurred before European-American settlers arrived. Often, analysis of aerial photographs helps reveal the extent and width of past river meander bends or belts. If it meandered over a half` mile-wide corridor in the past, there is a possibility that it can do so again. Figure 3.1-1 shows this kind of analysis of an aerial photograph.

Examples of channel migration on the Carson River were seen during the New Years Flood of 2005/2006 which was estimated to be a 10-25 year event. By comparing 2004 LiDAR/Hyperspectual Survey data to the more recent 2006 data, movement of the channel can be seen from this relatively small event on the East Fork in Carson Valley and the main channel in Dayton Valley. Figure 3.1-2 and 3.1-3 show some of the channel migration experienced during the flood of 2005/06.

Floodplain managers throughout the nation are urging local jurisdictions to consider the risks of allowing urban and residential development near meandering channels. On the other hand, keeping such areas in agricultural or other open space uses are ideal in terms of avoiding economic losses for property owners and the community as a whole.

Figure 3.1-2: Example of Channel Migration in Dayton Area (provided by J. Stone, NDEP)

Photo taken of Dayton Area in 2004

Same area in 2006 after flood event.

Figure 3.1-3: Example of Channel Migration in Carson Valley (provided by J. Stone, NDEP)

2004 Photo taken in Carson Valley

Same area in 2006 after flood event.

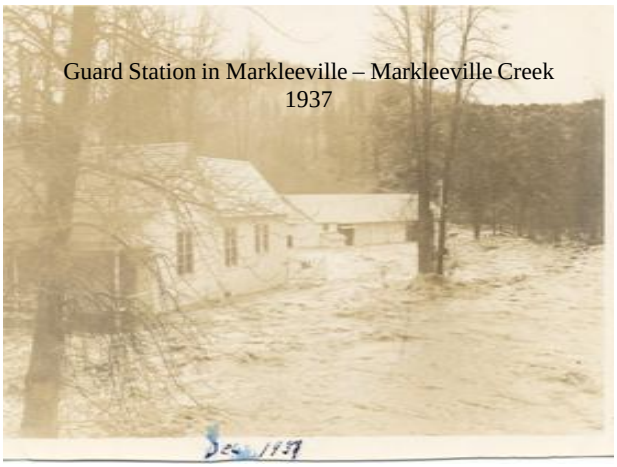
3.2 Summary of Rapid Evaluation of River System

Floodways and flood zones are denoted on FEMA flood insurance rate maps or FIRMs. FIRM maps delineate the flood hazard areas and divide the mapped areas into zones according to flood hazard factors. FIRMs are prepared for the purpose of insurance rating, land use regulations, and for lenders in determining areas where flood insurance must be purchased. These are the maps that local governments typically use for determining locations of SFHAs. SFHAs are areas that have a high risk of flooding and are delineated by FEMA as flood zones A and V (refers to coastal flooding). County maps showing the FEMA flood zones are provided in Appendix D. The problem is that the FIRMs for the watershed are outdated and do not correctly represent the current watershed conditions.

In order to assess flood hazard areas that may not be represented on the FIRMs, the working group conducted a rapid evaluation of the river system from the headwaters to terminus. This evaluation was conducted by using photographs, flood extent and other maps, and on-the-ground experience with flooding events. The working group conducted the evaluation from a flood hazard and floodplain function viewpoint, did not conduct additional analysis, and did not necessarily consider the political or landowner factors. The objective was to identify floodplain lands that have higher potential for severe flooding, allow space for channel migration, and provide flood volume storage. The recommendations from the rapid evaluation were combined with information gained during meetings and workshops, and were formulated into the categories and suggested actions presented in Section 4.0. The full rapid evaluation is available in Appendix B. The following provides a summary.

3.2.1 East and West Fork Drainages in Alpine County

The majority of the watershed in Alpine County is located in wilderness areas with populated areas centered in Markleeville and Woodfords. Over 95% of the land in Alpine County is publicly owned. The floodplain is very narrow throughout the upper river system with canyon walls and wilderness areas preventing development in many areas. There are some small reservoirs, but they provide very limited storage. Flood hazards are mainly due to close proximity of highways to the river, and the erosive nature of the soils. There is an active landslide by Wolf Creek meadows that creates hazard during heavy rainfall. The recommendations for the upper watershed include:



Guard Station in Markleeville – Markleeville Creek
1937

- Maintain river system to allow floodwaters to access floodplains in valley and meadow areas
- Support Markleeville Guard Station Restoration Project to reduce flood damages to downtown Markleeville
- Investigate potential for restoration activities in Upper Hope Valley and Hot Springs Creek to enhance floodplain accessibility and reduce erosion

- Investigate opportunities for road, culvert and bridge enhancement to accommodate floodwaters better and decrease erosion

3.2.2 Stateline to Cradlebaugh Bridge

From the Nevada/California state line the river travels through a narrow bedrock canyon until it reaches the Carson Valley. Carson Valley is situated between the eastern face of the Sierra Nevada and west of the Pine Nut Mountains. The wide valley floor is the floodplain for both the East and West Forks of the Carson River and is a natural floodwater storage area. Old river channels, also called sloughs, interlace the valley's floor between the East and West Forks and the Brockliss Slough (which carries the West Fork's water). During flood events sedimentation and debris deposition often result in rapid channel obstruction and channel migration in Carson Valley due to the very limited upstream water storage capacity and the highly erosive soils. The main stem of the Carson River begins at the confluence of the West and East Forks about a mile southeast of Genoa, Nevada.

Some areas along the river through this reach contain spoils from a 1965 project which were turned into a berm when the tops of the spoils were compacted. The berm runs from the Allerman Canal to Riverview Drive Bridge. The effort was intended to create channel capacity, not to protect homes and other infrastructure. Since the creation of the berm the area has had to be defended from high water. In 1997, over 300 homes got wet, and many of the homes have since been elevated using funding from FEMA.

East Fork - Centerville Lane to Highway 88: This reach is prone to flooding and is an aggrading reach. Aggrading reaches are typically unstable. They tend to shift their course frequently because significant deposits of sediment in the channel divert the flow, leading to bank erosion and lateral shifting of the channel. Head cuts have resulted in 20 – 25 feet of incised banks in areas around the Cottonwood Diversion.

Looking upstream from Muller Lane Bridge during 2005 spring run-off.

East Fork - Highway 88 to Muller Lane: There are old levees along the river on the right side from projects implemented in the 1960's. This reach has had a considerable number of conservation projects, including river workdays, grazing management, fencing, plus a $1 million restoration project. This area is very prone to flooding and is critical for the storage of floodwaters. The area west of Highway 395 contains critical flood water storage areas and should be protected to the greatest extent possible.

East Fork - Muller Lane to Genoa Lane: The entire area is prone to flooding. There is a large scale restoration project that runs from the Muller Lane Bridge to Genoa Lane Bridge that will address multiple issues including floodplain protection. Berms along this reach will be evaluated as part of the project to see what the opportunities are for removal of

portions to allow for floodwaters to access the floodplain. The River Fork Ranch is located within this reach. It is a critical area for floodplain and wetlands management and is owned in fee title by The Nature Conservancy.

Main Stem - Genoa Lane to Cradlebaugh Bridge: The length of this reach is approximately 31,152 feet of the mainstem Carson River. The reach contains a mix of private and tribal lands. Floodplain protection in this reach is a priority for the Washoe Tribe and The Nature Conservancy. The river is incised dramatically through this reach with approximately 20 feet of vertical bank. This reach also has a high potential for channel migration.

The Willowbend Subdivision is located within this reach. Homes in this subdivision are built very close to the river channel and are very prone to flooding. Three of the homes are included on the FEMA Repetitive Loss list.

West Fork Carson River and the Brockliss Slough

Approximately three miles north of the state line, the West Fork Carson River becomes the Brockliss Slough. The Brockliss then becomes the principal watercourse on the west side of the Carson Valley. From this point the West Fork of the Carson River is referred to as the West Fork Ditch. The West Fork Ditch carries the waters from the Rocky Slough, Home Slough, and other ditches that originate from the East Fork and flow to the west.

West Fork "Ditch" at Highway 88
Looking upstream

Lands north of Mottsville Lane and west of Highway 395 are critical for flood water attenuation and storage. Without this storage, the cumulative impacts to downstream could be significantly altered and areas that did not flood will most likely experience flooding to a greater degree. The water table rises significantly in this area during high water events. Mottsville Road acts as a dam during high water events and can cause flooding even to buildings that have been elevated.

General Recommendations for Stateline to Cradlebaugh Bridge:

1. Retain agricultural pasture lands west of Highway 395 and upstream of Highway 88 Bridge as floodplain and floodwater storage areas where possible but still provide infrastructure protection where necessary.
2. Maintain areas from Genoa Lane to Cradlebaugh Bridge in its current undeveloped state to the extent possible due to the high potential for channel migration.
3. Investigate opportunities for using existing infrastructure to move floodwater.
4. Utilize the irrigation ditches for stormwater retention, not for river release during flooding events.
5. Investigate opportunities to remove portions of berms to allow floodwaters to access floodplain.

6. Support conservation easements that include long-term management plans as a means to protect critical floodplain and flood hazard areas.
7. Design future bridges and roads to protect the floodplain, accommodate and not restrict the changing course of the river, and don't create additional levees.
8. Address inadequate FEMA flood zone designations and complete floodway delineation.
9. Evaluate existing bridges more thoroughly for safety and flow constraint concerns.
10. Investigate the use of the West Fork as a flood storage channel.
11. Assess alluvial fan drainages for flood hazards and opportunities for hazard reduction.

3.2.3 Carson River: Cradlebaugh Bridge to Deer Run Road

This section of the river system is in very good shape with regards to riverine flooding and floodplain management. The Nature Conservancy working with the landowner was successful in securing a large area of the floodplain with a conservation easement, the Kirman Field. The Kirman Field area is a particularly dynamic section exhibiting considerable sinuosity and structural complexity. The Carson City Open Space Program has been very active in acquiring lands along the river corridor and securing conservation easements. The Silver Saddle Ranch and the Ambrose Natural Area also provide floodplain protection. The property owned by the State of Nevada for the purpose of providing a state prison and associated prison farm provides for storage of flood waters and should remain in open space. Most of the damage caused by flooding in the Carson City is the result of alluvial fan flooding from the east side of the Sierra Nevadas.

Ambrose Natural Area
Spring Run-Off 2005

General Recommendations:

- Support Carson City's Open Space Program, The Nature Conservancy, and other organizations in their ongoing acquisition and protection of critical floodplain lands along the river corridor
- Stay abreast of issues with the State Land prison property.
- Investigate opportunity to enhance grade control structures, including Mexican dam and Anderson diversion.
- Investigate opportunities to enhance future bridge designs to protect the floodplain, and to accommodate and not restrict the changing course of the river.
- Assess alluvial fan drainages for flood hazards and opportunities for hazard reduction.

3.2.4 Carson River: Deer Run Road to Lahontan Reservoir

Carson River through Carson Canyon

The river travels from Deer Run Road through the Carson Canyon for about five air miles until it reaches the Santa Maria Ranch area upstream of Dayton. The Carson Canyon is steep and rugged terrain with no development. The river then travels through Dayton, the Fort Churchill Historic Park, and then finally into the Lahontan Reservoir system. Portions of this reach have been under tremendous development pressure for the last decade, and this pressure is expected to continue. The prospect of future floods and associated impacts are of concern to landowners and natural resource managers. Controlling noxious weeds, such as tall whitetop (TWT), has also become a huge issue on floodplain lands from the Carson River Estates downstream to Lahontan Reservoir.

During the 1997 event, floodwaters inundated many areas in Dayton Valley and spread from ¼ to ½ mile wide and between 2 and 4 feet deep in places. The Winters Ranch, at the upstream portion of the Dayton area, used to flood on a regular basis, providing an area for the river to access its floodplain and slow flood waters. This crucial floodplain area has been filled and developed into the Santa Maria Ranch subdivision. There is now an increased risk and a level of uncertainty regarding how the area will respond to future flooding events and what the impacts will be on downstream properties. The remaining agriculture and other open space lands in this area are critical for providing areas for the river to access its floodplain.

Much of this area is part of the U.S. EPA designated Carson River Superfund site, so there is a need to provide bank stabilization. As a result, there have been many bank stabilization, restoration, and flood repair projects constructed on the middle Carson River. These projects are well documented in the Stewardship Plan (CWSD 2007).

<u>Recommendations for Deer Run Road to Lahontan Reservoir</u>

- Manage development in special flood hazard areas to provide public safety and protect the natural functions and benefits of floodplain lands.
- Assess alluvial fan drainages for flood hazards and opportunities for hazard reduction.
- Design storm water drainage and future roads and bridges to protect the floodplain and not constrict flood flows.
- Utilize bio-engineering techniques and other proven methods in river restoration projects.
- Incorporate principles of low impact development in subdivision designs to limit impervious surface.

- Support conservation easements and other methods for protecting critical floodplain lands and channel migration hazard areas.
- Monitor and treat noxious weeds.
- Provide public education regarding the importance of riparian habitat, floodplain protection, and noxious weeds.

3.2.5 Lahontan Reservoir to Carson Sink

Lahontan Reservoir and Dam were not built as a flood control facility; they were designed as part of an irrigation system. Some storage of floodwaters is provided if there is storage capacity available in the reservoir. There are concerns by residents living in communities below the dam that upstream development along the river corridor and floodplain lands will increase flood flows to the reservoir, exceed reservoir capacity, and cause an increase of flooding to their area.

Homes along the Carson River in Fallon

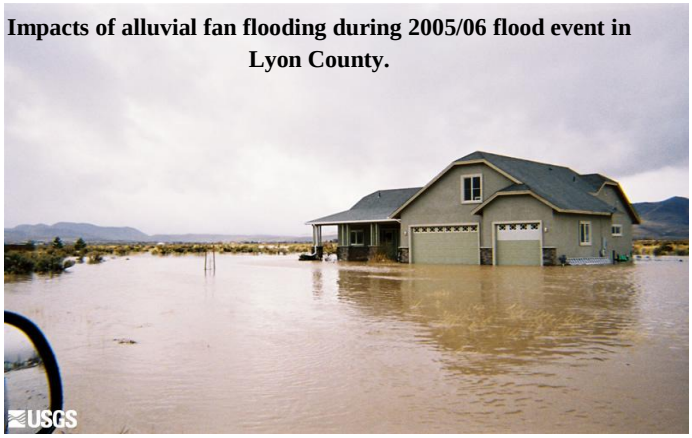
The river system below Lahontan Dam is very different from reaches above Lahontan Reservoir due to the Newlands Irrigation Project and associated irrigation canals. The main river has been highly developed with approximately 50% of the main channel having homes in close proximity to the channel. The Lahontan Valley Environmental Alliance is working on behalf of Churchill County and other stakeholders to investigate opportunities for protecting the river corridor and other areas through conservation easements and other tools. The Frey and Bell Ranch conservation easements are great examples of river corridor protection.

<u>Recommendations for Lahontan Reservoir to Carson Sink</u>

- Support conservation easements and other methods of protecting river corridor lands.
- Investigate opportunities to utilize existing infrastructure for moving flood waters.
- Investigate opportunities to help maintain drainage and other infrastructure so that flood flows are not impeded.
- Design future roads and bridges to accommodate and not restrict the river and irrigation channels so that they may pass flood waters more efficiently.
- Continue public outreach about flooding hazards and river corridor protection.
- Assess alluvial fan drainages for flood hazards and opportunities for hazard reduction.

3.2.6 Alluvial Fan Flooding

FEMA defines alluvial fan flooding in 44 CFR 59.1 as "flooding occurring on the surface of an alluvial fan or similar landform which originates at the apex and is characterized by high-velocity flows; active processes of erosion, sediment transport, and deposition; and unpredictable flowpaths". Due to the mountainous nature of the watershed, many areas experience alluvial fan flooding. Alluvial fan flooding is extremely dangerous. There is typically no warning and flows can be very swift and often filled with sediment and debris, further increasing the erosive power of the flood waters. Alluvial fan flooding is also very site and drainage specific. There has been very limited analysis conducted on the alluvial fan areas within the watershed to determine flood risks. Development at the base of an alluvial fan area can be a very risky proposition, yet these landforms have been developed in many parts of the watershed.



Impacts of alluvial fan flooding during 2005/06 flood event in Lyon County.

3.2.7 Unintended Hazards

The watershed has numerous canals serving agricultural needs that may have structures located below them. Recent events have shown that there can be unintended hazards associated with these channels due to breaching or spills that can result in damage to adjacent properties.

An example of this includes the following:

- The watershed is connected to the Truckee River Watershed via the Truckee Canal. This canal was built as a water conveyance structure and was never intended to provide flood control. Development close to the canal has resulted in unintended consequences with regard to flooding. Over 600 homes were damaged and residents were forced to evacuate when the canal breached in 2008. This unfortunate disaster serves as a reminder that it is crucial to consider the existing and potential flood hazards of an area prior to development.

Breach in Truckee Canal Leaves Many Residences Flooded

3.3 FEMA Repetitive Loss Areas

A repetitive loss property is a property that is insured under the NFIP that, since 1978, has experienced:

- Four or more paid flood losses or more than $1,000 each; or
- Two paid flood losses within a 10-year period that, in the aggregate, equal or exceed the current value of the insured property; or
- Three or more paid flood losses that, in the aggregate, equal or exceed the current value of the insured property.

The history of the loss includes all flood claims paid on the property, regardless of any change(s) in ownership since the buildings construction or back to 1978.

The watershed currently has seven repetitive loss areas as shown in Table 3.31:

Table 3.3-1: Repetitive Loss Areas

Community Name	Community Number	Property Locator Number	Address Line 2	City	State	Zip Code
Carson City	320001		300 South Curry St	Carson City	NV	89703
Carson City	320001		3955 Golden Eagle Lane	Carson City	NV	89701
Carson City	320001	0047422	1500 Kings Canyon Rd	Carson City	NV	89703-4581
Churchill County	320030	0054657	Canvas Back Churchill	Churchill	NV	89406
Douglas County	320008	0081930	2228 Willowbend Rd	Genoa	NV	89411
Douglas County	320008	0017123	2246 Willowbend Rd	Genoa	NV	89423
Douglas County	320008	0081822	2262 Willowbend Rd	Genoa	NV	89411

4.0 Flood Risk Reduction and Floodplain Protection Strategies

The opportunities and strategies formulated during the rapid evaluation and stakeholder process were categorized into the following components.

1. Protect Natural Floodplain Functions and Values
2. Higher Regulatory Standards
3. Flood Data Information and Maintenance
4. Channel Migration and Bank Erosion Monitoring
5. Floodplain and Flood Hazard Outreach and Education
6. Reduction of Infrastructure Impacts

These components are described in the following sections, along with suggested actions for implementation. These suggested actions are not mandatory but rather are considered desirable actions that may be completed within staffing and budgetary limitations. **Table 4.7-1 provides a summary of the suggested actions.**

4.1 Protect Floodplain Natural Functions and Values

FEMA and the Association of State Floodplain Managers (ASFPM) recommend the protection of the natural functions and values of a floodplain as a priority in floodplain management. The CRS has increased the amount of credit that is available for communities implementing these types of strategies. This concept is being recognized nationwide as economically less expensive to communities and provides a multi-objective approach. For example, the National Wildlife Federation offers a description of floodplain functions as follows:

Carson River and its floodplain at Kirman Field
Photo Courtesy of The Nature Conservancy

"As a Nation, we are only beginning to realize the extent of harm that is caused by the wholesale alteration of one of nature's essential ecosystems. Serving their natural functions, floodplains are vast absorptive reservoirs of floodwaters; they are Earth's primary filter and dissolver of waterborne contaminants; their coastal marshes and riverine wetlands provide the creative essentials for countless forms of life; and left to themselves, floodplains and the life they generate offer enjoyment and recreation."

The Carson River system is fortunate in that there are still large areas of floodplain that have not been developed and that can provide ecosystem services to our communities. Agricultural land and areas of open space adjacent to the river provide the opportunity for the river to access its floodplain, thereby providing a variety of benefits to the river system and to the adjacent communities upstream and downstream.

This approach of keeping land adjacent to a river system in a natural state is often referred to as a "***Living River" approach***. This approach provides numerous benefits including:

- Provides continuity (un-impeded flow conditions) and connectivity (connection of the river to its floodplain)
- Minimizes disruption and alteration of river and riparian habitat
- Conveys variable flows and restores habitat in floodplain
- Balances sediment input with sediment transport
- Provides fish and wildlife habitat
- Enhances water quality and supply
- Maintains aesthetic and recreational qualities
- Generally enhances the human environment

Developing natural areas often results in increased flooding and impacts. This leads to increased public expenditures to manage and pay for the costs of flood damage. We also need to provide water treatment to a greater extent. Nature provides these services to us for free. No other water quality improvement practice can equal the benefits of retaining undisturbed natural areas adjacent to waterways.

There are many areas where there are existing structures next to the river channel. However, if we can limit or prevent the development of any new structures that are incompatible with floodplain function within the river corridor, alluvial fans, and other critical floodplain areas, we can decrease the expenses related to flood damages and increase public safety to our communities. There are also areas, for example in Carson Valley, where the floodplain is very expansive. In these areas it may not be feasible to totally prevent structural development, but there are strategies that can be implemented that would limit the impact to the natural function of the floodplain. These types of strategies could include implementation of ***low impact development*** and ***Smart Growth*** principles, and the establishment of building setbacks and/or buffer zones.

On the Carson River much of the land adjacent to the river is private property. ***Programs that provide compensation to landowners for allowing their lands to flood needs to be investigated.*** Conservation easements are especially effective and are being established in many locations within the river corridor and other floodplain lands further from channels. Other programs, such as a floodplain leasing program, should be investigated.

This Plan also suggests that communities adopt a ***"Good Neighbor Policy."*** This policy is based in the understanding that what one property owner does on his or her property has the potential to impact not only their adjacent neighbor, but also communities downstream. A "Good Neighbor Policy" would help raise awareness of this issue and help to reduce negative impacts to others. Negative impacts to other

property owners and other communities can be measured by an increase in flood stages, flood velocity, peak flows, the potential for erosion and sedimentation, degradation of water quality, or increased cost of public services.

A "Good Neighbor Policy" encourages communities to be proactive in understanding potential impacts and implementing prevention and mitigation activities before the impacts occur.

Suggested Actions for Protecting Floodplain Natural Functions and Values:

- Adopt a "Living River" approach for the Carson River that allows the river to access its floodplain and provide natural, no cost, benefits.
- Adopt a "Good Neighbor Policy" for floodplain management that recognizes that actions by one property owner can impact adjacent and downstream property owners and communities.
- Floodplain function and flood hazards should be considered with open space program objectives when selecting acquisition targets and establishing management strategies for open spaces.
- Investigate areas where the implementation of a stream zone buffer would provide multi-objective benefits for the river system, landowners and downstream communities.
- Plan for and mitigate cumulative effects of watershed urbanization.
- Manage development in special flood hazard areas and other flood hazard areas (those known flood hazard areas that are not represented on current FIRMs) to provide public safety, protect the natural functions and benefits of floodplain lands, and minimize the loss of floodplain storage capacity.
- Retain open lands that provide floodplain storage and maintain or restore connection of river with floodplain through land acquisition, conservation easements, local open space programs, TDR/ PDR programs, and other protection measures.
- Encourage the incorporation of low impact development principles into sub-division development plans to decrease generation of run-off and minimize loss.
- Indentify and promote options for landowner incentive programs, such as a floodplain leasing and flood damage insurance programs that provide compensation to landowners providing ecosystem services.
- Promote and utilize best management practices as a means for protecting riparian habitat.

4.2 Higher Regulatory Standards

FEMA has established minimum regulatory standards for communities that participate in the NFIP. This includes the adoption of a floodplain ordinance that meets minimum federal requirements. Often communities adopt the model FEMA ordinance with limited adjustments for their community. This may provide the community with an adequate level of protection. A higher standard would include the adoption of an ordinance that is more specific to the actual flooding hazards of the community and includes good neighbor language that protects adjacent and downstream properties. The minimum NFIP standards provide some flood protection but damage can still occur because:

- Estimates of flood heights are subject to various errors;
- Buildings may be damaged by floods exceeding the predicted 100-year flood;
- Urbanization and other changes in the watershed can increase the flood hazard; and
- Filling and other development in the floodplain can reduce storage capacity

(see Figure 4.2-1).

FEMA highly recommends that communities or states enforce more restrictive requirements. The State of Nevada currently does not have any stricter requirements that communities would need to enforce. The NFIP requires communities to at least consider additional measures for flood-prone areas as stated in 44 CFR 60.22. These measures are summarized in Figure 4.2-1.

Figure 4.2-1: Impacts of Filling on Floodplain Storage Capability (Source: ASFPM)

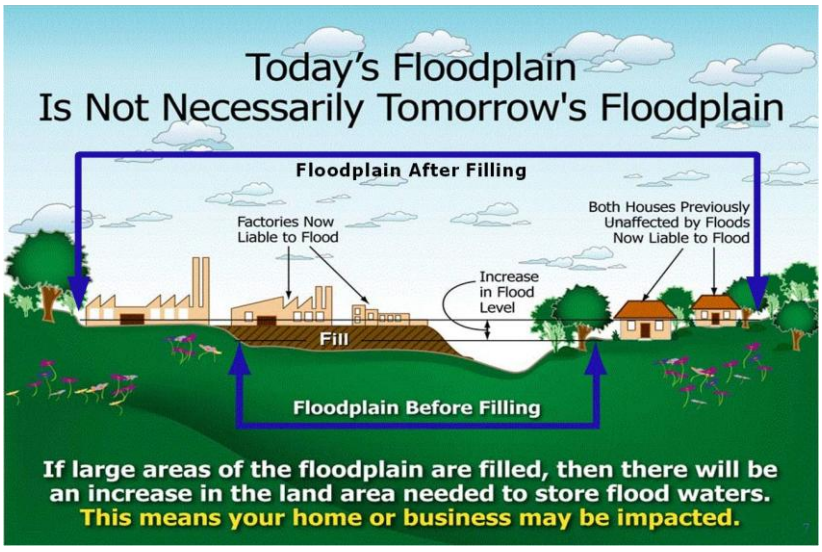


Figure 4.2-2: NFIP Higher Regulatory Standards Planning Considerations (FEMA 2005)

(a) The floodplain management regulations adopted by a community for flood-prone areas should:

1. Permit only that development of flood-prone areas which:

   i. Is appropriate in light of the probability of flood damage

   ii. Is an acceptable social and economic use of the land in relation to the hazards involved

   iii. Does not increase the danger to human life

2. Prohibit nonessential or improper installation of public utilities and public facilities.

(b) In formulating community development goals after a flood event, each community shall consider:

1. Preservation of the flood-prone areas for open space purposes
2. Relocation of occupants away from flood-prone areas
3. Acquisition of land or land development rights for public purposes
4. Acquisition of frequently flood-damaged structures.

(c) In formulating community development goals and in adopting floodplain management regulations, each community shall consider at least the following factors:

1. Human safety
2. Diversion of development to areas safe from flooding
3. Full disclosure to all prospective and interested parties
4. Adverse effects of floodplain development on existing development
5. Encouragement of flood-proofing to reduce flood damage
6. Flood warning and emergency preparedness plans
7. Provision for alternative vehicular access and escape routes
8. Minimum retrofitting requirement for critical facilities
9. Improvement of local drainage to control increase run-off
10. Coordination of plans with neighboring community's floodplain management programs
11. Requiring subdividers to furnish delineation of floodways
12. Prohibition of any alternation or relocation of a watercourse
13. Freeboard requirements
14. Requirement of pilings or columns rather than fill to maintain storage capacity

4.2.1 Enhanced Ordinances

One of the best tools to protect floodplain natural function and provide increased public safety is to enhance and/or implement regulatory standards that go beyond the FEMA minimum standards.

Typically, engineering practices, as well as community enforcement, has limited its concern to the study of impacts to the immediate area adjacent to a proposed development or reach. Cumulative impacts to downstream communities and loss of floodwater storage volume are not typically included with this approach. Through the enhancement of ordinances this concern can be addressed. HDR provided a review of existing county ordinances for the watershed and found them to be based on the minimum FEMA requirements (HDR 2006).

This Plan supports FEMA's recommendation that local governments should go beyond the minimum requirements and provide additional protection to their residents and to the natural resources. During the public planning process, stakeholders suggested that a model "watershed" ordinance be developed that local counties could utilize in enhancing their existing ordinances.

Suggested Actions for Higher Regulatory Standards:

- Implement or enhance county ordinances to: a) include protection of floodplain function as a purpose of the ordinance; b) be based on a good neighbor policy; c) require mitigation for the loss of floodplain storage; and, d) account for the cumulative impacts associated with floodplain development.
- Investigate feasibility of implementing additional measures that go beyond minimum FEMA requirements, such as those presented in Figure 4.2-2;
- Develop "model" watershed floodplain management ordinance language that can be adopted by counties to provide watershed-wide consistency.

4.3 Flood Data Information and Maintenance

The types of technical information that can be used for flood risk analysis and risk reduction include hydrologic and hydraulic studies, floodplain and channel migration zone maps, geologic studies, geographic information system (GIS) land use data, habitat studies, risk assessments, flood hazard management maps, and FIRMs. To be used effectively these data need to be collected in a consistent manner and managed in a way that makes the data readily accessible and allows new or updated information to be easily integrated.

4.3.1 Up-to-Date and Consistent Data Collection

In order to properly manage our floodplains and any development that may occur we must have current data and information. This has always been a challenge for local governments and others trying to implement good floodplain management. Staff from all counties expressed frustration with the lack of reliable data upon which to base decisions and defend these decisions. Examples of data inaccuracies include:

1) Most of the Carson River FIRMs are based on analysis that was performed over 30 years ago.

2) Floodways on current FIRMs are incomplete and contain numerous inaccuracies.

3) Conditional Letters of Map Amendments (CLOMRs) are submitted and approved by FEMA, but the Letter of Map Revision (LOMR) that would make the actual map amendment is not always completed and submitted by applicant. This results in inaccurate data in the mapping and planning process.

4) Major flood events often result in significant changes to the river system. The current maps do not reflect these changes.

Problems such as these leave local governments and others in the position of having to use highly inaccurate maps for planning purposes. This Plan suggests that, to the extent possible, flood data and other related information should be updated and managed in a manner that provides the most current information to all users in a timely and useful manner.

4.3.2 Map Modernization Program

To address the need to update flood studies and maps FEMA has implemented the *Map Moderization Program*. This program is intended to reduce the age of flood maps, produce digital mapping for high priority areas, develop flood maps for many previously unmapped communities, and encourage states and communities to share the costs of flood mapping.

Cost-sharing is achieved through FEMA's Cooperating Technical Partner Program. The goal of this program is to incorporate local knowledge into the mapping process resulting in more accurate and representative information. In 2005, CWSD became a partner through this program. The goal was to update flood maps for the entire watershed, incorporating the LiDAR data and future conditions. International political conditions placed restraints on the funding that was available to the program, and the original goals have not yet been achieved for this watershed.

Some of the watershed FIRMs have recently been updated through the program; however no new analysis was conducted for the river corridor areas. Preliminary maps have been issued for some portions of Carson City, Churchill, Lyon and Douglas Counties. This Plan suggests that we continue to work with FEMA to update the data and incorporate into the new digitized FIRMs (dFIRMs).

4.3.3 Updating and Maintaining dFIRMs

In order to fully utilize the map modernization program a process needs to be developed that would provide procedures for coordinating with FEMA on how county GIS, planning and engineering departments, and floodplain administrators can best utilize and update dFIRMs. A challenge faced by the counties is that the base map changes much faster than the FEMA process. A consistent watershed-wide process would be beneficial and allow for easier sharing of data and for keeping maps up to date.

4.3.4 Elevation Reference Mark Maintenance

Elevation reference marks (ERMs) are very important as they provide a ground elevation reference for surveyors to start from when they determine the elevation of a building, cross section, or topography for a site. To maintain consistency and accurate data the following items should be implemented:

1. ERMs should be permanent monuments, and the location and elevation of each ERM should be confirmed every three years or more frequently, if necessary.

2. ERMs must be in the same datum as the base flood elevations on the communities FIRMs or a datum that is readily convertible to the FIRMs datum.

3. A master list of the ERMs with clear descriptions of their locations should be compiled and be available for use by surveyors, developers, and other interested parties.

4.3.5 Floodway Delineation

The floodway is the area with the greatest danger during flood events. A floodway is determined with a computer program that "squeezes" the floodplain toward the channel and causes the flood level to rise. At the point where the water level is one foot above the base flood elevation the floodway boundaries are drawn. Some states and communities use a more restrictive standard for delineating floodways. Some allow a less than one foot rise. This results in a wider floodway and less area in the flood fringe. This approach provides the community with a higher level of protection during flood events. FEMA suggests that no development be allowed in floodways due to their hazardous nature. However, development in floodways is permitted if it can be demonstrated that no rise in base flood elevation will occur.

As part of the Map Modernization Program, FEMA has recently delineated floodways in some sections of the watershed. These proposed floodways are currently in the public review process and have not been formally adopted or approved. Proposed floodways were added for portions of the alluvial fan areas in Douglas County, expanded through portions of the river system and alluvial fans in Carson City, and added on the river system through the Dayton area. The proposed floodways are shown in Figure 4.3.5-1. This Plan recommends that floodway delineation should be completed for the entire river system with appropriate data verification, and inconsistencies be addressed.

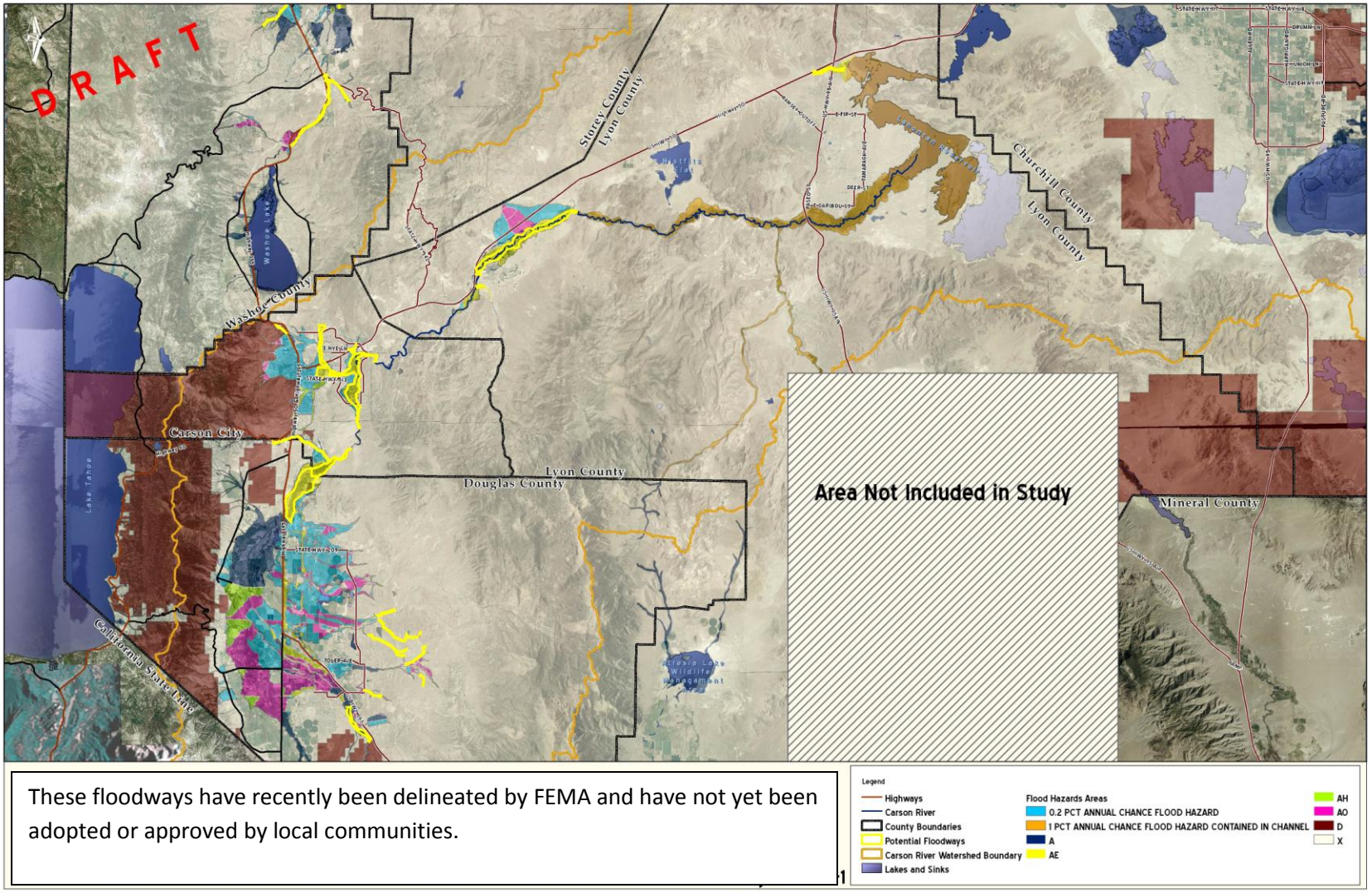


Figure 4.3.5-1: Overall View of Proposed Floodways of the Carson River

4.3.6 Unsteady State Model for the Carson River

Typical floodplain management tools include the use of a steady state backwater calculation program to establish a water surface elevation at flood stage. The most widely used program is the HEC-RAS program developed by the U.S. Army Corp of Engineers (USACE). The steady state module in HEC-RAS utilizes information from each cross section in the model to calculate the conveyance, energy, and ultimately the water surface elevation for the cross section.

This model is useful for verifying compliance with municipal floodplain regulations for most proposed developments. Most developments are only required to analyze for changes in water surface elevation that would impact the surrounding properties, and the steady state model is the "model of choice" for that purpose. However, the steady state model does not take into account the significant volume of water that may be stored in existing floodplains, as well as the resulting attenuation of the peak flows due to that storage.

Incrementally, each new development could justify that "their" development makes an insignificant impact to the overall floodplain, certainly within the accuracy tolerance of the models; however, the cumulative impact from the loss of floodplain storage could be significant, especially in river systems like the Carson River where large areas of land flood and hold water during a significant storm event.

The unsteady module in HEC-RAS utilizes flood plain storage volume to make a more accurate estimate of flooding. Moreover, it is highly successful for shedding light on a growing problem faced by planners, that of loss of flood plain storage and the potential for increased flooding downstream. This impact has been studied by the Corps of Engineers along the Truckee River in Washoe County. It was found that the Truckee Meadows holds significant potential for flood storage, and loss of that storage can significantly increase the risk of flooding downstream. This fact was demonstrated effectively by development of an unsteady model of the Truckee River.

This Plan recommends that the development of an unsteady state model for the Carson River be investigated. The model could be used by all counties and would provide consistency with baseline data and subsequent updates and account for cumulative impacts from the loss of floodplain storage.

4.3.7 Evaluation of Alluvial Fan Areas

Historically, extensive flooding damage has resulted from alluvial fan flooding throughout the watershed. Such flooding presents unique problems to federal and state planners in terms of quantifying flood hazards, predicting the magnitude at which those hazards can be expected at a particular location, and devising reliable mitigation strategies. Recent and future development at the base of alluvial fans and other areas subject to flash floods is of great concern. Most of the alluvial fan areas have not been analyzed for the flood risk to residents. This Plan recommends that the identification and mapping of flood hazards occurring on alluvial fans be pursued and mitigation strategies developed.

4.3.8 Photo-Monitoring

Photographs of flooding events are an invaluable tool for showing the impacts of flooding events. The development of a photo-monitoring program with individuals and/or organizations assigned as photo-monitors during events would provide historical documentation and data for tracking flooding trends. A process for cataloging the photographs would be developed.

Suggested Actions for Flood Data Information and Maintenance:

- Investigate the feasibility of conducting unsteady state modeling to identify flood water storage requirements and to look at cumulative effects of watershed development.
- Support FEMA's Map Moderization Program and work with EMA to update FIRMs with current and future conditions.
- CWSD should continue to participate in the Cooperating Technical Partner Program with FEMA to leverage funding, strengthen inter-jurisdictional partnerships with counties, and maximize federal, state, and local funding opportunities submittal for the completion of new and revised FEMA Flood Insurance Studies and Flood Insurance Rate Maps.
- Strive for up-to-date and consistent data collection and maintenance. This includes updating of flood studies where necessary and conducting studies for significant water courses and alluvial fan areas that have not been analyzed. This data should be used to update FEMA maps and fill data gaps. Floodway delineation for the entire river system should also be completed.
- Flood studies and maps should be updated after significant flooding events.
- Elevation reference mark maintenance. Maintaining current and consistent elevation reference marks makes it easier and less expensive for developers and property owners to determine ground, floor, and base flood elevations for construction and insurance purposes. The EFM's should be permanent monuments, maintained in a master list and updated on a regular basis.
- Photo-Monitoring should be used as a tool to document flooding events and assist with monitoring for flooding trends.

4.4 Channel Migration and Bank Erosion Monitoring

Impacts of Channel Migration on a House in Dayton during the 1997 Flood Event. (Photo courtesy of the Reno-Gazette Journal

As discussed in Section 3.1, the Carson River tends to change course, or move laterally during flood events in places. Areas with high potential for channel migration (movement) are extremely hazardous areas for development. Long-term monitoring of the river system can help to identify areas with high potential for excessive erosion and migration. In some areas building set-backs or buffer zones may be appropriate in order to provide public safety in these hazardous areas.

Suggested Actions for Channel Migration and Bank Erosion Monitoring

- Known and projected hazard areas, including channel migration hazards, should continue to be documented and updated information should be incorporated in the planning processes.
- LiDAR and/or aerial photography (on a watershed level) should be conducted on a 5-year basis to provide updated information on channel movement and floodplain condition.
- Establish building set-backs or buffers in flood hazard areas, where appropriate, to reduce severe hazards from channel migration.
- Channel cross-sectional surveys should be conducted and and well documented to track long term changes in river channel.
- Identify unstable areas and areas with high potential for erosion, including areas prone to channel meandering and avulsion.
- Promote the use of bio-engineering techniques with hard points where necessary in river restoration projects.
- Update the 1996 Fluvial Geomorphic Assessment.

4.5 Floodplain and Flood Hazard Outreach and Education

Outreach and education is a critical and low-cost tool that can be used to increase public safety, reduce flood risks, and raise awareness of the importance of functioning floodplains. A watershed-wide outreach program could assist the counties with local programs and reinforce the flood hazard message in a consistent format. Some outreach activities that may be implemented include the following:

- Brochures. A brochure will be developed that describes the importance of floodplains; identifies local flood hazards and available services through flood warning and emergency response programs; makes recommendations for flood insurance and personal preparedness; and provides important phone numbers and websites that can provide assistance and information.

- Websites: CWSD will expand their website to include a flood hazard and floodplain protection section that could be linked to all of the counties within the basin. The website would provide information for the general public about local flood hazards, emergency numbers, and importance of floodplain protection. The website will also provide this plan for public use and connect to the USGS Flood Chronology and NOAA websites as well as other related websites.

- Annual Flood Awareness Week: A media campaign is proposed to increase public awareness and preparedness prior to the flood season. The campaign would include press releases to local television and radio stations, newspaper articles, and public events that would provide floodplain protection and flood hazard information.

- Special Events, River Works and Other Outreach Opportunities: An inter-active activity about flooding and floodplains will be developed that can be used at special events and at Carson River Work Days. Displays will be provided at special events and at public facilities, such as public libraries.

- Conferences and Workshops: The CWSD, CRC and others will continue to provide forums for stakeholder exchange of information and learning opportunities about this issue.

4.6 Reduction of Infrastructure Impacts

There are opportunities throughout the watershed for the enhancement and/or design of roads, culverts, grade controls, and bridges to accommodate floodwaters better, protect floodplains, and decrease bank erosion.

Highway 88 Bridge during 2005 spring run-off

Several restrictions to the movement of flood waters due to existing infrastructure have been identified. These include:

- Raised roadways and driveways that do not have appropriate drainage to pass flood waters. This can result in a back up of floodwaters affecting not only the landowner but adjacent properties.

- Work conducted in the 1960's by various governmental organizations resulted in berms along portions of the Carson River that restrict

access of the river to its floodplain. This results in faster, more erosive flows impacting downstream communities.

- Many of the bridges crossing the Carson River have low capacity during flood events and act as constrictions to the passage of flood flows. This can result in increased flood damages and excess streambank erosion.

- Grade control structures in the river are frequently damaged during flood events. Repairs to the structures after flooding events has historically returned them to the same pre-flood condition per FEMA requirements. This can result in similar damages to the structures in future flooding events, thereby requiring the same types of repairs.

- Culverts and other drainage infrastructure often experience filling in of sediments and debris, thereby restricting the amount of flood waters that can flow through them and in many cases backing up flow. Limited county resources have not allowed for the necessary continued maintenance of these structures.

Suggested Actions for Reduction of Infrastructure Impacts:

- Investigate opportunities to remove existing restrictions, such as berms, to allow flood waters to access floodplain.

- Limit the use of future management measures, such as dams, levees and floodwalls

- Design future bridges and roads to protect floodplains, accommodate and not restrict changing river course, and minimize back up of flood water. Flood hazard management objectives should be used to influence the project design and construction methods associated with repair or improvements to bridges, roads, and other infrastructure that may experience frequent inundation or erosion.

- Investigate opportunities to enhance grade control structures in order to provide added protection and decrease damage costs.

4.7 Summary of Suggested Actions

Table 4.7-1 provides a summary of the suggested actions presented in this section. The table also includes suggested responsible parties and potential sources of funding for specific actions.

Table 4.7-1

Summary of Suggested Actions

Plan Element	Suggested Action	Responsible (or suggested responsible) Party	Existing or Potential Funding Source
Protect Floodplain Natural Functions and Values			
SA-1	Adopt Living River approach to retain river system in a more natural state that allows the river to access its floodplain. Recognize that not all areas of the river system can be allowed to migrate freely due to special designation (i.e., Superfund area) and/or existing infrastructure.	All entities	n/a
SA-2	Adopt a good neighbor floodplain management policy that recognizes that actions by one property owner can impact adjacent and downstream property owners.	All entities	n/a
SA-3	Floodplain and flood hazards should be considered with open space program objectives when selecting acquisition targets and establishing management strategies for open spaces.	Local and tribal governments, NGOs, CWSD	n/a
SA-4	Investigate areas where the implementation of stream zone buffers would provide multi-objective benefits for river system and downstream communities.	Local and tribal governments	n/a
SA-5	Plan for and mitigate cumulative effects of watershed urbanization.	All entities	n/a
SA-6	Manage development in special flood hazard areas and other flood hazard areas (those known flood hazard areas not included on most current FIRMs) to provide public safety and protect the natural functions and benefits of floodplain lands.	Local and tribal governments; CWSD	n/a
SA-7	Retain lands that provide floodplain storage and maintain or restore connection of river with floodplain through land acquisition, conservation easements, local open space programs, TDR and PDR Programs, and other protection methods.	Local and tribal governments, NGOs, landowners	Question 1; SNPLMA; NGOs; local governments
SA-8	Encourage the incorporation of low impact development principles into sub-division development proposals for floodplain lands to decrease run-off and minimize loss of floodplain storage capacity.	Local governments	n/a

Plan Element	Suggested Action	Responsible (or suggested responsible) Party	Existing or Potential Funding Source
SA-9	Identify and promote options for landowner incentive programs, such as floodplain leasing program and conservation easements that provide compensation to landowners providing ecosystem services.	Local & tribal governments, NGOs, CWSD, CRC, landowners	Federal, State and local sources, Question 1, SNPLMA
SA-10	Promote and utilize best management practices as a means of protecting riparian habitat.	All entities	n/a
Higher Regulatory Standards			
SA-11	Implement or enhance county ordinances that include floodplain protection as a purpose, account for the loss of floodplain storage volume, and mitigate losses through a variety of methods.	Local governments	n/a
SA-12	Investigate feasibility of implementing additional measures that go beyond minimum FMEA requirements.	Local governments	
SA-13	Develop model watershed floodplain management ordinance language that can be adopted by counties to provide watershed-wide consistency.	CWSD, CRC, local governments	n/a
Flood Data Information and Maintenance			
SA-14	Secure funding for and conduct watershed-wide unsteady state modeling to identify flood water storage requirements and to look at the cumulative effects of watershed development.	Local & state governments, CWSD	NDEP, CWSD, other local & state entities
SA-15	Support FEMA's Map Modernization Program and encourage FEMA to update FIRMs with current and future conditions. Significant verification of topography and other variables should be conducted prior to release of draft FIRMs.	Local governments FEMA CWSD	n/a
SA-16	CWSD continue to participate in FEMA's Cooperating Technical Partner Program.	CWSD, FEMA	n/a
SA-17	Strive for up-to-date and consistent data collection and maintenance to include updating of flood studies where necessary and conduct studies for significant water courses and alluvial fan areas that have not been analyzed. This data should be used to update FEMA maps and fill data gaps. Complete delineation of the floodway throughout river system and incorporate into FIRMs.	CWSD Local governments	Federal, state and local grant sources
SA-18	Flood studies and maps should be updated after significant flooding events.	Local governments	All grant sources

Plan Element	Suggested Action	Responsible (or suggested responsible) Party	Existing or Potential Funding Source
SA-19	Elevation Reference Marks (ERM) should be permanent monuments and updated on a regular basis.	Local governments	n/a
SA-20	ERMs should be in the same datum as base flood elevations on FIRMs or a datum that is readily convertible to FIRM datum. Move towards FEMA recommended NAVD 88 datum.	Local governments	n/a
SA-21	A master list of ERMs should be developed, maintained, and made available to interested parties.	Local governments; CWSD	n/a
SA-22	Photo-Monitoring program (on-the-ground and aerial) should be developed and coordinated on a watershed level to document flooding and flood hazards in a consistent matter.	CWSD	n/a
Channel Migration and Bank Erosion Monitoring			
SA-23	Known and projected hazard areas including channel migration hazards should continue to be documented and updated information should be incorporated into planning processes.	Conservation Districts, CWSD, NDEP, WNRC&D, FEMA, local & tribal governments	Federal, state and local resources
SA-24	LiDAR and/or aerial photography (on a watershed level) should be conducted on a 5-year basis, or as needed, to provide updated information on channel movement and floodplain condition.	CWSD, NDEP, CVCD, DVCD, WNRC&D, NGOs, BOR, local governments	Federal, state and local grant sources
SA-25	Establish building set-backs in flood hazard areas, where appropriate, to reduce severe hazards from channel migration.	Local and state entities	n/a
SA-26	Channel cross-sectional surveys should be conducted and well documented to track long term changes in river channel.	CWSD, conservation districts, WNRC&D	Federal, state and local grant sources
SA-27	Identify unstable stream banks and areas with high potential for erosion.	Conservation districts, WNRC&D, NDEP, CWSD	n/a
SA-28	Promote the use of non-structural, bio-engineering (soft-engineering utilizing natural materials) techniques in river restoration projects in combination with other proven methods.	All entities	n/a

Plan Element	Suggested Action	Responsible (or suggested responsible) Party	Existing or Potential Funding Source
SA-29	Update the 1996 Fluvial Geomorphic Assessment.	WNRC&D, CWSD, NDEP, conservation districts	Federal, state and local grant sources
Floodplain and Flood Hazard Outreach and Education			
SA-30	Develop watershed-wide outreach and education program about floodplain importance and flooding hazards.	CWSD, CRC	Federal, state and local grant sources
SA-31	Brochures should be developed for distribution on a watershed level with consistent messages and information for the general public.	CWSD, CRC	n/a
SA-32	CWSD website will provide information on the Regional Floodplain Management Plan and provide emergency contact information. Local governments and other entities can link to this website to increase distribution.	CWSD	n/a
SA-33	Annual Flood Awareness Week will be established with the objective of providing information about flooding and flood hazards to the general public.	CWSD, CRC, Local & tribal governments	n/a
SA-34	Special Events, River Work Days, and other outreach opportunities should be utilized to help raise awareness of flooding hazards and importance of floodplains.	CRC, WNRC&D and other local & tribal entities	Federal, state and local grant sources
Reduce Infrastructure Impacts			
SA-35	Investigate opportunities to remove existing restrictions, such as berms, to allow flood waters to access floodplain.	Local & tribal government organizations, landowners	Federal, state and local sources
SA-36	Limit the use of future management measures such as dams, levees, and floodwalls.	Local & tribal government organizations, landowners,	n/a
SA-37	Design future bridges and roads to protect floodplain, accommodate and not restrict changing river course, and minimize back up of flood water.	NDOT, local governments	Federal, state and local sources
SA-38	Investigate opportunities to enhance grade control structures	Local governments, CWSD	n/a

5.0 Implementation

Implementation of this Plan will require the cooperation of numerous stakeholders and is dependent upon available funding and staffing resources. Detailed studies and costs may need to be developed as implementation proceeds. The CWSD will guide efforts for plan implementation from a regional perspective and coordinate with entities to implement local actions. The River Corridor working group will continue to serve as a technical advisory group and steering committee for implementation.

5.1 Steps for Plan Implementation

Potential first steps for plan implementation are presented in the following subsections for each of the suggested actions categories. (See Table 4.7-1).

Protect Floodplain Natural Functions and Values

1. Coordinate with floodplain landowners to determine what type of landowner compensation programs, in addition to conservation easements and land acquisition, would be favorable.
2. Develop a strategy for obtaining funding for developing landowner compensation programs.
3. Coordinate with University of Nevada Cooperative Extension to provide information and/or workshops on Low Impact Development practices.
4. Work with local governments, NGOs and other entities to further identify floodplain lands and landowners interested in conservation easements or land acquisition.
5. Integrate existing literature on best management practices for riparian areas into a guide specific to the Carson River.
6. Delineate areas that may be appropriate for setback and buffer zones.

Higher Regulatory Standards

1. Develop model watershed floodplain management ordinance language that could be incorporated into existing ordinances or used to develop new ordinances.

Flood Data Information and Maintenance

1. Investigate funding opportunities to develop an unsteady state model for the Carson River to identify flood water storage requirements. Establish a technical working group.
2. Develop a list of flood-related studies and maps that are in need of updating.
3. Work with FEMA and local governments to complete the delineation of floodways throughout the river system and to update FIRMs.
4. Develop a list of current Elevation Reference marks and associated datum and determine where updates may be necessary.

5. Work with GIS, planning, and engineering departments to establish a procedure for updating dFIRMs in a consistent matter on a watershed basis.

6. Establish contacts from each region to serve as photo-monitors and establish protocols and catalog system for photo-monitoring programs.

Channel Migration and Bank Erosion Monitoring

1. Coordinate with local entities on aerial photography or LiDAR efforts to reduce or eliminate duplication of efforts and to gain the most from our efforts.

2. Establish a procedure for properly documenting changes in channel movement and areas of excessive bank erosion to track long-term changes.

3. Investigate the potential for updating the 1996 Fluvial Geomorphic Study.

4. Investigate areas for the establishment of setbacks or buffers zones in highly hazardous areas.

5. Continue to support and encourage non-structural approaches and bio-engineering techniques with any river projects.

6. Continue to support and fund river restoration projects.

Floodplain and Flood Hazard Outreach and Education

1. Outline a Flood Hazard and Floodplain Awareness Public Outreach Campaign.

2. Coordinate with local media sources to identify the best methods to reach general public.

3. Conduct annual flood awareness week, beginning in the fall of 2008.

4. Provide training workshops to local entities on a flood management program.

5. Develop brochures for distribution to the general public.

6. Provide access to this Plan and any other pertinent sources of information regarding flooding and floodplain protection in an easy, understandable manner.

7. Include flooding and floodplain protection outreach with existing efforts, such as Carson River Work Day and at school water festivals.

8. Complete the interactive learning center at the Children's Museum.

9. Secure funding to develop an interactive flooding display at Children's Museum.

10. Provide outreach materials to local libraries and other community facilities.

Reduce Infrastructure Impacts

1. Work with NDOT to investigate options for future road and bridge designs.
2. Investigate designs that could be used to enhance grade control structures following any future flood damage and subsequent repair work.
3. Investigate funding opportunities for enhancing or replacing failing structures, such as the Mexican Dam.

Other Implementation Measures:

- Establish coordination procedures for county floodplain administrators and the CWSD floodplain manager to ensure regional coordination as well as local.
- CWSD to develop a comparison of this plan with the Community Rating System and work with the counties to submit proper documentation to allow the counties to receive credit for this regional plan and associated activities. This credit is important to potentially lowering flood insurance rates for community members.

5.2 Monitoring and Revision

An annual report evaluating progress towards implementing the suggested actions will be coordinated and prepared by CWSD and provided to the county floodplain administrators and other interested parties.

The floodplain management plan and suggested actions will be reviewed and updated on an as-needed basis, not to exceed a five-year time frame. CWSD will work with stakeholders, including the working group and local floodplain administrators, to achieve this. The Plan and updates will be distributed via email to all counties, agencies and other stakeholder groups to increase awareness and expand and strengthen the core group of individuals committed to carrying out the stated goals and suggested actions.

Success and improvements in the effectiveness of the suggested actions and the regional approach to floodplain management can be measured by factors such as: reduction in flood damage, enhancement of sediment transport capabilities, enhancement of water quality, and general awareness of flooding issues by general public.

5.3 Linking Regional Floodplain Management with Other Plans

This Plan is consistent with the following documents as pertaining to flooding and floodplain management.

Table 5.3-1: Linkage with Existing Government Plans

Applicable Plans	Date	Applicable Section(s)
State of Nevada		
Standard Multi-Hazard Mitigation Plan	Oct 2004	Pages 53 – 56
Nevada Model Floodplain Management Plan	Oct 2004	All sections
State of California		
Water Plan Update 2005	2005	Chapter 10 - Page 10.3, Box 10-1
Alpine County, California		
Floodplain Development Standards Code		16.08
Douglas County, Nevada		
Douglas County Master Plan 2006 Update	Jan 2007	Goal 5.03 - Policies 5.03.03, 5.03.07, and 5.03.08
Carson City, Nevada		
Carson City Master Plan	Apr 2006	3.1a; 3.3d; 8-9 SR-SPA4.5; 8-9 SR-SPA6.1; 8-22 LR-SPA 3.1; 8-27 V&T SPA 3.1; A-5; B-19; B-27; 9-9 3.3d; 9-9 4.3a
Carson River Master Plan	1996	Chapter 3
Lyon County, Nevada		
1990 Master Plan	1990	Section B – flooding not mentioned
Comprehensive Master Plan (Currently Updating)	2008	View www.lyon-county.org/document/Planning for latest on updated plans
Churchill County		
Master Plan 2005 Update	2005	3.0; 3.1

Alpine County Processes

The following provides information specific to Alpine County regarding floodplain management and planning processes.

There are three primary components to floodplain management in Alpine County

- Alpine County Floodplain Development Standards (Alpine County Code Sec. 16.08)
- Alpine County General Plan – Stream Environment (SE)
- California Environmental Quality Act (CEQA)

The Alpine County Floodplain Development Standards were adopted in 1988. They set development standards and permit requirements that must be satisfied prior to issuance of a building or development permit within flood-prone areas of the County. Flood-prone areas of the County have not been specifically mapped. All areas of Alpine County are designated on FEMA Flood Insurance Rate Maps as Zone D – areas of undetermined, but possible flood hazards.

The Land Use Element of the Alpine County General Plan establishes a designation for Stream Environment (SE). No residential, commercial, industrial, or institutional structure or facility should be allowed in a Stream Environment designated area unless variance special study provisions are satisfied. The Stream Environment designation is based on USGS classification of year round (perennial) and seasonal (intermittent) streams. Criteria for site specific evaluation and application of varying setback requirements for the Stream Environment area are identified in a data base of information maintained at the Alpine County Planning Department.

The California Environmental Quality Act (CEQA) establishes policy and regulations that apply to all state and local agencies within the state of California. In short, CEQA requires evaluation of the potential environmental consequences of proposed government actions or projects. It applies to government decisions on private projects, as well as projects carried out or funded by the government. As a consequence, any development proposal within Alpine County that has the potential to result in a significant adverse impact on a floodplain will be required to reduce the impact to a non-significant level. Alpine County has the responsibility to determine the significance of the impact and the appropriate level of mitigation required.

CEQA also potentially applies to adoption of plans and ordinances by local jurisdictions in California. Alpine County will need to insure that all applicable provisions of CEQA have been satisfied before adopting this proposed Regional Floodplain Management Plan and before taking any action on proposed implementation within Alpine County.

5.4 Additional Regulatory and Permitting Agency Coordination

The following programs are associated with floodplain management and should be considered when implementing suggested actions (FEMA 2005):

Executive Order 11988

Requires Federal agencies to first assess whether a property will be located within the SFHA or 500-year floodplain, and, if so, to follow an eight-step process to assure all alternatives and guidelines are met before proceeding with the project.

Enacted to "Avoid to the extent possible the long and short term adverse impacts associated with occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative."

Clean Water Act of 1972

Section 303: Authorizes States and Tribal governments to establish water quality standards for navigable waterways to protect and enhance water quality.

Section 311: Addresses pollution from oil and hazardous substances.

Section 401: Provides that no Federal permit or license is issued for activities that might result in a discharge to navigable waters unless a 401 certification is issued.

Section 402: The National Pollutant Discharge Elimination System (NPDES) is a permitting system established to regulate point source discharges of pollutants and is under the purview of the U.S. EPA.

Section 404: Establishes permitting systems to regulate the placement of dredged or fill materials into waters (including wetlands) under the U.S. Army Corp of Engineers' purview.

U.S. Fish and Wildlife Service Endangered Species Act of 1973

Consultations are required under Sections 7 and 10 of this Act if development is proposed in an endangered/protected species habitat.

U.S. Coast Guard

Project may require a permit if the proposed development includes a bridge or causeway that may affect navigation.

U.S. Army Corps of Engineers

All projects within a navigable waterway require permits.

State Permits

The following activities may require a state permit:

- Construction in floodways or other designated areas
- Stream crossings or projects that affect navigable rivers

- Installation of septic systems
- Subdivision standards of subdivision plat or lot filling requirements
- Manufactured housing (mobile home) park or tie down requirements
- Public health facilities, such as hospitals and nursing homes
- Operating a landfill or hazardous materials storage facility

5.5 Potential Funding Sources

Federal Funding Sources
U.S. Environmental Protection Agency
Federal Emergency Management Agency (FEMA)
    Flood Mitigation Assistance Program
    Pre-Disaster Mitigation Program
    Repetitive Flood Claims Program
    Severe Repetitive Loss Program
Natural Resources Conservation Service
Farm Service Agency
U.S. Bureau of Reclamation
U.S. Army Corps of Engineers
U.S. Bureau of Land Management
    Southern Nevada Public Land Management Act Program
U.S. Fish and Wildlife Service
U.S. Forest Service

State Funding Sources
California State Water Resources Control Board Lahontan Region
Nevada Division of State Lands - Question One Funds
Nevada Division of Environmental Protection
    Bureau of Water Quality Planning
    Bureau of Water Pollution Control
Nevada Division of Water Resources
    Channel Clearance Fund
    Floodplain Management Program
Nevada Division of Forestry
Nevada Division of Conservation Districts

Local Funding Sources
Carson-Truckee Conservancy District
Carson Water Subconservancy District
Western Nevada RC&D
Private and Non Profit Organizations

6.0 Planning Process

This planning process was conducted by the CWSD and the working group. Guidance was provided by the CWSD Board of Directors and Floodplain Administrators from all five counties along the Carson River. The FMA Project Director is Edwin James, General Manager of the CWSD and Civil Engineer. Genie Azad, Watershed Coordinator and Certified Floodplain Manager of the CWSD, serves as the FMA Project Coordinator, Working Group Chair, and primary author of the Plan.

The CWSD is the responsible entity for watershed management and planning for the watershed. CWSD was originally formed in 1959 and in 1989 the Nevada Legislature passed legislation that recreated the CWSD pursuant to Chapter 541 of the Nevada Revised Statutes. The Legislature gave CWSD the responsibility for management and development of the water resources of the Carson River to alleviate reductions or loss of water supply, to assume responsibility for conservation and supply of water, and protect against threats to the health, safety, and welfare of the people of the Carson River Basin. These threats include those related to flooding. The 14 member Board of Directors consists of elected and non-elected officials from the five counties along the Carson River including two agricultural representatives. These counties are: Alpine County in California and Douglas, Carson City, Lyon, and Churchill Counties in Nevada.

The CWSD has serves as the clearinghouse for flood-related funds from FEMA and is a FEMA Cooperative Technical Partner. The CWSD is also the lead agency for integrated watershed planning within the watershed and the coordinating agency for the CRC. Funding for CRC activities is provided by the Nevada Division of Environmental Protection Bureau of Water Quality Planning and the CWSD. The CRC, formed in 1998, is a diverse group of dedicated individuals representing Federal, State and local agencies and organization, universities, environmental groups, and private citizens from throughout the watershed. The purpose of the CRC is to form relationships so that problems, threats, and issues are addressed in a spirit of communication and cooperation. Within the CRC are working groups that address specific issues.

Most Important Watershed Issue Survey

In 2003, the University of Nevada Cooperative Extension (UNCE) developed a ***survey*** for CRC participants in order to determine the most important message that the public needs to understand about the watershed. The following message was voted the most critical issue to address:

> *"Protect the floodplains from future development. Once the floodplains - and especially the river's meander belt corridor – are impacted by development, the river loses the ability to re-establish its natural functions. Agricultural fields near the channel are critical for floodwater attenuation, groundwater recharge, nonpoint source pollution buffering, and providing habitat for wildlife."*

Floodplain Management Conference

As a result of the strong interest indicated by the survey, in 2004, CRC participants organized a ***conference*** to provide a forum to discuss floodplain protection. The conference was well attended by over 130 stakeholders from all regions of the watershed and included landowners and elected officials. The outcome of the conference was the consensus that a Regional Floodplain Management Plan needed to be developed that would provide strategies for protecting the remaining floodplains and the river corridor to the extent possible.

Working Group

In 2005 the ***Working Group*** was formed to heighten community awareness of flooding issues and to develop strategies to protect the floodplain. An initial invitation to participate in the working group was extended via electronic mail (e-mail) to more than 150 community stakeholders. This resulted in 41 individuals, representing over 30 organizations that were interested in participating. The core working group consists of 15 individuals from 12 organizations (see Page 2 of this Plan for names). The remaining 26 individuals received updates, agendas, and meeting notes via email. As a result of the public workshops an additional 50 individuals were added to an e-mail list to receive updates specific to the Plan. Milestones during the planning process were conveyed to the entire main group CRC.

The working group met on a monthly basis throughout the planning process from March 2, 2005 until September 2008. Meeting announcements, agendas and meeting notes were provided to the entire e-mail list. The CRC and working group meetings are open to the public and meeting dates, locations, and times are provided on the CWSD website. Information on agendas and meeting notes are available from the CWSD.

Flood Mitigation Assistance Grant

In 2005, the CWSD received a ***Flood Mitigation Assistance*** (FMA) grant from the Nevada Division of Water Resources to develop the Plan. The working group serves as the steering committee.

Community Workshops and Public Meetings – Planning Stage

The working group developed a ***community presentation***, "Protecting Our Lifeline in the Desert: the Carson River Corridor", along with a companion questionnaire to be provided at community workshops and other public meetings. The presentation provided information on the following:

- Flooding history
- Future flooding predictions
- Floodplain importance and natural functions
- Channel migration
- Current development trends in watershed

- Floodplain regulation and FEMA requirements
- Strategies employed by other communities to protect floodplains and reduce flooding impacts
- Floodplain management options for watershed

The questionnaire was completed by attendees of a series of public meetings at the beginning of the planning process. The questionnaire sought to identify the number of people in favor of protecting the river corridor and the most important components to consider for establishing a river corridor.

The presentation was made to 15 groups throughout the watershed at the beginning of the planning process. Public input and discussion was encouraged at each of the meetings. There were 292 attendees total. Ninety attendees completed the questionnaire for a response rate of 31 percent. The results showed that all 90 respondents were in favor of preserving a river corridor. ***The majority of respondents felt that a river corridor should be preserved for flood control and recognition of historic floodplain.*** Many identified wildlife habitat, life and property safety, water quality/quantity, natural resource system, and aesthetics as main reasons to preserve a corridor. Others felt that a corridor would benefit open space, water conveyance, recreation, future generations, agriculture, and the remaining undeveloped lands. Respondents were also asked to identify the best approaches to honor private property rights and keep the river corridor lands free from development. Most felt that the best approaches were to impose zoning and setback regulations, and to purchase development rights, and create conservation easements. Groups that received the presentation and the opportunity to discuss floodplain and river corridor protection measures included the following:

Alpine Watershed Group	Carson Valley Kiwanis Club
Douglas County Water Conveyance Committee	Carson Valley Conservation District
Washoe Tribe of Nevada and California Council	Dayton Valley Conservation District
Carson River Advisory Committee (2 meetings)	Carson City Open Space Advisory Committee
Carson Water Subconservancy District Board of Directors	Lahontan Valley Environmental Alliance
Washoe Tribe Environmental Protection Department	Carson Valley Sertoma Club

A **community workshop,** organized by the working group and facilitated by UNCE, was held in Minden, Nevada. The workshop was advertised in all of the local newspapers and was well attended by approximately 50 local ranchers and landowners along the Carson River. The goal of the workshop was to gain input from local ranch owners about ways to compensate them for the "ecosystem and flood mitigation services" that their floodplain land provides the community.

In addition, in November and December of 2007 individual meetings were held with the **floodplain administrators** of each county and their staffs to discuss suggested strategies and how these strategies might benefit their communities and to gain input on additional strategies that should be included in the Plan.

Newspaper Article Series

In 2005, working group members from UNCE wrote a series of five articles regarding the benefits of conserving river corridors and methods for compensating landowners for keeping river corridor lands in open space. The titles of the articles are:

- "Give River Room to Roam: Development along river channel subject to flooding"
- "River Corridor Gets Protection through Conservation Easement"
- "County Master Plan Rewards Landowners for Creating Open Space Near River"
- "Landowners Protect River Corridor Between Genoa and Cradlebaugh Bridge"
- "Funding Available for Conservation Easement Along River"

The articles appeared on the editorial page in the Nevada Appeal and the Record Courier newspapers between July 5th and August 30th, 2006. The timing of the articles coincided with public meetings and hearings on the Douglas County Master Plan update.

CWSD provided several articles for local publication during the course of the planning process. These articles appeared in the Reno-Gazette Journal and the Leader-Courier.

Conference Presentations

During the planning process CWSD provided numerous presentations about the floodplain management process and potential strategies to statewide and national groups. The goal of the presentations was to help raise awareness of the challenges faced in the watershed and to request input on strategies that other communities have found to be beneficial. These groups include the Nevada Water Resources Association, the Watershed Management Council, and the Floodplain Management Association.

Community Workshops and Public Meetings - Draft Plan Stage

A preliminary draft of the Plan was published and disseminated throughout the watershed for public review. Seven workshops were held to discuss the Plan's intent and contents and to solicit input (Appendix E). Workshop locations were strategically identified to encourage public participation from the headwaters in Alpine County through the watershed's terminus in Churchill County. Local newspaper articles and e-mail correspondence to key community contacts were used to advertise workshop dates, places, and times.

Workshops consisted of:

- an introduction and description of the workshop purpose (to gather input);
- a twenty minute presentation on the plan concentrating mainly on the suggested actions;
- an open discussion and feedback on changes needed, strong opposition to suggested actions; potential to save floodplain lands, and recommendation for counties to adopt; and
- feedback forms for individuals to complete.

Input for changes to the preliminary draft plan was captured via feedback forms and main points recorded on flipcharts during public discussion.

Seventy-one workshop participants completed the feedback form, for a response rate of 64%. A little less than half of the respondents (47%) fully supported the Plan as written, while 18% didn't know whether they would or wouldn't commit to fully supporting the Plan in its draft form. Elected officials and agricultural producers were the two interest groups least willing to support the Plan fully in its draft form. Suggested changes were offered by 35% of the respondents. Only 13% of the respondents, primarily elected officials and agricultural producers, were strongly opposed to one or more of the Plan's suggested actions, while 76% expressed no strong opposition to any of the suggested actions. Very few respondents (8%) indicated a lack of confidence or readiness to oppose actions suggested in the Plan. A large majority (86%) felt the Plan will help communities save floodplain lands, while 3% indicated the Plan will not. Only 11% of the respondents claimed they didn't know if the Plan would help save floodplain lands. Eighty-three percent of the respondents recommended their county adopt the Plan, 3% claimed they would not, and 11% didn't know if they would recommend the Plan be adopted.

Written comments and suggestions gathered from the feedback form and public discussion are in Appendix E. The most favorable aspects of the Plan were the outreach and education component and the collaborative/regional approach. Written comments of opposition or suggested changes that were common or most prevalent included No Adverse Impact, 1:1 mitigation, funding implementation, and compensation for loss of development potential.

Changes to the preliminary draft were made based on the input received from these workshops. Agenda, meeting notes and other information concerning the community workshops, working group meetings and other community outreach efforts are available from the CWSD.

County Adoption Process

The CWSD Board of Directors (Board) provided feedback and input throughout the entire plan development process. This step was critical as the Board is comprised of elected officials from each of the five counties along the Carson River. At each step of development the Board was provided presentations and discussion opportunities about the Plan and voted to approve draft documents. This Board also made approvals for the Plan to be presented to each planning commission of each county and ultimately to the County Boards of Supervisors or Commissioners.

Presentations and discussion about the draft were conducted at each of the five planning commissions and to the Carson River Advisory Committee and Carson City Open Space Program. Recommendation to

take the Plan to the County Commissioner/Supervisor level was received from each of these entities. Presentations were also made to other organizations including the Washoe Tribe, Lahontan Water Quality Control Board, the Town of Gardnerville, and the Northern Nevada Development Authority.

In August and September of 2008, the Final Draft will be presented to the counties for formal adoption which will be in the form of a resolution. The final draft will then be submitted to the Nevada Division of Water Resources and FEMA by September 30, 2008. At this point implementation of the suggested actions will begin.

7.0 Emergency Response

Each county has an emergency response plan on file, but according to the Nevada Attorney General's ruling which cites NRS 239c, these plans are no longer deemed public documents due to homeland security concerns. First responders in appropriate agencies will receive a copy of a given county's or city's emergency response plan.

The following individuals are responsible for emergency response in the event of a flood. Information is also available on the CWSD website at www.cwsd.org and at www.floodsmart.gov**.**

Table 7.0-1: Emergency Response Contacts

Alpine County, California	
Emergency Response Officer: Robert Levy	(530)694-2231
Sandbag Materials Location:	Alpine County Road Department 50 Diamond Valley Road, Markleeville Contact Number: 530-694-2140
Carson City, Nevada	
Emergency Manager: Stacey Giomi	Contact Number: (775)887-2210x1014
Sandbag Materials Location: City Corporate Yard	3303 Butti Way Contact Number: 775.887.2355
Churchill County, Nevada	
Emergency Manager: Mert Mickelson	1175 Wood Dr., Fallon, NV 89406 Contact Numbers: (775)423-3375(H); (775)427-4224 (cel); (775)423-4188(W)
Floodplain Manager: Eleanor Lockwood (Planning Director) Cliff Van Woert (Building Official)	155 N. Taylor, Fallon, NV 89406 Contact Number: (775)423-7627 Contact Number: (775.428.0264
Sandbag Materials Location: County Road Department Yard	330 N. Broadway Contact Number: (775)423-4133
Douglas County, Nevada	
Emergency Communications Manager: Dick Mirgon	P.O. Box 218, Minden, NV 89423 Contact Number: (775.782.6290
Sandbag Materials Locations:	1110 Airport Road, Minden NV 89423 All Fire Departments in County
Lyon County Nevada	
Emergency Manager: Jeffrey Page	27 S. Main Street, Yerington, NV 89447 Contact Number: 775.463.6551 24-Hour Dispatch: 775.463.6620
Floodplain Manager: Rob Loveberg	775.463.6591 or 775.246.6140
Sandbag Materials Location:	**Pending**

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Appendices

A Carson River Watershed Flood History Table

B Rapid Evaluation of the River System

C HDR White Paper – Review of Existing County Ordinances

D County Flood Zone Maps

E Public Workshops Feedback Summaries

Appendix A

Carson River Watershed

Flood History Table

Flood Events on the Carson River

Source: *USGS Flood Chronology of the Carson River Basin, California and Nevada*; http://nevada.usgs.gov/crfld/data_siteid_byflood.cfm?site_id=12&flood_id=5

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
12/1852	N/A		Rain-on-snow	Even though flooding was extensive, little damage occurred because the settlements were located away from the low areas of the valley.	On December 24, a heavy wet snowstorm lasting 2 days resulted in 3' of snow on Carson Valley floor. On 3rd day of storm, snow turned to rain, which continued 4 days.
12/1861 to 1/1862	N/A		Snow/Frozen Ground/Rain	Carson Valley described as a lake, but little damage was reported since at that time most of settlements were located out of the Valley along the Eastern Sierra slope of the Sierra Nevada. In Carson City, a sawmill located in Ash Canyon was swept away. In both Empire and Dayton, drownings were reported; buildings, bridges, and a stamp mill were swept away. By January 2, 1862, as the warm rains continued, the town and area surrounding Dayton had flooded.	Heavy wet snow deposited 2 feet of snow. Freezing temperatures froze snow and soil. On December 25 to 27, warm rains melted all the snow. Flooding continued through January.
12/1867 to 1/1868	N/A		Rain-on-snow	All bridges in Carson Valley crossing the East Fork, West Fork, and main-stem of the Carson River were swept away.	Two extensive rainstorms - December 20 to December 25, 1867, and December 20, 1867 to January 1, 1868, fell on existing snowpack.
1/1874	N/A		Snow/Rain-on-snow	No specific records describe flooding in Carson Valley; however, extensive flooding occurred in Eagle Valley and Carson City. Torrents of muddy water flowed down King's and Ash Canyon Creeks into Carson City. Flooding caused damages in Empire and on ore reduction mills in Carson River Canyon between Empire and Dayton.	A heavy wet snowstorm from January 20th to 22nd was followed by a heavy, warm rain January 28th and 29th.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
1/1875	N/A		Snow/Rain-on-snow	In Carson Valley, there was unspecified damage to roads, bridges, farm improvements, fields, and pastures. In Carson City, several streets became flowing rivers of water from overflow of King's Canyon Creek. Businesses in Empire also flooded.	Two feet of snow fell January 16, followed by rain January 18. Even though temperature lowered by January 19, the river rose six feet between noon January 19th and 20th through Carson and Eagle Valleys.
7/1875	N/A		Summer Convective Storm	Severe flooding in King's and Ash Canyon watersheds. Carson City was inundated with floodwaters from King's to Ash Canyon. One location on Carson Street on the west side of town became a shallow lake for several days.	Heavy rains combined with bare soils from logging in King's and Ash Canyons caused severe flooding.
1/1886	N/A		Rain	Streets and commercial structures in Genoa were severely damaged, along with farms in Carson Valley. Carson City streets were damaged as they became flowing rivers of water. The Empire business district of was flooded, and in and downstream of Dayton, the Carson and Colorado Railroad sustained several track washouts.	Rainfall from January 20th to 24th resulted in extensive flooding. The storm was characterized as the heaviest rainstorm observed since the 1861-1862 and the 1867-1868 floods. Carson Valley had the appearance of an inland sea, extending from about half a mile east of Genoa eastward to Cradlebaugh Road. Streams that had headwaters on the eastern side of Carson Valley in the Carson Range were flowing into floodwaters in Carson Valley.
3/1890	N/A		Rain-on-snow	In Carson Valley, some bridges along both forks were swept away by ice jams on the East and West Forks of the Carson River. Flooding in Empire and Dayton caused the stamp mills and some of the mines in Gold Hill and Virginia City to shut down for several days.	Carson Valley. East and north of Genoa was reported to look like a large lake, and between Genoa and Gardnerville, the Carson River was nearly a mile wide in places.
2/1904	**3,250**		Rain-on-snow	Some damage occurred to the road between Dayton and Silver City, the high water at Empire forced the closure of a new plaster mill, and the Virginia & Truckee Railroad tracks were damaged.	Flooding along the Carson River resulted from a warm storm that brought heavy rain to the eastern foothills of the Sierra Nevada on February 21 and continued until February 24. The local newspaper described the Carson River from Carson

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
					Valley to below Dayton as being bank-full, with the meadowlands next to it under water.
1/1906			mixed rain/snow and later rain	Flooding was confined mostly to Eagle Valley, lower Carson Valley, Carson Canyon, and Dayton area. The streets of Carson City were flooded, and in Empire, houses and commercial buildings were flooded.	
3/1907	**4,000**		Rain-on-snow	In Carson Valley, all bridges over the East Fork, West Fork and main-stem Carson River were destroyed or severely damaged. Agricultural land was severely impacted along with irrigation structures. **Residents living near the river or in low areas were forced to move to higher ground.** Schools in Carson Valley that were impacted by flood waters were forced to temporarily close. The Virginia and Truckee railroad in Carson Valley was severely damaged and closed for 6 weeks, which had a large affect on the economy of Carson Valley. Flooding near the former USGS gaging station on the Carson River near Empire destroyed several bridges and dams which were used by mills for mining and ore-processing.	May rank with 1950 and 1955 floods in Carson Valley
1/1909	**2930**		Rain-on-snow	One bridge was washed out on the Carson River. Clear Creek, Kings, Vicee, Coombs and Ash Canyons were overflowed, causing flooding in the Carson and Eagle Valleys.	
7/22/1913			Summer Convective Storm	The storm on July 22 resulted in flooding that caused damages to roads in Carson Valley and Eagle Valley, and damaged irrigation systems in Carson Valley.	Several daily convective storms started on July 20 and lasted for 11 days.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
7/28/1913			Summer Convective Storm	The storm on July 27 resulted in flooding that damaged roads in Carson Valley and Eagle Valley.	
1/1914	**5160** (near Empire) 6150 (peak near Churchill)	5-10	rain and later snow	Carson City flooded, irrigation ditches and diversions were destroyed or severely damaged at the Nevada State Prison Farm croplands, and one railroad bridge over the Carson River was damaged.	This storm affected the lower elevation watersheds on the Carson River rather than the Sierra Nevada catchment areas (U.S. Department of Agriculture, 1977).
3/1928	**2,570** (East Fork near Gardnerville) **2710** (near Churchill)	1.5 -2.3 2.3 – 5	Rain-on-snow	Little damage occurred except for halting train service between Minden and Carson City when a temporary dam on the Carson River in the north end of Carson Valley broke and was washed away. The dam protecting the railroad grade broke, and about 400 feet of train track was covered with water, mud, and debris.	
12/1937	**3,500** (gaging station 10310000 near Woodfords) **10,300** (gaging station 10309000 near Gardnerville); **5,500** (gaging station 10312000 near Fort Churchill)	25 -50 25 – 50 5 – 10	Rain-on-snow	The Douglas Power (Ruhenstroth) Dam on the East Fork Carson River upstream of Gardnerville was severely damaged. Along the West Fork Carson River, parts of State Route 88 flooded to a depth of 14 inches. Highway 395 between Carson City and Gardnerville was closed due to Cradlebaugh bridge which was under about 18 inches of water from the Carson River.	Rain fell on snow, crested at 10,300 in Carson Valley on 3/11/1937, but by the time it crested at Fort Churchill it was 5,500)
3/1938			Rain and Later Snow	The rapid rise of the East Fork Carson River dur the period of rain caused some damage to a temporary highway bridge. Flooding along Pine Creek caused damage to nearby ranches.	Flooding, primarily on Carson Valley's east side was caused by heavy rains from March 11 through March 13, with the rain turning to snow.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
1/1943	**5,420** (gaging station 10309000 near Gardnerville); **6,300** (gaging station 10312000 near Fort Churchill	5-10 10 – 25	Rain/Rain-on-snow	By January 21, several bridges along the East Fork Carson River were washed out, and the West Fork had damaged a road south and west of Minden. Some roads within the Carson Valley were damaged. On January 22, a mile of US Highway 395 both north and south of Cradlebaugh Bridge was under water.	
11/1950	**4,750** (gaging station 10310000 near Woodfords) **12,100 (**gaging station 10309000 near Gardnerville) **15,500** (gaging station 10311000 near Carson City) **7,850** (gaging station 10312000 near Fort Churchill	50 -100 25 – 50 25 -50 10 - 25	Rain-on-snow		A sequence of rapid moving storms and unseasonably high temperatures melted most of the early snowpack in the Sierra Nevada.
12/1955	**4,810** (gaging station 10310000 near Woodfords, Calif.,)	50 – 100 100 –	rain/rain-on-snow	More than 16,000 acres were flooded in Carson Valley, about the same amount as in 1997, and **many families were forced to move out when their homes were isolated and flooded**. Lutheran Bridge on the East Fork Carson River in Carson Valley collapsed on	During an unseasonably warm period, several days of intense rainstorms partially melted the snowpack. Ten to 13 inches of rain fell in the headwater basin.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
	17,600 (gaging station 10309000 near Gardnerville); **30,000** (gaging station 10311000 near Carson City) **9,680** (gaging station 10312000 near Fort Churchill)	200 50 -100 25 -50		December 23.	
5/1956	n/a	n/a	Possible rapid snowmelt	Spring runoff in Carson Valley flooded ranch lands.	
8/1958	n/a	n/a	Summer convective storm		On August 16, an intense thunder storm moved over Eagle Valley and the surrounding mountains, causing flash flooding off of “C Hill" which was barren as a result of a fire on June 30, 1958. Floodwaters included a slurry of water, mud and burned material.
7/1960	n/a	n/a	Summer convective storm		On July 29, a summer convective storm along the eastern front of the Sierra Nevada caused flooding, and triggered an extensive mudflow out of the North Fork of King's Canyon Creek.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
2/1963	**15,100** (gaging station 10308200 at East Fork near Markleeville **4,890** (gaging station 10310000 at Woodfords); **13,360** (gaging station 103090000 near Gardnerville, Nev.,); **21,900** (gaging station 10311000 near Carson City); **15,300** (gaging station 10312000 near Fort Churchill)	25 -50 50 – 100 25 – 50 25 – 50 50 – 100	rain/rain-on-snow	Flooding was severe, irrigation systems were destroyed, and the abutments of one bridge in Carson Valley were washed away.	An unseasonably warm and intense storm started on January 28, while western Nevada was having one of its worst winter droughts.
12/1964	**9,100** (gaging station 10308200 at East Fork near Markleeville **3,100** (gaging station 10310000 at Woodfords); **8,230** (gaging	10 – 25 10 – 25 10 – 25	Rain-on-snow	In Carson Valley, 13,500 acres of agricultural land flooded.	Flooding in the Carson River Basin was caused by an unseasonably warm storm with torrential rain that melted part of the snowpack. Warm winds and heavy rain, with more than 14 inches at Woodfords, melted most of the new snow at lower elevations and compacted snow at higher elevations.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
	station 103090000 near Gardnerville); **8,740** (gaging station 10311000 near Carson City); **7,220** (gaging station 10312000 near Fort Churchill	5 – 10 10 – 25			
5/1967	n/a	n/a	Possibly rapid snowmelt		Spring runoff produced flood conditions in Carson Valley.
1/1980	**8,000** (gaging station 10308200 at East Fork near Markleeville **1,060** (gaging station 10310000 at Woodfords); **7,910** (gaging station 103090000 near Gardnerville); **8,000** (gaging station 10309100 near Minden); **8,320** (gaging	10 – 25 2.3 – 5 10 – 25 5 – 10 5 – 10	rain/rain-on-snow		Warm rains melted the existing snowpack flooding Carson Valley. The Woodfords precipitation gage recorded a total of 8.5 inches for this period, and around 2 inches at the Minden gage. This period was also recorded as having unseasonably warm air temperatures.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
	station 10311000 near Carson City); **6,170** (gaging station 10312000 near Fort Churchill	5 – 10			
2/1982	**8,170** (gaging station 10308200 at East Fork near Markleeville **6,310** (gaging station 103090000 near Gardnerville); **6,400** (gaging station 10309100 near Minden); **7,480** (gaging station 10311000 near Carson City); **6,400** (gaging station 10311400 near Deer Run Bridge)l	10 – 25 10 – 25 2 - 5 5 – 10 5 – 10 5 – 10	rain/rain-on-snow		Warm rains following a substantial build-up of mountain snowpack earlier in the season produced flood conditions in Carson Valley.

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
6/1983	**3,160** (gaging station 10312150 below Lahontan Reservoir)	50 – 100 years	rapid warming		Late spring runoff produced flood conditions in the Fallon area. Flooding was accentuated by floodwater releases from Lahontan Reservoir.
2/1986	**8,210** (gaging station 10308200 at East Fork near Markleeville **7,380** (gaging station 103090000 near Gardnerville); **13,200** (gaging station 10311000 near Carson City); **16,600** (gaging station 10312000 near Fort Churchill	10 – 25 10 – 25 10 – 25 100 – 200	rain/rain-on-snow	Flooding in Carson Valley caused closure of one bridge on Highway 395. Deterioration of a tributary dam near Dayton during the storm caused temporary evacuation for about 200 residents	Flooding along the Carson River resulted from a warm rainstorm.
7/1994	**1,400** at Johnson Wash	n/a	Summer convective storm		An intense summer convective storm hit the east side of Carson Valley on July 22, and resulted in flash flooding down several alluvial fan drainages in the Johnson Lane area and Buckeye Wash.
1/1997	**18,900** (gaging station 10308200 at East Fork near Markleeville	50 -100 200 -	rain-on-snow	Some homes and part of the Genoa Country Club sustained damage from the flood as some areas were submerged in 2 feet of water. Large areas of Carson City were flooded, particularly those on or near the toes	In December 1996, several moderate to heavy snowstorms built up a large snowpack (more than 180 percent of normal) in the higher altitudes of the Sierras with two to three feet on the valley

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
	8,000 (West Fork gaging station 10310000 at Woodfords **20,300** (East Fork gaging station 103090000 near Gardnerville); **10,900** (East Fork gaging station 10309100 near Minden); **30,500** (gaging station 10311000 near Carson City); **24,000** (gaging station 10311400 near Deer Run Bridge)l **22,800** (gaging station 10312000 near Fort Churchill	500 100 - 200 5 -10 100 50 -100 200 - 500		of the alluvial fans around the uplands of Eagle Valley, and the lowlands along major drainage routes. Specifically, serious flooding occurred along Kings Canyon Creek, Vicee Canyon, and Ash Canyon. As the floodwater emerged from the Brunswick Canyon area two miles upstream of Dayton, the floodwaters spread over a quarter to half mile wide alluvial floodplain causing damage to some farms, ranches and homes upstream of Dayton. A mobile home park immediately downstream from Dayton was flooded as was the Dayton State Park. In addition about 30 homes in the River Valley subdivision were flooded. Downstream from this reach there is little development so damage was relatively minor.	floors. A series of three subtropical storms originating in the central Pacific Ocean brought heavy rainstorms to the region

Date	Est cfs	Estimated Recurrence Interval	Type	Damage Description	Notes
1/2006	**10,300** (gaging station 10308200 at East Fork near Markleeville **2,720** (gaging station 10310000 at Woodfords); **9,730** (gaging station 103090000 near Gardnerville); **11,900** (gaging station 10311000 near Carson City); **9,800** (gaging station 10312000 near Fort Churchill	10 – 25 at all sites	rain at lower elevation and rain-on-snow at higher elevations		Widespread heavy rain began the afternoon of December 30, 2005 and continued until mid-morning of December 31, 2005.

Appendix B

Rapid Evaluation of Carson River System

Draft Rapid Evaluation of Carson River System

In order to assess where the critical floodplain and flood hazard areas are within the basin that are not necessarily shown on FEMA flood insurance maps, the working group conducted a rapid evaluation of the river system using photographs, maps and on-the-ground knowledge. The evaluation was conducted with the primary focus on known flood hazard areas and critical floodplain areas and did not necessarily consider the political or landowner factors.

For the purposes of this document the following definitions apply:

Critical Floodplain areas: Lands adjacent to the river that allow the river to access the floodplain, store floodwaters, dissipate flood velocities and provide critical habitat for wildlife. These lands are highly valued for the public safety and natural resource protection services that they provide.

Flood Hazard areas: Lands adjacent to the river that are at high risk for hazards associated with channel migration due to factors such as excessive bank erosion.

The following subsections are the result of this evaluation.

East and West Fork Drainages in Alpine County

The majority of the watershed in Alpine County is located in wilderness areas with populated areas centered around Markleeville and Woodfords. Over 95% of the land in Alpine County is publicly owned. The floodplain is very narrow throughout the upper river system with canyon walls and wilderness area preventing development in many areas. Flood zones in this area are undetermined by FEMA.

General Recommendations

- Maintain river system to allow floodwaters to access floodplains in valley and meadow areas.
- Support Markleeville Guard Station Restoration Project.
- Investigate restoration activities in Upper Hope Valley and Hot Springs Creek to enhance floodplain accessibility and potential plus reduce erosion.
- Investigate opportunities for road, culvert and bridge enhancement to accommodate floodwaters better and decrease erosion.

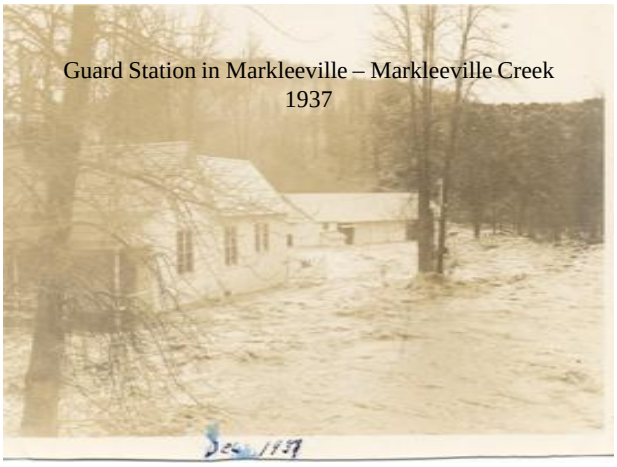
Wolf Creek – Landslide area

Flood Hazard Area - Wolf Creek Landslide:
The landslide is located downstream of Wolf Creek meadows area on land managed by the USFS. The landslide causes damage to the road that accesses the meadow and the campground when active. This road is the only access to Wolf Creek meadow and the campground area. Documented landslides have occurred since the 1960's with the most recent during the 1997 flood event. Debris from the landslide has come across the channel during flood events causing channel blockage and excessive sediment loading.

Critical Floodplain Area – Wolf Creek Meadow:
This meadow is wide and long and provides for good storage of floodwaters. Currently there are 4 homes located in the meadow. Allowing the meadow to act as a sponge for floodwaters would decrease the amount of flood water that enters into the East Fork.

Flood Hazard Area - Upper East Fork:
Highway 89 closely follows the East Fork Carson River from the confluence of Silver and Wolf Creeks to Hangman's Bridge. There is a high potential for damage to the road during flooding events.

Flood Hazard Area – Monitor Creek:
Monitor Creek is heavily laden with tailings from historic mining activities. During flood events these tailings could be washed into the East Fork increasing sedimentation and contamination of the river. The USFS currently has a project that is reducing the amount of acid mine drainage entering the stream system.


Guard Station in Markleeville – Markleeville Creek
1937

Flood Hazard Area - Markleeville Guard Station:
The guard station, which is located in the heart of Markleeville, experiences flooding on a regular basis. Currently there are designs to remove the station and return the area to a more natural state with floodplain. There are flood walls and a bridge at this location that constrains high flows causing flooding to occur in adjacent areas. In addition, drains on the guard station property frequently back up causing flooding during even small events.

Critical Floodplain Area – Hope Valley:
The meadow provides for storage of floodwaters. The area is used for recreational primarily and there is little or no development upstream.

Flood Hazard Area – Indian Creek Bridge at Dresserville Road:
During high water events clogging occurs at the bridge resulting in flooding to the tribal property.

Hot Springs Creek

Flood Hazard Area – Hot Springs Creek:
The portion of Hot Springs Creek between Markleeville and Grover Hot Springs has high potential for channel migration and excessive erosion.

East Fork Carson River: Stateline to Cradlebaugh Bridge

From the Nevada/California Stateline the river travels through a canyon until it reaches the Carson Valley. Carson Valley is situated between the eastern face of the Sierra Nevada and the Pine Nut Mountains. The wide valley floor is the floodplain for both the East and West Forks of the Carson River, and is a natural floodwater storage area. Old river channels, also called sloughs, interlace the valley's floor between the East and West Forks and the Brockliss Slough (which carries the West Fork's water). There is very limited water storage available in the upper watershed, and the drainages are composed of highly erosive materials. During flood events, sedimentation and debris deposition often result in rapid channel obstruction and channel migration.

General Recommendations for this reach:

1. Retain agricultural lands west of Highway 395 as floodplain and floodwater storage areas where possible but still provide infrastructure protection where necessary.
2. Investigate opportunities for using existing infrastructure to move floodwater.
3. Utilize the irrigation ditches for stormwater retention not for river release during flooding events.
4. Investigate opportunities to remove portions of berms to allow floodwaters to access floodplain.
5. Support conservation easement as a means to protect critical floodplain areas
6. Properly manage and control future development in flood hazard and critical floodplain areas.
7. Design future bridges and roads to protect the floodplain, accommodate and not restrict the changing course of the river and not create additional levees.
8. Address inadequate FEMA flood zone designations and inconsistent floodway delineation.
9. Evaluate existing bridges more thoroughly for safety and flow constraint concerns.

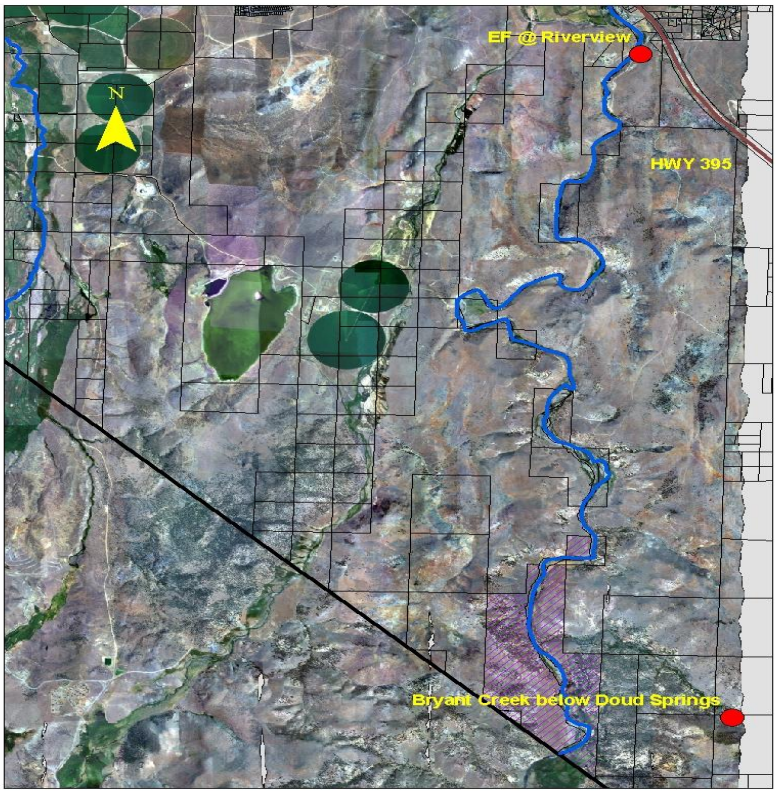
California/Nevada Stateline to the Old Power Dam

Overlook at Stateline (July 2003)

From the Nevada/California line to the site of the Old Power Dam, also known as the Broken Dam, the river is largely confined through a canyon consisting of a relatively steep, bedrock, boulder and cobble bed stream. The Old Power Dam was removed after the 1997 flood event. Long time residents attribute the increase of sediment loading to the river to the removal of the dam.

There are no recommendations for this reach.

Old Power Dam to Riverview Drive



Throughout much of this section, spoils from a 1965 project were turned into berms or unintended levees when the tops of the spoils were compacted. The effort was intended to create capacity, not to protect homes and other infrastructure. Since the creation of the berms the area has had to be defended from high water. In 1997 over 300 homes got wet and many of the homes have been raised using funding from FEMA. The berms run from the Allerman Canal to Riverview Drive Bridge. Locations where there may be potential to remove portions of the berm to allow floodwaters to access the floodplain are noted below.

Please see Figure 1 for location.

1. Tribal RV and Campground Area: The Tribe would like to protect this area from flooding.

2. Diversion and Canal: Investigate if some floodwater could be diverted onto the adjacent agricultural lands during flood events.

3. Flood Area from Indian Creek: Tribal property in this area typically floods due to bank overflows from Indian Creek and the clogging up of the culvert.

4. Potential Berm Removal Area: There is the potential to remove sections of the berm and allow for flooding of adjacent agricultural lands.

5. Future Development with roads and bridge: There are 2,800 new homes projected southwest of this area. New roads and bridges will be required. The road and bridges should be designed to protect the floodplain area, accommodate and not restrict the changing course of the river and not create additional levees. There is a high bluff and the bridge may need to be a causeway.

Please see Figure 2 for locations.

6. Critical Floodplain Area: Investigate the opportunity to remove portions of the berm to allow the river to access the floodplain. The banks would need to be re-vegetated. As with many of the historic ranches the ranch did not flood even before the creation of the berm.

7. Flood Hazard Area - Dresserville Community Levee: During the 1997 flood event the river went out of bank by the levee and returned to the river further downstream.

8. Critical Floodplain Area: Investigate if there is an opportunity to remove portions of the berm in this area to allow floodwaters to access agricultural lands.

Please refer to Figure 3 for locations of the following areas.

9. Critical floodplain area - Tribal Headquarters Ranch: The berm through this reach is preventing the river from accessing its floodplain and provides a false sense of security to local residents. Water breached the berm in 1997. During the 2005/06 event the berm backed water up onto Tribal land. The berm on this property may need to be investigated further to see if there is a potential to remove portions to allow floodwaters to access the floodplain, while still protecting the Tribal headquarters infrastructure.

10. Flood Hazard Area: During flood events the river wants to go to the west and the residential area has been impacted by flood waters in 1997 and 2005.

Riverview Drive to Centerville Lane

The river is incised (up to 15 feet) on both sides from the Riverview Drive Bridge to the Cottonwood Diversion, significantly limiting the river's ability to meander. From the Cottonwood Diversion to the Lutheran Bridge the river is able to meander.

Please refer to Figure 4 for locations

11. Flood Hazard Area: The river overflowed below Riverview Bridge during the 1997 flood event to the east towards Highway 395. There is a large culvert that runs under the highway by the medical center which needs to be protected and could possibly be used to help route floodwaters.

12. Gravel bars: The gravel bars with willow growth in this section may have a significant influence of river behavior. Clearing and snagging funds may be able to be used to remove the vegetation from stream bottom and allow the sediment load to continue downstream.

13. Flood Hazard Area: The River overflowed its banks during the 1997 flood event and migrated to the west through the ranch property.

14. Critical Floodplain Area: This ranch property should be protected in order to conserve the floodplain and its benefits. It is in an area that historically floods. The buildings on the ranch were constructed after the 1997 flood so it is unknown what the extent of the inundation would be during a large flood event (100 year). The buildings did not flood during the 2005/06 event. This property is a good candidate for a conservation easement.

15: Critical Floodplain Area – Hussman Ranch: The ranch has been in the Hussman family since the 1800's and the family's management approach to the river is "hands off". They report that channel migration occurs on the regular basis throughout this area. There is the potential to utilize the property for storage of floodwaters. This property is under a conservation easement.

Please refer to Figure 5 for locations

16 & 17. Critical Floodplain Area – Hussman Ranch: This ranch, which has a large portion on the east side of the river (#16) and a smaller portion on the west side (#17), is now under a conservation easement. There is a cottonwood gallery adjacent to the river and the Hussman's have seen the river migrate all throughout this area. Some of the area appears to serve as a sediment sink.

18. Lutheran Bridge: The river is dramatically incised by the bridge. The bridge could be causing a backwater affect.

Centerville Lane (Lutheran Bridge) to Highway 88

This entire reach of the East Fork is prone to flooding and is an aggrading reach. Aggrading reaches are typically unstable; tend to shift their course frequently because significant deposits of sediment in the channel divert the flow, leading to bank erosion and lateral shifting of the channel. There are berms on both sides of the river except by the ranch on the south side of the river between Hwy 88 and Waterloo Lane, where the berm is less apparent. Head cuts have resulted in 20 – 25 feet of incised banks from the Cottonwood Diversion up to the mining site (#25). Conservation easements and other protection methods should be supported and encouraged. This area is critical for the storage of floodwaters.

19. Flood Hazard Area: The river changed its path during the 1997 flood event and headed to the west.

Please refer to Figure 6 for locations

20. Flood Hazard Area: This area is the continuation of the changed river path area identified on Figure 5, #19.

21. Potential area for berm removal: Investigate opportunities to remove portions of the berm through this area to allow floodwaters to access floodplain. This could relieve pressure and divert waters away from residential development.

22. Infrastructure Protection: Residential area needs to be protected from flooding. Removal of portions of berm upstream of area may help protect homes by allowing floodwaters to access floodplain on opposite side of river.

23. Critical floodplain area & flood hazard area: This property is regularly inundated during flooding events. There is a berm on the left side of the river but not on the right so considerable sediment deposition occurs here. Landowner may be interested in a conservation easement or other protective measures.

24. Critical Floodplain Area: If the family chooses to build close to river channel there may be infrastructure protection issues associated with this property.

25. Alluvial Gravel Mining Site: This area was mined in the 1970's. There was a cement plant where the High School is today and they used material from this area. The sand bars through this area keep changing and the landowner believes that the reach functioned better when the material from this area was mined.

26. Critical floodplain area: Landowner may be interested in conservation measures that improve river bank stability.

27. Critical floodplain area: This ranch has one acre zoning. This property has been nominated for a conservation easement. Property would provide excellent storage for floodwaters.

28. Highway 88 Bridge. The bridge is heavily scoured underneath. This bridge tends to act as an obstruction during high water events because it wasn't designed to accommodate the flood flows - both width & height may be insufficient. The next large flood event could result in significant damage to this bridge. Upstream of the bridge the river is not as incised as it is at the Lutheran Bridge.

Photo: Highway 88 Bridge during 2005 spring run-off

Highway 88 to Muller Lane

There are old levees along the river on the right side from projects implemented in the 1960's. This reach has been the site of numerous conservation projects including river workdays, grazing management, fencing, and a $1 million restoration project. The river tends to move to the west in this area during high water events.

Please refer to Figure 7 for locations

29. Flood Hazard Area - New Housing Development: This property is targeted for 32 townhomes. The rancher that historically owned this property deeded it to the County because it flooded so frequently. Later the County brought in 4 feet of fill to build the high school. Development of the area has continued since. Wetlands are located on the east and west sides of Highway 88 near this area.

30. Flood Hazard Area - Westwood Subdivision: Residents are very interested in protecting structures through this reach. When the river breaches its bank it tends to move left towards the Cottonwood and Home Sloughs. Historic maps show that the East Fork used to flow through this area. Some homes are very close to the river and have flooded during recent events.

31. Critical floodplain area and flood hazard area: The property on the west side of river frequently floods and provides an excellent area for storage of floodwaters. Currently the area is not designated by FEMA as an "A" (100 year) floodplain but should be. The current management approach by Park Cattle is to let the area flood. A conservation easement or other floodplain protection measure would be highly desirable for this area.

32. Muller Lane Bridge: This Bridge has the smallest capacity of any of the East Fork bridges, acts as dam during high flows and tends to capture considerable sediment. There is effluent and power lines running under it that could be damaged during a flood event. The 1996 Interfluve Assessment suggests that the river is unpredictable in this area, possibly resulting in further pier and abutment scour and threats to the overall stability of the bridge. The west side of this area is a good storage area for floodwaters despite the poor conveyance capacity of the bridge.

Muller Lane to Genoa Lane

This entire area is prone to flooding and should be considered critical floodplain area.

Please see Figure 8 for site locations.

33. Question 1 Project Starting Point: This large scale restoration project that runs from the Muller Lane Bridge to the Genoa Lane Bridge will address multiple issues including floodplain protection. Restoration approaches will include installation of stream deflectors, instream weirs, and low-flow channel meanders. The project is estimated for completion in 2008 and is managed by the Carson Valley Conservation District. Berms along the reach will also be evaluated as part of the project. Where feasible, portions may be removed to to allow for floodwaters to access floodplain.

Photo: Area where the river blew the bank out during 2005/06 flood event.

34 & 35. Critical Floodplain Areas: Below the Muller Lane bridge, floodwaters tend to flow east and west onto adjacent fields. Park Cattle is the landowner and is interested in allowing the fields to flood. However, effluent is used for irrigation and some infrastructure defense may be necessary in order to maintain permits.

Photo is looking upstream from Muller Lane Bridge during 2005 spring run-off.

36. Effluent Storage Basins: Two storage basins are located in close proximity to the river. The basins will require protection and/or best management practices to prevent the treated effluent from contaminating the river during a flood event.

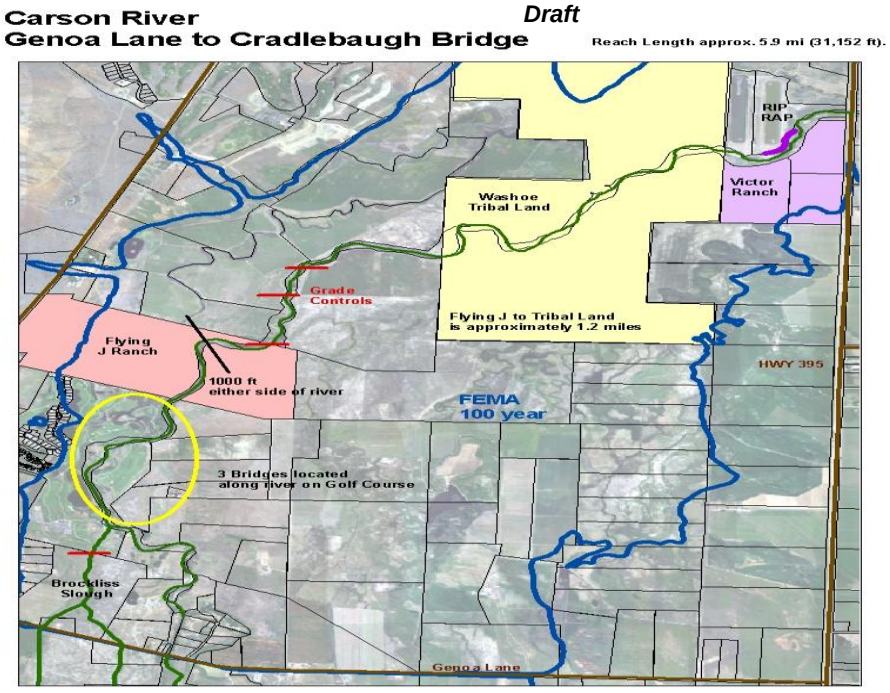
37. Critical Floodplain Area - River Fork Ranch: This area is where the East and West Forks of the Carson River merge to form the mainstem Carson River. It is a critical area for floodplain and wetlands management. The Nature Conservancy has removed the berm on the ranch that was at the confluence of the West and East Forks. This may be a good area for floodwater storage even during modest events. This area is under fee title with floodplain protection as one of the main goals.

38. Wetlands – Critical Floodplain Area: This area is part of the River Forks Ranch. It is the desire of The Nature Conservancy to increase the capacity of the wetland area. This creates a good opportunity for storage of floodwaters.

39. End of Question 1 Project: Please see # 33 for description of project.

40. Genoa Lane Bridges: Bridges cross the mainstem Carson River just after the confluence of the East and West Forks, and the Brockliss Slough (upper and lower). According to the Interfluve report (1996), the bridges are undersized and given the large in-channel sediment supply from upstream, there could be problems with local aggradation and abutment scour during large flood events. All the Genoa Lane bridges are at risk in the event of significant channel shifts above the bridge locations.

Genoa Lane to Cradlebaugh Bridge



Reach length is approximately 31,152 feet of the mainstem Carson River. The reach contains a mix of private and tribal lands. Floodplain protection in this reach is a priority for the Washoe Tribe and The Nature Conservancy. The main recommendation for this section is to maintain it in its current undeveloped state and support proposed conservation easements. There are 3 grade controls in this reach.

Please see Figure 9 for site locations.

Canoe Trip 3/14/01
Willow Bend House

41. Flood Hazard Area – Willowbend Subdivision: FEMA repetitive loss area. Homes are built close to river in floodplain and are very prone to flooding. The potential for channel shifts and backwater problems may also affect this area. CVCD is currently working on a restoration/stabilization project in this area.

42. Flood Hazard Area - Genoa Golf Course: The golf course was built to allow for flooding and does not have houses adjacent to the river but some homes flooded in 1997. The Interfluve report states banks were already incised up to 12 feet from Genoa to Cradlebaugh. The river further incised dramatically through this reach during the 1997 Flood resulting in vertical banks of approximately 20 feet. There are three bridges through the golf course and a golf path along the riverbanks so there is a need to protect infrastructure.

43. Critical Floodplain Area: All of the areas east of the river to Highway 395 should be considered critical floodplain and flood storage areas. It is obvious from the aerial photos that the river has shifted course through this area on numerous occasions. Conservation easements and other methods of protection should be encouraged and implemented.

Please see Figure 10 for site locations.

44. Critical Floodplain Area: There is a proposal for a conservation easement on this ranch property just downstream of Genoa Lakes Golf Course on the north side of the river. The owner wants to work the ranch and has given no indication that they will sell or subdivide.

45. Old River Channel: The old channel has willow growth and water. The channel could support wildlife and serve as a flood channel.

Upstream Cradlebaugh
2200 cfs at CC gage

46. Critical Floodplain Area - Stewart Ranch: The Washoe Tribe of Nevada and California owns this property. The Tribe has constructed fencing 100 to 300 feet from the river on 2.5 miles each side of river. The purpose of the fencing is to reduce grazing pressure and protect the floodplain.

West Fork Carson River and the Brockliss Slough

In addition to areas covered in the previous section the following observations were noted.

General Recommendations:

- Maintain critical floodplain areas for storage of floodwaters.
- Investigate opportunities to enhance road and bridge construction to allow for flooding and protection of floodplain areas
- Investigate the use of the West Fork as a flood storage channel
- Investigate opportunity to utilize existing infrastructure to move floodwaters.

WF "ditch" at Hwy 88 looking upstream

Critical Floodplain Area – All areas north of Mottsville Lane: This area is critical for flood water attenuation and storage. Development in these areas may significantly alter downstream flow patterns. Property previously unaffected may be flooded if urbanization increases in the floodplain.

Big Ditch: The ditch runs through the Mottsville Development. It has no defined source and is a collection of tail waters including waters from the Carson Range. It flows into the Brockliss Slough.

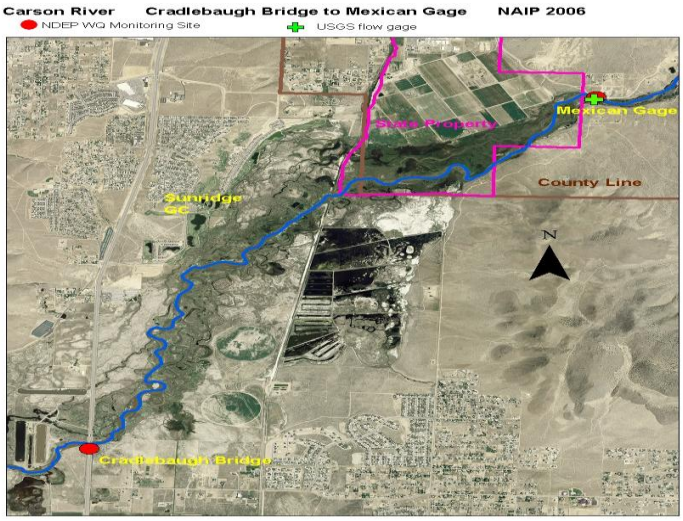
Flood Hazard Area – Mottsville Development: The development is in the floodplain of the West Fork and Brockliss Slough. The homes are elevated and are on septic systems engineered above ground. The cumulative impacts from this development during a flood event will need to be watched. Homes that may not have flooded previously may now have increased risk due to the changes in the floodplain in this area.

Critical Floodplain Area – Wally's Hot Springs: The area around Wally's Hot Springs has wetlands and is critical for floodwater retention and storage.

Flood Hazard Area & Critical Floodplain- Centerville to Mottsville: The water table rises significantly in this area during high water events. Mottsville Road acts as a dam, even though it is at ground level, and can cause flooding even when the buildings in the area have been elevated.

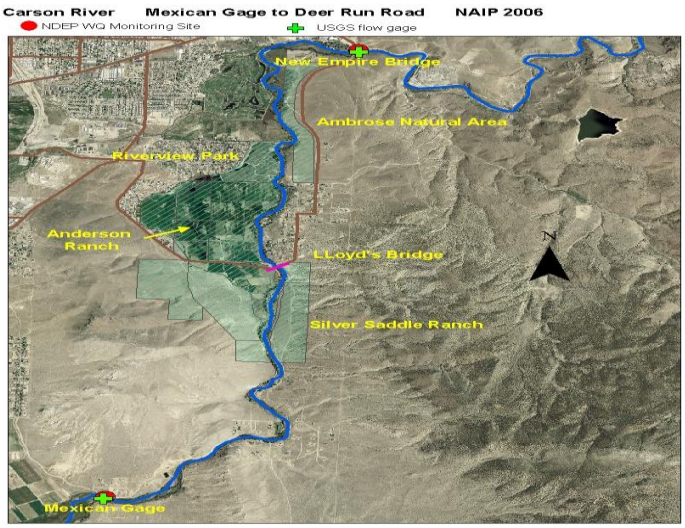
Main Carson River from Cradlebaugh Bridge to Deer Run Bridge

This section of the river system is in very good shape with regards to flooding and floodplain management. The Nature Conservancy successfully worked with the landowner to secure a large area of the floodplain with a conservation easement (Kirman Field). The Carson City Open Space Program has been very active in acquiring lands along the river corridor and securing conservation easements. The Silver Saddle Ranch (BLM) and the Ambrose Natural Area (Carson City) also provide floodplain protection. Most of the damage caused by flooding in the Carson City is the result of alluvial fan flooding. A study was recently conducted by RCI to look at this issue and present potential solutions.



General Recommendations for Carson City – Main Carson River

- Support Carson City's Open Space Program and other organizations, with their ongoing acquisition and protection of critical floodplain lands along the river corridor
- Stay abreast of issues with the State Land prison property
- Investigate opportunity to enhance grade control structures, including Mexican dam and Anderson diversion.
- Consider bridge designs that do not create a barrier in the floodplain or obstruct flood flows in the river channel.



Please see Figure 11 for site locations

47. Cradlebaugh Bridge: According to Interfluve (1996) the base level is lowering and pier footings are exposed. An inspection might determine if structural fortifications are feasible to improve bridge stability, allow greater flow capacity and reduce scour.

48. Critical Floodplain Area - Kirman Field Conservation Easement: The Nature Conservancy and landowner were successful in protecting this critical floodplain area.

49. Potential Site for Railroad ROW Bridge: There is the possibility that a railroad bridge may be needed in this area to accommodate the revived V&T Railroad. Investigate the opportunity to design and construct bridges that do not obstruct floodplain and allow greater flow capacity.

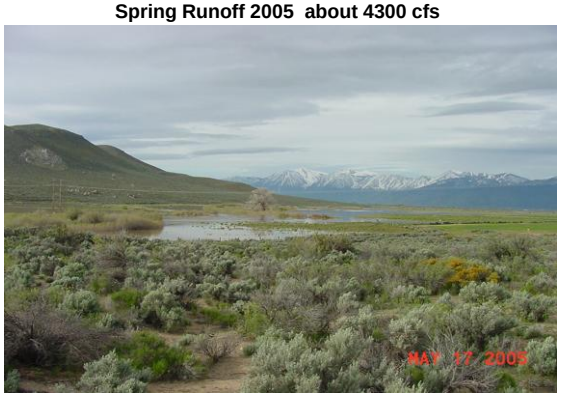
50. Critical Floodplain Area – Prison Farms: This property is owned by the State of Nevada for the purpose of providing a State prison and associated prison farms. The area provides for good storage of flood waters and should remain in open space.

Golden Eagle Lane

51. Flood Hazard Area - Golden Eagle Lane: There are several homes very close to the river and in the immediate floodplain in this area. According to the Carson City Floodplain Administrator the flooding base elevation for one of the homes is above the garage door. One of the homes in this area is on the FEMA Repetitive Loss List

Please see Figure 12 for site locations

Upstream of MG/McTarnahan Bridge
Spring Runoff 2005 about 4300 cfs



52. Critical Floodplain Area – MCTarnahan Bridge to Mexican Gage: This area provides excellent storage of floodwaters.

Sediment/Debris

53. Flood Hazard Area – Mexican Gage to Lloyd's Bridge: There are areas that are highly erosive as evidenced by gullywashers and sediment deposits.

54. Critical Floodplain Area: There is one parcel for sale and the CC Open Space Program is investigating acquiring the property.

55. Mexican Dam: The dam is very old and in disrepair. It should be investigated for repair or possible replacement.

56. Anderson Diversion Structure – This structure should be investigated for enhancement of flow capacity. Currently there is a beaver dam at the diversion and during the high water event of 2005/06 the river cut to the right and created a side channel.

57. Critical Floodplain Area: This property is currently targeted for acquisition by the Carson City Open Space Program. This is a critical area for flood water attenuation. Reuse water will be used for irrigation which may represent additional challenges with regard to management of the property once acquired.

58. Critical Floodplain Area – potential land purchase: There is a small piece of the Anderson Ranch on the right side of the river that may be included in the Anderson Ranch acquisition. The Carson City Open Space program is investigating this property which is located by the Ambrose Natural Area.

Ambrose Spring Runoff 2005 NDOW

59. Critical Floodplain Area – Ambrose Natural Area: This area has been provided protection through the Carson City Open Space Program and is managed to accommodate flood flows.

Empire Ranch GC looking downstream
RCI photo 1/11/07

60. Critical Floodplain Area - Empire Golf Course: The golf course is managed to allow for flooding and is crucial for storage and attenuation of floodwaters in the area.

Carson River: Deer Run Road to Lahontan Reservoir

Portions of this reach have been under tremendous development pressure for the last decade and this pressure is expected to continue. The prospect of future floods and associated impacts are of concern to landowners and natural resource managers. Controlling noxious weeds, such as tall whitetop, has also become a huge issue on floodplain lands from the Carson River Estates downstream to the reservoir.

This reach has high potential for channel migration and excess sediment deposition. During the 1997 event floodwaters spread from ¼ to ½ mile wide and between 2 and 4 feet deep in places through this reach. Extensive volumes of sand deposited on many fields and ranch lands were attributed to channel migration and bank erosion.

Recommendations for Deer Run Road to Lahontan Reservoir

- Manage development in special flood hazard areas and other flood hazard areas (those known hazard areas that are not documented on FEMA flood maps) to provide public safety and protect the natural functions and benefits of floodplain lands;
- Incorporate principles of low impact development in subdivision designs to limit impervious surface and retain stormwater runoff onsite;
- Support conservation easements, and other methods for protecting critical floodplain lands and channel migration hazard areas, that take into account long-term management of the lands;
- Monitor and treat for noxious weeds;
- Support river restoration projects that incorporate principles of bio-engineering and utilize non-structural designs to the extent possible with hard points where necessary;
- Provide public education regarding the importance of riparian vegetation, floodplain protection and noxious weeds such as TWT.
- Design future bridges and roads to protect floodplain, accommodate and not restrict the changing course of the river and not create additional levees.
- Address inadequate FEMA flood zone designations and inconsistent floodway delineation.

Carson River through Carson Canyon

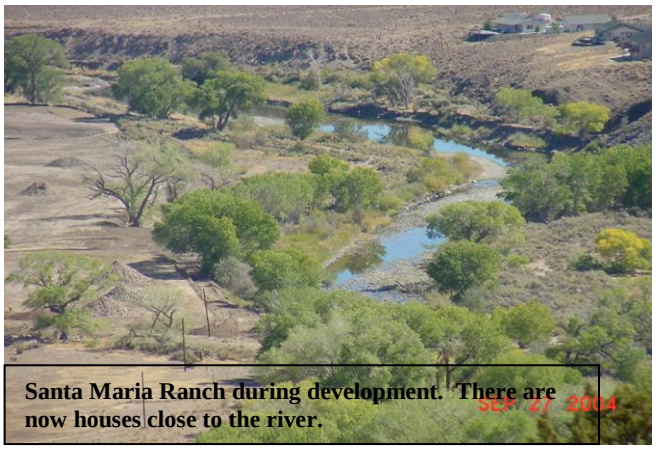
Deer Run Road to Santa Maria Ranch

The river travels from Deer Run Road through the Carson Canyon for about five air miles until it reaches the Santa Maria Ranch area upstream of Dayton. The canyon is a deep, narrow, twisting canyon with steep and rugged terrain. There is no development in the canyon. This reach is part of the proposed Carson River Aquatic Trail and of the revitalization project for the Truckee-Virginia Railway.

Santa Maria Ranch to Dayton Bridge

There has been numerous bank stabilization, restoration and flood repair projects constructed on this reach of the Carson River. These projects are well documented in the Stewardship Plan. The lands along this segment of the river flood on a regular basis. There is a fair amount of unknown risk and uncertainty associated with some of the development that has occurred along the river channel in recent years.

61. Flood Hazard Area:



Santa Maria Ranch during development. There are now houses close to the river.

Upon emerging from the Carson Canyon the Carson River used to be able to access its floodplain and spread the floodwaters out over a ¼ to ½ mile wide alluvial fan area. This area has been developed in recent years.

The Santa Maria Ranch subdivision was developed on the old Winters Ranch that used to flood on a regular basis. Portions of the land where the subdivision is now were underwater during the 1997 flood. A tremendous amount of fill was brought in for the development. There is an increased risk to the ranch and downstream properties during future flood events.

The mobile home park, neighborhoods and agricultural lands downstream of the Santa Maria Ranch flooded in 1997 including about 30 homes and the Dayton State Park.

FEMA designated zone AE floodplain on Santa Maria Ranch

62. Critical Floodplain and Flood Hazard Area:

These fields flood on a regular basis and provide critical storage of floodwaters during flooding events. Damage to downstream properties may increase significantly without the storage volume that these fields provide. Lands across the river from the fields have been developed and did flood during the 1997 event. During the 1997 event over 150 feet of bank was lost from this area due to channel migration and erosive action.

Dayton Bridge to the River Park Estates

Please see Figure 13 for site locations for the following

Waterford / Carson River Estates NAIP 2006 1:5000

63. Flood Hazard Area

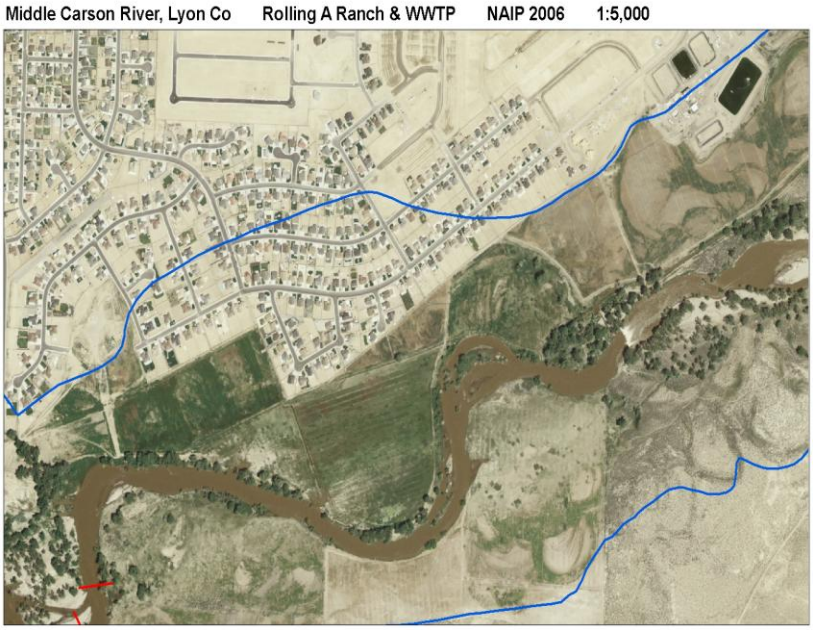
Encroachment on both sides of the river increases the potential flood risk. The blue line outlines the FEMA Zone A floodplain.

Middle Carson River south of Dayton

64. Critical Floodplain Area

The ranch lands and open space along this reach of the river are ideal for allowing the river to access its floodplain, storage of flood waters, dissipation of flood velocities, and critical habitat for wildlife. The river has changed its course numerous times in this area as evidenced by the old river channels and oxbows that can be seen in Figure 13.

65. Critical Floodplain and Flood Hazard Area:



River Park Subdivision and Park/Trail Project
Blue line denotes the FEMA 100-year floodplain zone

Lyon County was successful in acquiring the Rolling A Ranch. Portions of this ranch were sold and developed into the River Park Subdivision. Approximately 276 acres of the property adjacent to the river was retained and is part of a large Question 1 funded project that involves river restoration, developing a trail system, floodplain protection, weed abatement and public education opportunities. Lyon County and the Dayton Valley Conservation District are working together along with other stakeholders to implement this project.

Tall Whitetop (brown vegetation on far bank) and sediment deposits from flooding events

An extensive infestation of Tall white top (TWT) is found in this reach. Of the 276 acres of floodplain land mentioned above 50-75% of the lands are infested with TWT. Lyon County and the DVCD are actively pursuing treatment options.

The lands adjacent to the river are considered critical flood storage areas and serve as a buffer to the adjacent development. However, it is uncertain how safe the subdivision and associated infrastructure will be during a 100-year event like in 1997 when river flows exceed 20,000 cfs. In addition, the raised subdivision may act as a levee and push floodwaters to other properties that previously were not prone to flooding.

66. Critical Floodplain Areas (shown on Figure 14)
These lands provide areas for the river to access its floodplain and provide habitat for wildlife.

River Park Estates to Lahontan Reservoir

The river leaves the Dayton area and flows northeastward across the broad alluvial valley of the Carson Plains. During the 1997 event this area was inundated with 2 to 4 feet of water and approximately ½ mile wide. Extensive blankets of sand were deposited on many of the fields and ranch in the area.

From the Carson Plains the river flows through a relatively confined bedrock channel through the northern Pine Nut Mountains for about 12 air miles before reaching the area by Fort Churchill Historic State Park. There is little to no development within this reach. During the 1997 flood event the automobile test track property was totally inundated. Portions of the Fort Churchill road (unpaved) and part of the old Carson River Route of the California Emigrant Trail were washed away and flooded in many places.

By Fort Churchill there is an approximately 25' vertical bank that is approximately 1,100' long that is within 20 feet of the Buckland Ditch and within 35 yards of the Fort Churchill Road. A flood event could easily erode this bank to the point that it impacts the ditch and road. Nevada State Parks, Dayton Valley Conservation District and others are currently investigating options for addressing this issue. A considerable amount of sediment was deposited throughout this area during the 1997 and 2005/06 flood events.

Tall white top is a huge problem within the floodplain next to the Buckland Station off of U.S. 95 Alternate. Flood waters can easily carry seed to downstream properties.

Week's Bridge crosses the Carson River at U.S. 95 Alternate and was fully surrounded by the flood waters in 1997. Flood debris was trapped by the bridge foundation.

The river flows from the Week's Bridge area into the Lahontan Reservoir system.

Lahontan Reservoir to Carson Sink

Lahontan Reservoir was not built as a flood control facility; it was designed as part of an irrigation system. It can provide some storage of floodwaters if there is storage capacity available in the reservoir.

The river system below Lahontan Dam is very different than the reaches above Lahontan Reservoir due to the Newlands Irrigation Project and associated irrigation canals. During the 1997 flood the area did not experience flooding of homes or other structures but did have bank erosion problems. Much of the flooding problems in this area is the result of alluvial fan flooding and storm water drainage issues.

Bafford Bridge has been identified by Churchill County as a flood hazard due to low capacity and sediment clogging. The County is in the process of addressing this issue.

Homes along the Carson River in Fallon

The river corridor is highly urbanized. Approximately 50% of the property along the river has homes in close proximity to the channel. The Lahontan Valley Environmental Alliance is working on behalf of the Churchill County and other stakeholders to investigate opportunities for protecting the river corridor and other areas through conservation easements and other tools. The Frey and Bell Ranch conservation easements are great examples of river corridor protection.

Excessive bank erosion results in the accumulation of sand and other sediments that can clog at bridges and lessen the amount of channel available for floodwaters.

Excessive vegetation in many portions of the lower Carson River can cause increase of flooding hazards.

Recommendations for Lahontan Reservoir to Carson Sink

- Support conservation easements and other methods of protecting river corridor lands;
- Investigate opportunities to utilize existing infrastructure for moving flood waters;
- Continued public outreach about flooding hazards and river corridor protection.
- Investigate ways to minimize the flood hazard impacts of excess sediment and vegetation

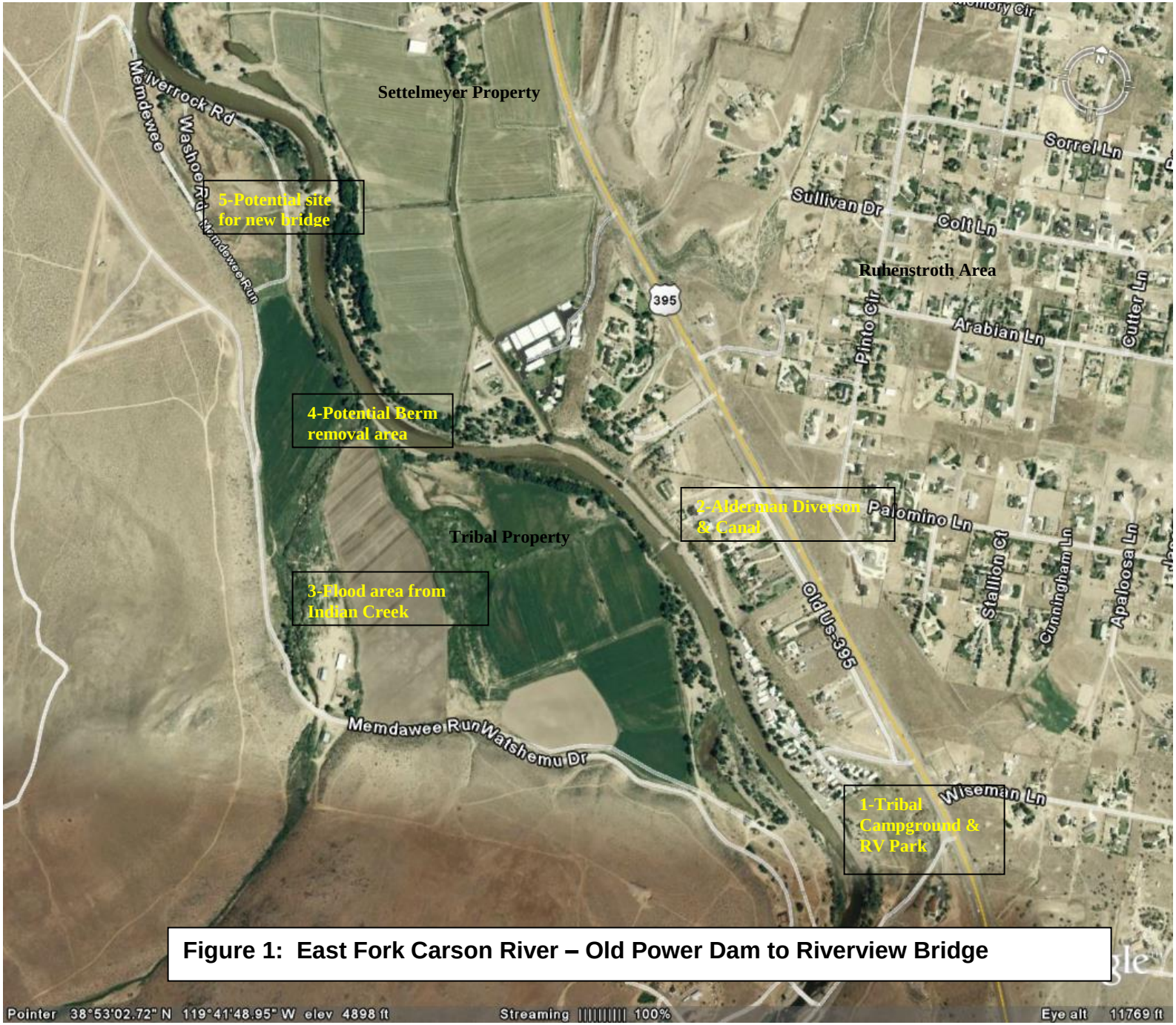


Figure 1: East Fork Carson River – Old Power Dam to Riverview Bridge

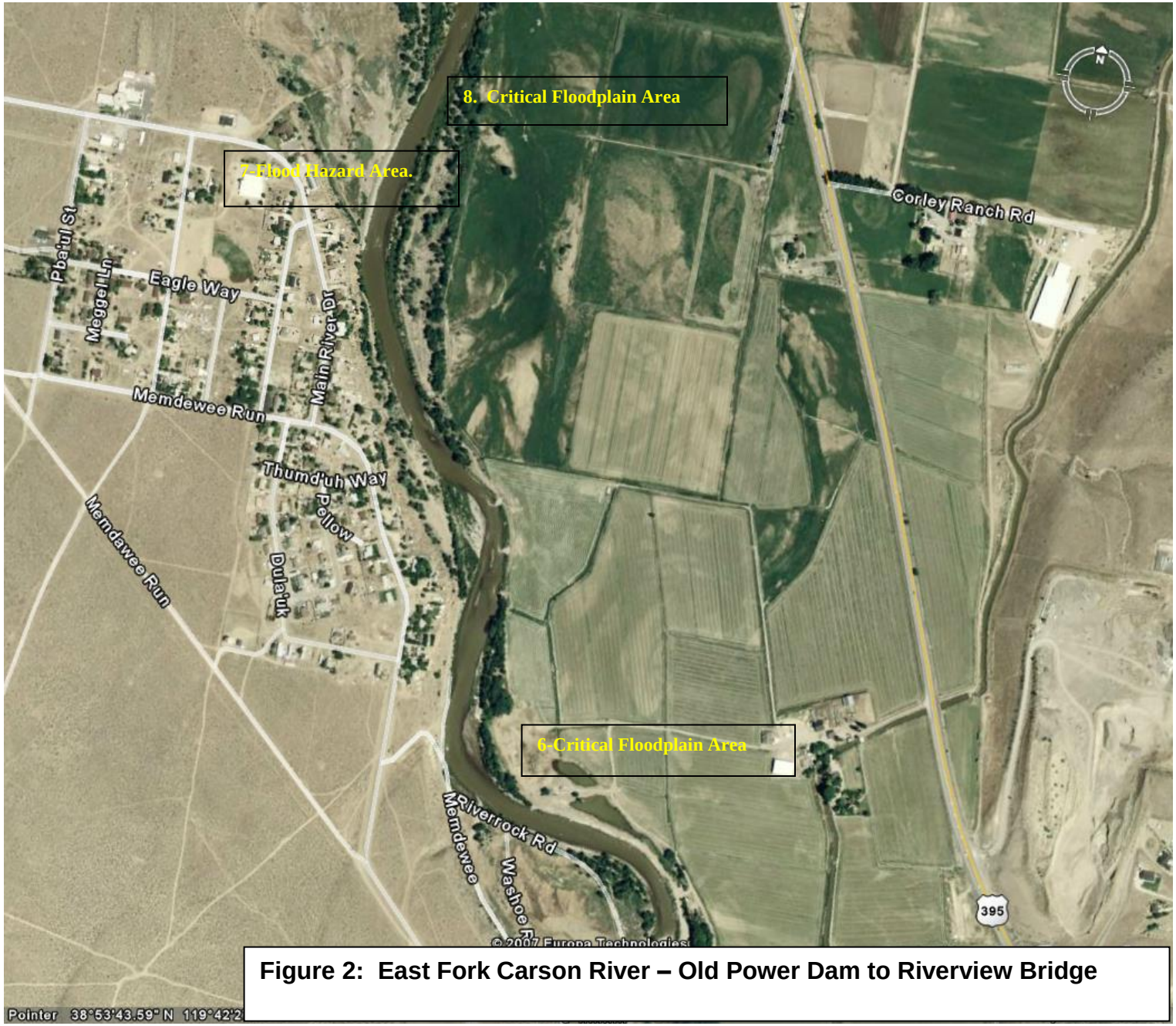


Figure 2: East Fork Carson River – Old Power Dam to Riverview Bridge

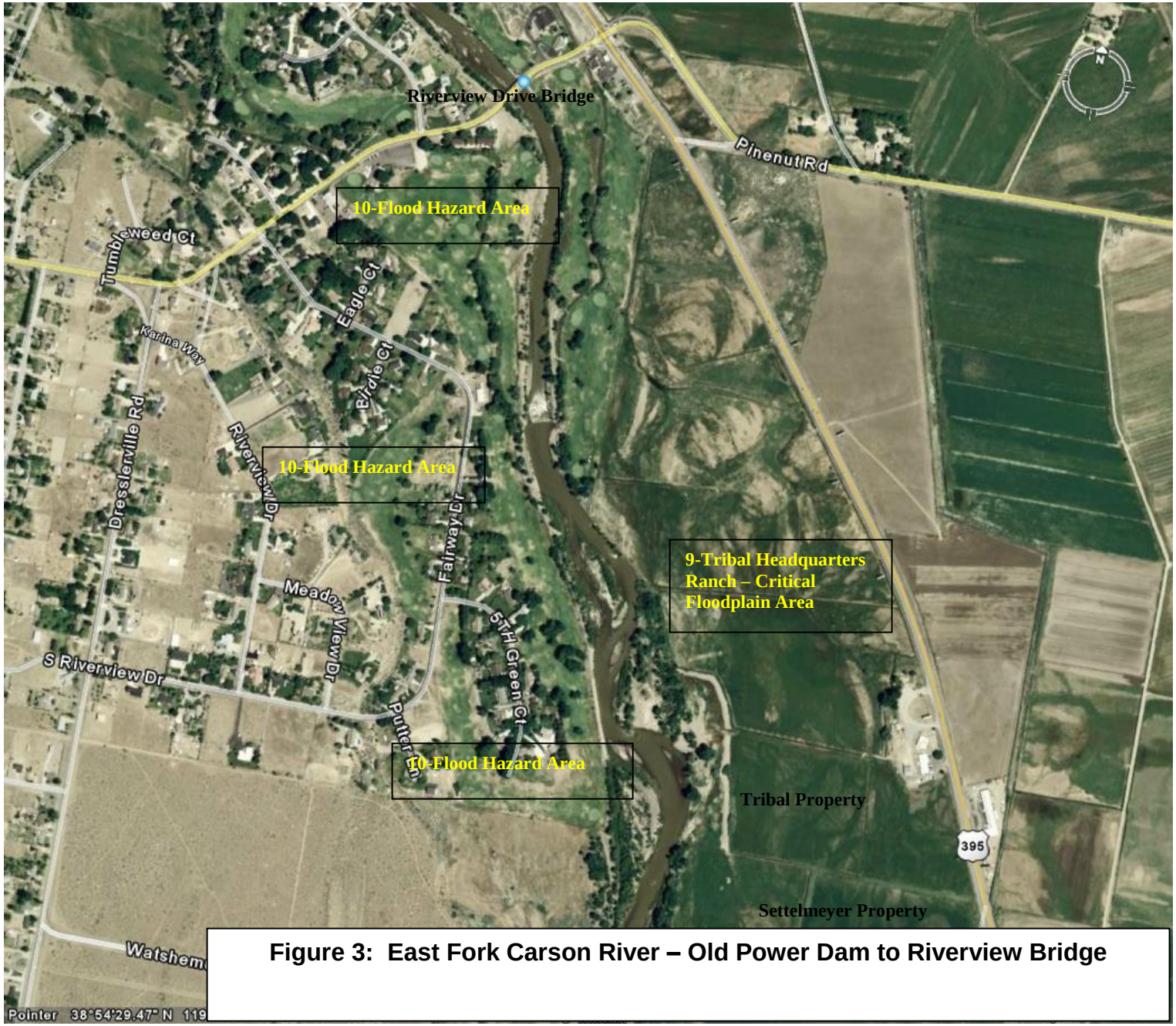


Figure 3: East Fork Carson River – Old Power Dam to Riverview Bridge

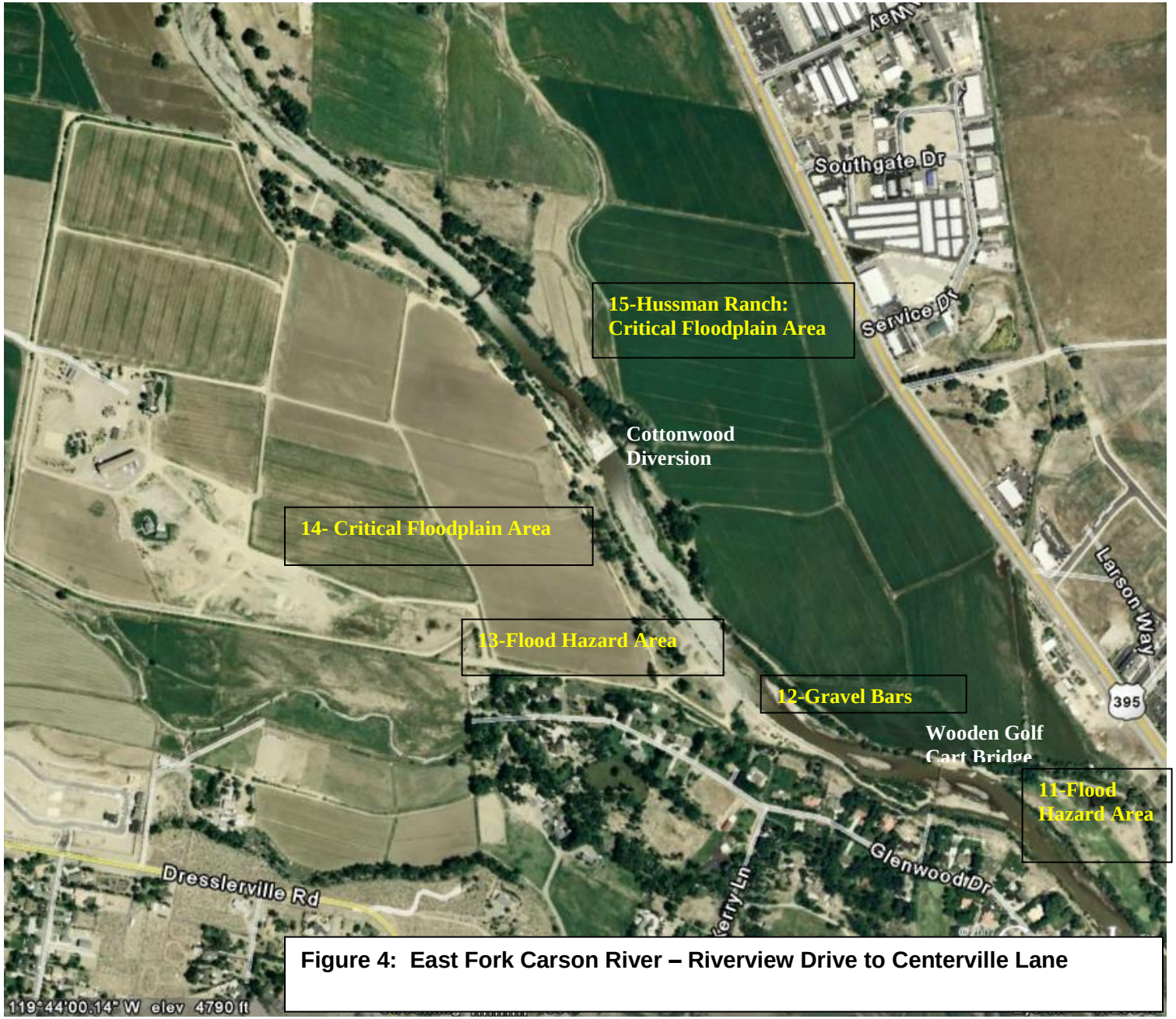


Figure 4: East Fork Carson River – Riverview Drive to Centerville Lane

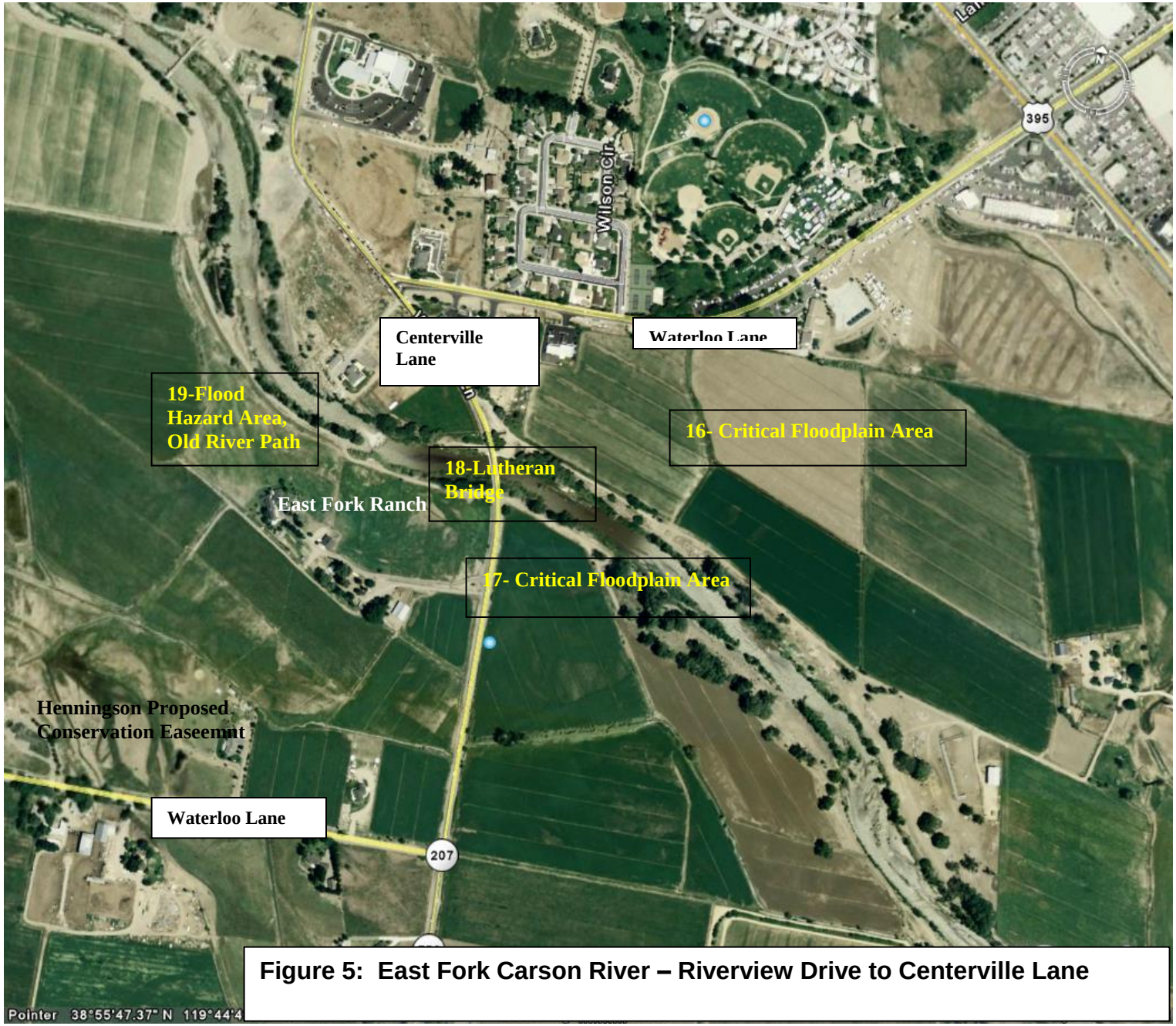


Figure 5: East Fork Carson River – Riverview Drive to Centerville Lane

Figure 6: East Fork Carson River – Centerville Lane to Highway 88

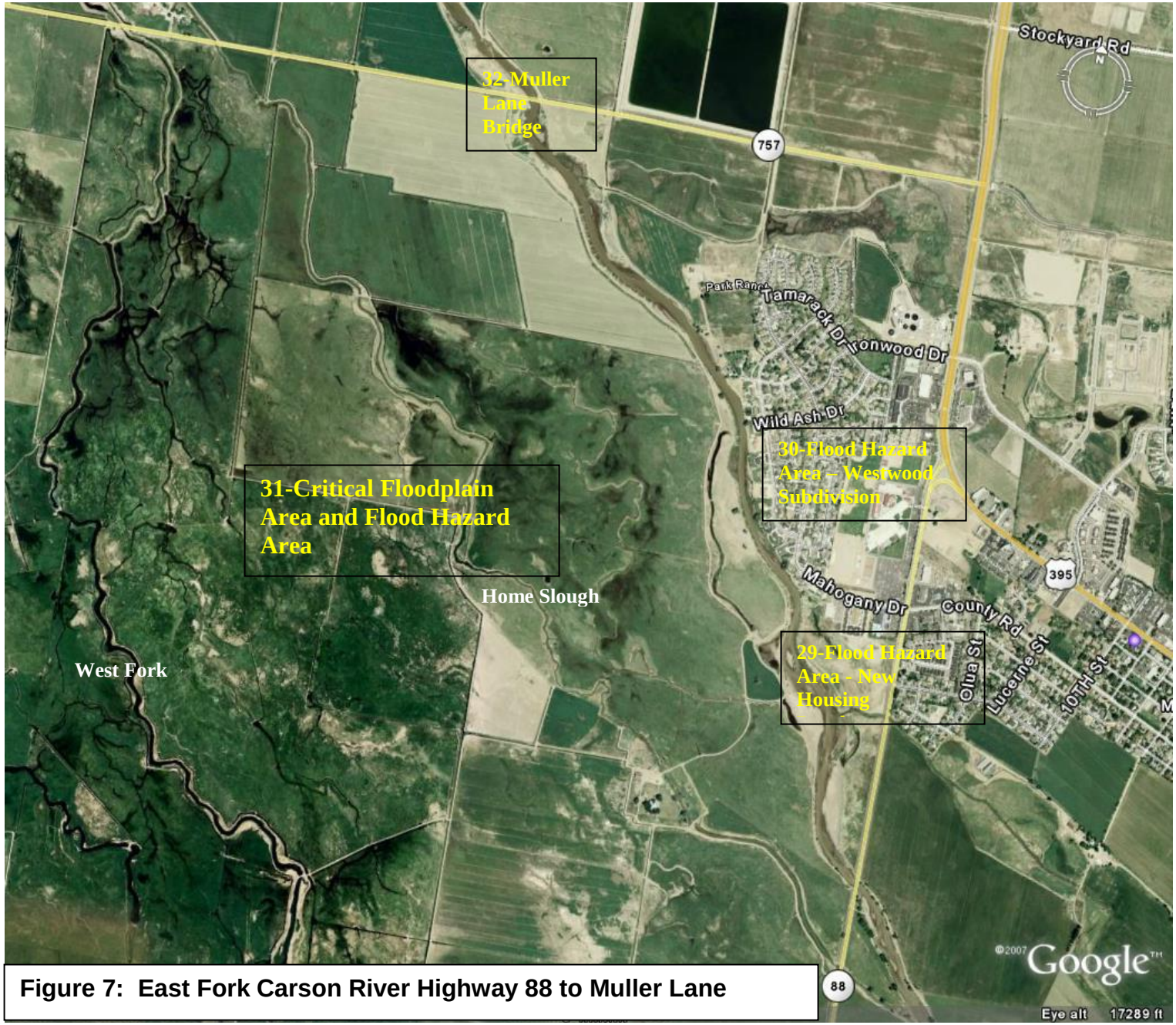


Figure 7: East Fork Carson River Highway 88 to Muller Lane

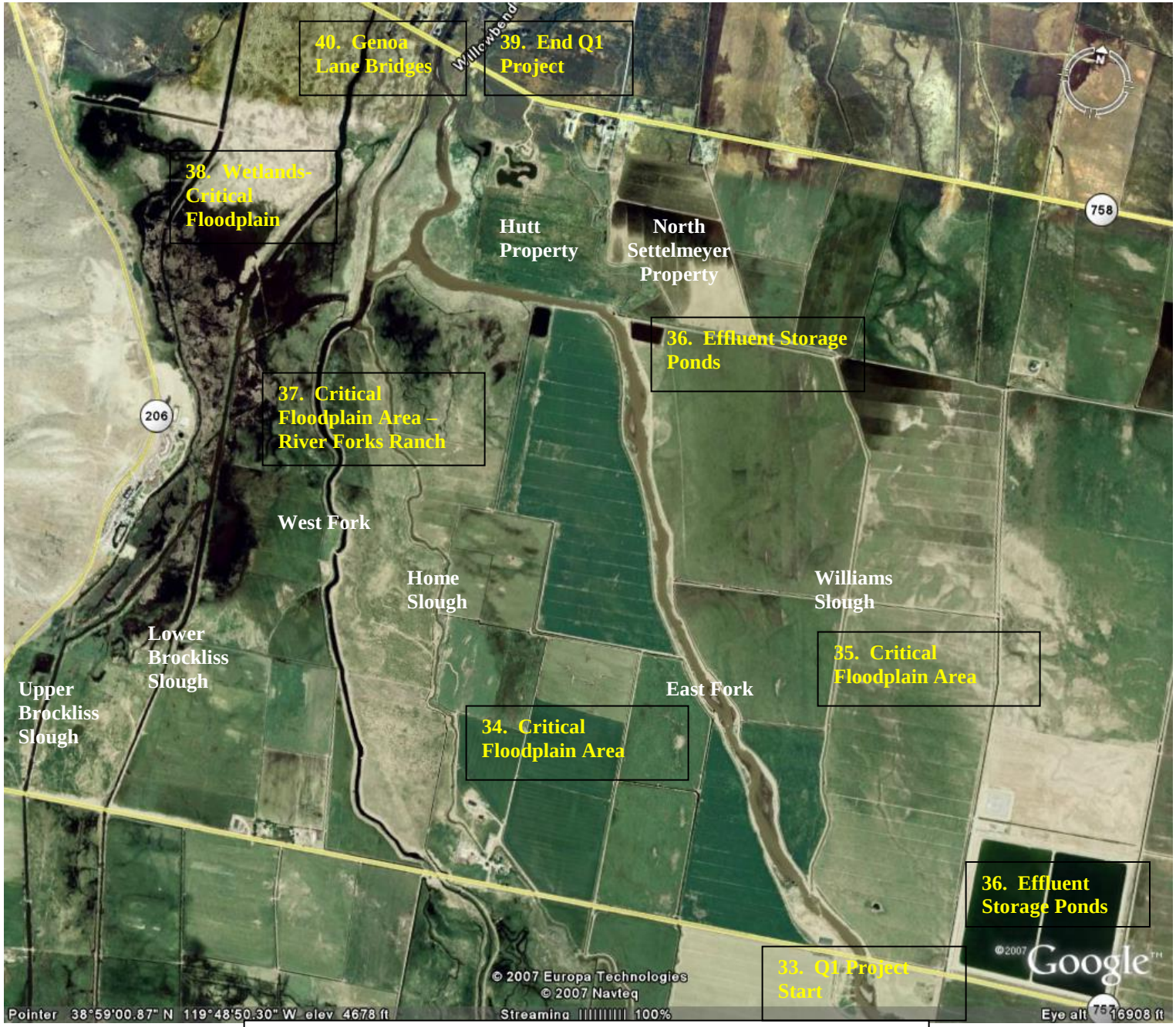


Figure 8: Muller Lane to Genoa Lane

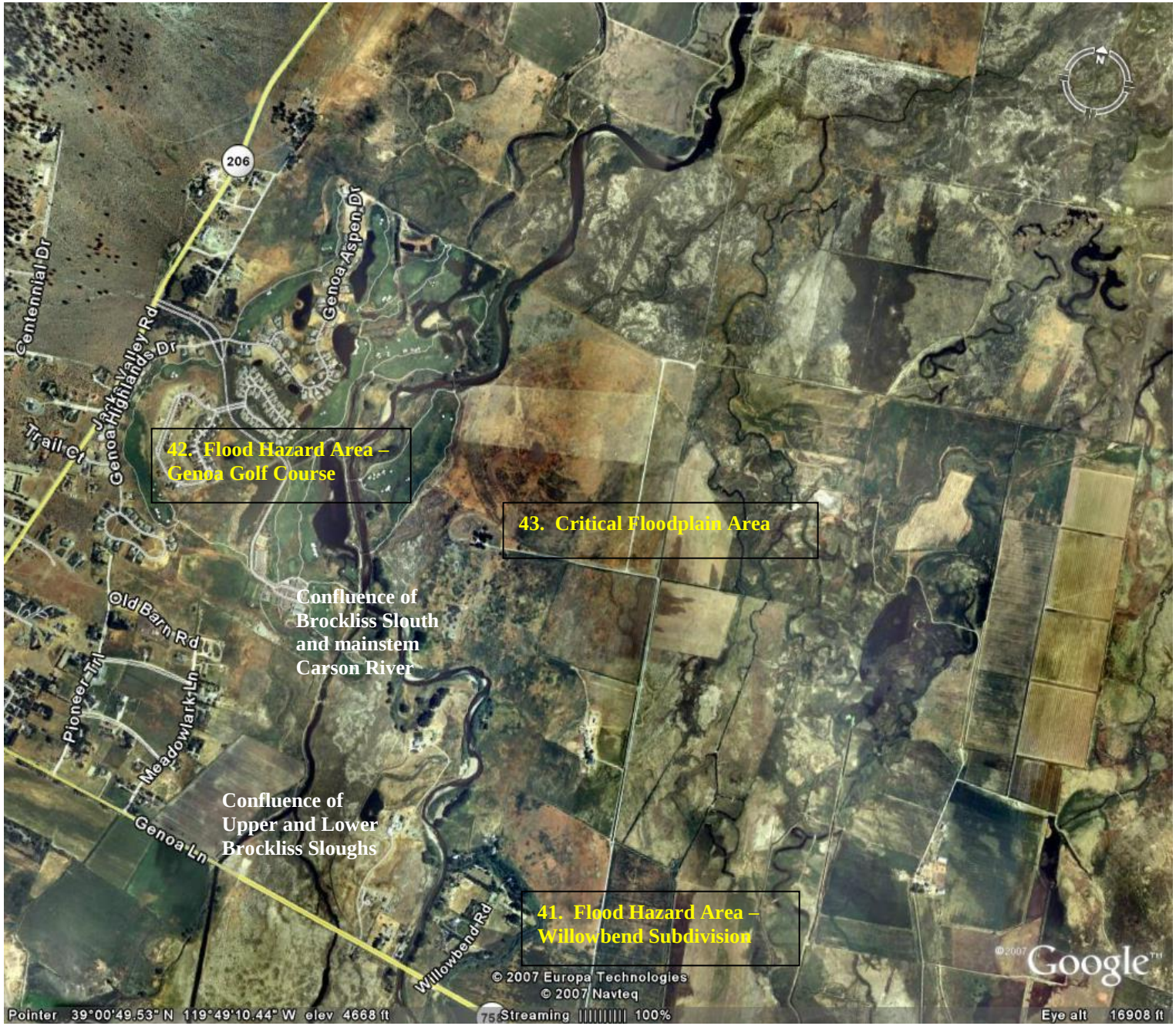


Figure 9: Genoa Lane to Cradlebaugh Bridge

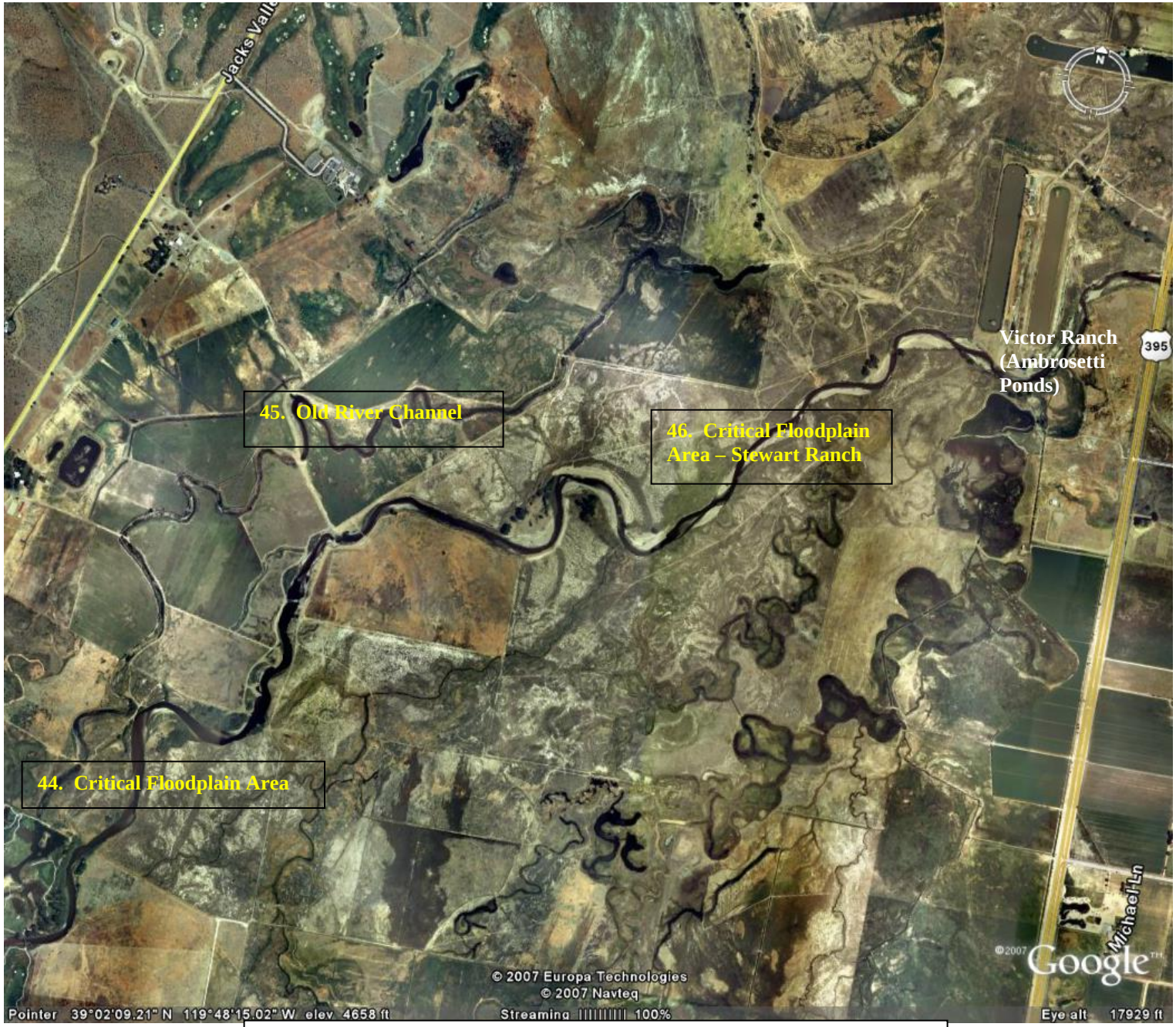


Figure 10: Genoa Lane to Cradlebaugh Bridge

Figure 11: Main Carson River – Cradlebaugh Bridge to Mexican Gage

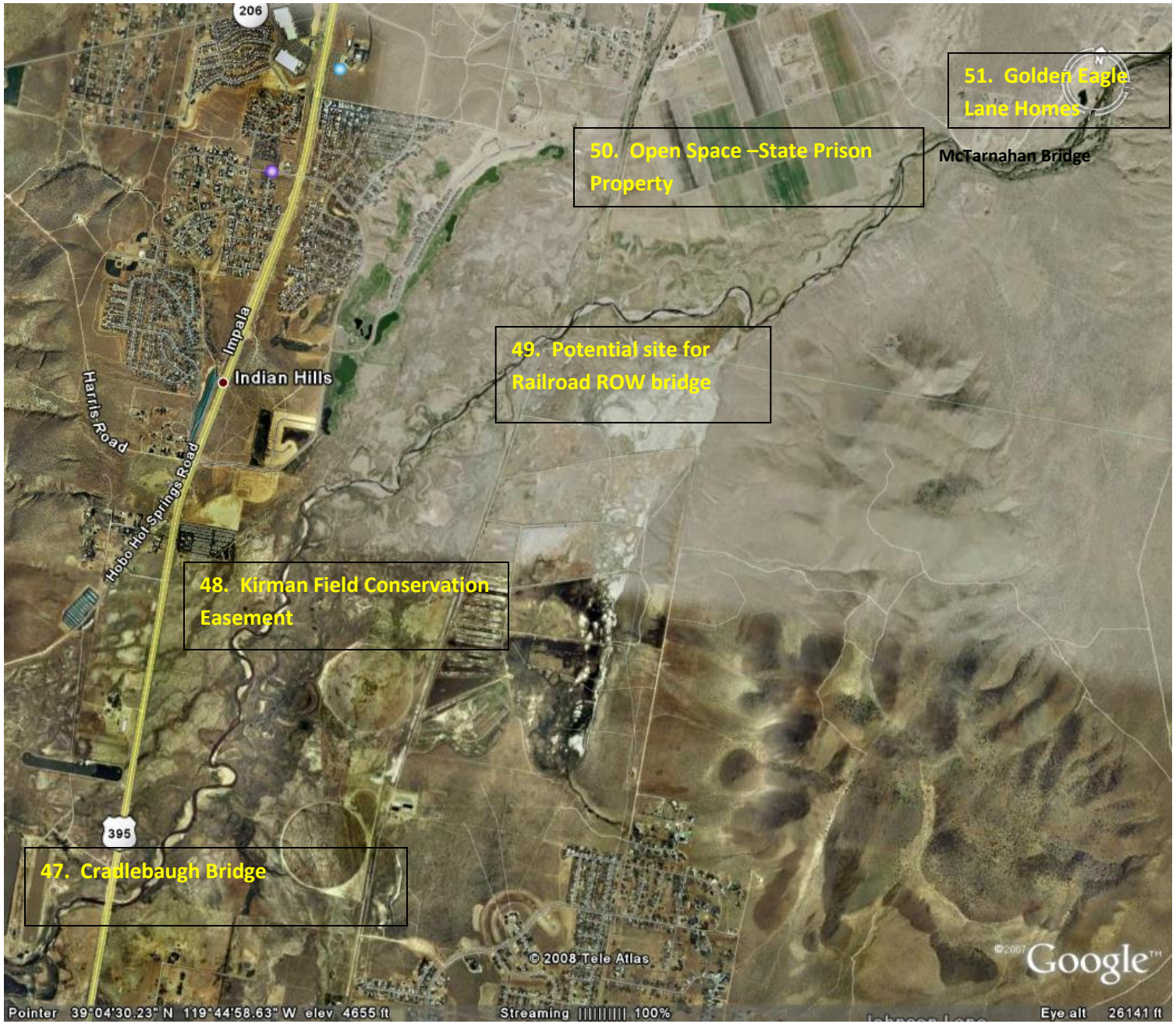
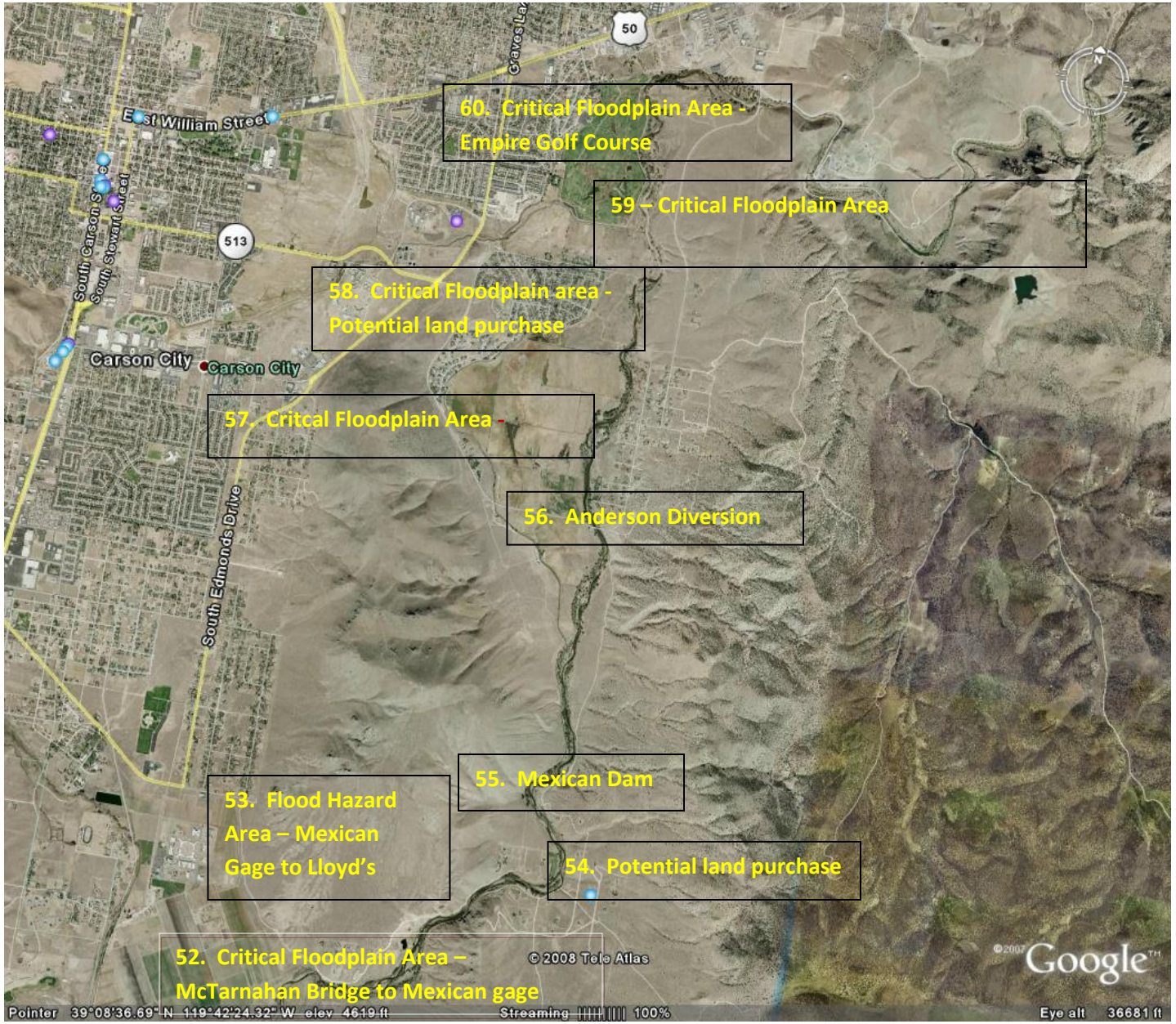


Figure 12: Main Carson River – Mexican Gage to Deer Run Road



Appendix C

HDR White Paper

Review of Existing County Ordinances

REVIEW OF COUNTY FLOOD PLAIN ORDINANCES

CWSD Flood Planning Assistance ***March 22, 2006***

Reviewed by:

Prepared by: Jay Aldean, P.E.

This memorandum was written following a review of the flood plain ordinances from counties which incorporate the geographical boundary of the Carson River Watershed. These counties/cities include Alpine County, CA; Douglas County, NV; Carson City, NV; Lyon County, NV; and Churchill County, NV. The intent of these comments is to focused on the goal or providing justification for using additional techniques through the land development process to provide for reducing the potential for downstream flood damage and degradation to the watershed.

It is evident that the code as reviewed from each county was based on the FEMA model ordinance. This is a common occurrence among communities that participate in the FEMA Community Rating System Program (CRS). FEMA traditionally requires each community to approve some type of flood damage prevention ordinance and usually supplies its generic ordinance to the community which is edited to conform to the local code format.

During the review there were three issues that seemed to be common among each county's code. The format used in this memo is to cite each reference (shown in italics) and include a discussion of the issue regarding each reference. Each section is entitled in bold with the subject of the code reference.

Purpose of the Ordinance

"…to promote the public health, safety, and general welfare,….".

Alpine County, Section 16.08.010;

Douglas County, Section 20.50.020:

Carson City, Section 12.09.040:

Lyon County, Section 12.01.03:

Churchill County, Section 19.03.030:

This section sets the purpose of the ordinance and is concerned primarily with protection of property, and public safety. Standard engineering practice has translated this into the concept that if the water level doesn't rise sufficiently to inundate structures and cause damage, or significantly alter the bed and banks of the channel through erosion, then this purpose has been met. The engineering concept most often used to meet this goal is through providing channel conveyance.

The significance of this section leads to the reasons why preventative measures can be required; therefore if a preventative measure is required, then it should be required for the expressed purpose as set forth in this section. Otherwise it would be difficult to require some of the more elaborate engineering concepts

also meant to affect other functionality of flood plain capability besides conveyance. However through a shift in the paradigm for interpreting the current flood plain ordinance some additional flood plain functionality may result. The benefits derived from a more progressive interpretation of the existing code would be secondary to the primary goal of property and life protection. For example, if additional development techniques were required of property owners developing adjacent to a flood plain for lets say bank stabilization; the primary benefit would be the stabilization of the immediate embankment which would protect the developer's property; the secondary benefit would be a river that might be closer to equilibrium so the reaction to the encroachment would not be as significant and the river would not continue downstream reeking havoc as it attempts to again reach equilibrium.

In general, engineering practice as well as community enforcement has limited their concern to study of impacts to the immediate areas adjacent to the proposed development or reach of study. This "micro" approach however could be expanded into a more "macro" approach using the logic discussed in the next section.

Ultimately it would be preferable to amend the code references on this issue to also include as a purpose for this ordinance the preservation or anti-degradation of flood plain functionality. The city of Sparks is currently developing code for this purpose on the Truckee River. A change in purpose would allow requiring additional studies of potential impacts as well as more restrictive development procedures.

Control Methods

"…controlling, filling, grading, dredging, and other development which may increase flood damage;…"

Alpine County, Section 16.08.020.D

Douglas County, Section 20.50.040:

Carson City, Section 12.09.050:

Lyon County, Section 12.01.04.D:

Churchill County, Section 19.03.040.D:

This citation may be of use to the municipal and county agencies to provide a basis from which to require additional study and design consideration for a flood plain development. Typically, the engineering standard of practice as well as community enforcement has limited its concern to study of impacts to the immediate areas adjacent to the proposed development or reach of study. The outcome is the conveyance studies mentioned previously. This "micro" approach concentrates solely on the proposed property and omits determining if any additional property is affected or impacted through the development. Using the citation above, the *general welfare* could be promoted further by limiting potential *flood damage* not just on the proposed development, but throughout the watershed. We can promote the concept that by expanding development requirements into a more "macro" or watershed approach, we can reduce the impact to all downstream residents by following appropriate measures when developing near or immediately adjacent to a flood plain.

The following logic develops some linkages between other issues to consider when allowing for flood plain development. These linkages are noted to provide specific development concepts that will prevent the *"increase in flood damage*" per code.

<u>Storage</u>

As previously mentioned, if damage is the result of inundation or erosion, then loss of flood plain storage volume can be demonstrated on a large scale to impact facilities downstream of the area where the loss in volume occurs. In other terms, flood plain storage acts directly in attenuating the peak flow downstream of where the storage occurs, or reversely stated, removing flood plain storage directly increases the flood peak flow rate experienced by all properties downstream. This concept has been recognized in Washoe County and is now being practiced with respect to the Truckee River flood plain. But there are problems with enforcement of this concept. The incremental loss of volume is extremely small for a single home development, so much so that using the current engineering study technology it would be difficult to prove an impact either way. However on a large scale the effect of storage on peak flow can be easily demonstrated.

Since enforcement of the storage issue is difficult using the "lets study the impact" approach required by most flood municipalities Washoe County uses a much simpler rule of thumb. They recognize that no change in flood storage volume can occur through any development and enforce this concept. The concept is easily applied and can easily be demonstrated by the developers and will yield acceptable results downstream. This concept also can be enforced under the current law. Finally, although this concept constrains properties currently susceptible to inundation by flooding it gives the property owners a way to configure the development a manner that reduces the impact to the downstream property owners.

Erosion and Sediment Transport

During the past two decades, river engineers have recognized the far reaching impacts of river geomorphology to individual encroachments to the flood plain. Issues such as natural sediment transport, stream power/energy, and other factors impacting the potential for change are beginning to be brought to the forefront. The problem is that local ordinances have not kept pace with new understanding. So instead of allowing an individual to place a structure that encroaches in the path of an existing river and just require that it is high enough or to require the embankment be protected with riprap, we should be requiring an experienced geomorphologist to assess the potential for that development to cause an impact to the other properties adjacent to and downstream of the proposed development.

In keeping with water quality issues, other states such as California, and Washington, as well as others are now imposing a condition of development to maintain post-development flows to the pre-development flow and volume level. This is being done in order to prevent the increase in erosion due either to an increase in peak flow, or through a longer time of discharge (volume). The general methodology used to address this is usually through the low impact development (LID) concept.

The issue of erosion is much more difficult to enforce. The requirement to involve a geomorphologist is straightforward and perhaps could be a useful tool in the prevention of geomorphic changes, but if the Carson river governments should attempt this approach there are many challenges to overcome. First the methodology is not easy explained. In-depth manuals and training would be necessary for the engineers whom will be providing the technical analyses for the developers. Second, the science behind this concept is complex. The linkage between flood damage and development may not be strong enough to interpret the current laws in favor of using this concept, especially if the only phrase on which to basis the development requirement is "flood damage".

Administrative Duties

..Alternation of watercourses within FEMA designated flood zones….the administrator must….verify that the applicant has notified all affected property owners and communities…"

Douglas County, Section 20.50.110

"…alteration of a watercourse. It is the responsibility of the director of public works to:

(1) Notify adjacent communities, ……
(2) It is required that the flood carrying capacity of the altered or relocated portion of said watercourse be maintained by the community…."

Carson City, Section 12.09.070.3.d

"…adjacent communities and the Nevada Division of Water Planning shall be notified prior to any alteration or relocation of a watercourse…"

Lyon County, Section 12.01.09.A

"…Notify adjacent communities and the state of Nevada prior to alteration or relocation of a watercourse…"

Churchill County, Section 19.09.030.G.1

Alterations of a watercourse can be in terms of realignment, change in flood stage elevation or even a change in the velocity and/or discharge. Given this understanding, it should be incumbent for the flood plain administrators in the code excerpts cited above to notify all counties when a new development is being proposed due the potential for change in river dynamics which will impact on others along the river. This most likely is not the current practice being followed by each government agency; but should be.

National Wildlife Federation vs. Federal Management Agency

This section is in reference to a lawsuit the NWF filed against FEMA. Apparently, Chinook Salmon were threatened in one or two streams in the State of Washington. The NWF asserted among other issues that FEMA's development requirements for the protection of property and life did not go far enough to prevent the decline in fish population in the rivers cited.

This lawsuit has some interesting merits, it hinges on the requirement for all Federal agencies to utilize their jurisdictions for the enforcement of the Endangered Species Act. The process followed is through what is known as Section 7 consultation which provides guidance for the process each Federal agency must follow when any project, etc. impacts a threatened or endangered species.

In general the NWF argued that FEMA could have done more when establishing its flood programs of mapping and CRS, as well as others, to have identified and prevented the environmental conditions which have contributed to the decline in the species in certain waters. The onus is not on FEMA to come up with the criteria for design, the outcome of the consultation with the NMFS will generate those requirements. FEMA merely must abide by these requirements and include and enforce them within their programs.

The FEMA requirements in a strict sense only apply to flood damage reduction, and its focus on reduction in insurance claims. Under this assumption, most engineering requirements apply only to the potential for inundation of the immediate property and as a result allow for the least expensive option to protect that

property. What may emerge from this lawsuit is the notion that impacts from some of the least cost improvements may in fact be damaging other species (endangered) within the same watershed.

Since this case is based on an endangered species, most likely there would not be a direct application between the ruling in this case and the Carson River Watershed FEMA flood prevention requirements. Although in the future it might have an indirect result to make FEMA flood prevention requirements a bit more environmentally friendly.

Flood Plain Function

A copy of the figure describing the various levels of flood plain encroachment and development is attached. The concept being described is one of flood plain function. Literature describes flood plain processes using two terms, the potential and the capability. The figure shows the definitions of each with various levels of flood plain capability.

Naturally occurring flood plains are extremely efficient. They constantly seek to maintain equilibrium by making adjustments to the flow regime and bed and banks alignment. These changes occur naturally with each new storm. When development occurs, the impacts to the flood plain are significant and likewise the reaction by the river becomes significant. We now know that these adjustments are what cause the destabilization of the river, banks and flow quantities (generally downstream). There are several points to be taken from this figure. First there are a number of engineering techniques designed to enhance some aspect of a naturally occurring function of a flood plain. Each level of engineering involvement on behalf of a project has with it an associated level of impact to the river system. The higher the number on the list the higher and more significant is the potential damage and impact to the river.

Second, when you follow only one of these techniques during development, the adjustment made by the river typically overcompensates and becomes significant, and the ramifications are experienced for a long stretch downstream. Finally, as combinations of each of these techniques are applied to a specific project, the flood plain moves further toward its natural state and gaining its naturally occurring function, or the conversely if development used just the conveyance criteria the flood plain would be furthest from its original function.

The figure was included in this memo to make it clear that there are other design requirements that can be incorporated into the existing county development process that have basis in fact and logic and should not be deemed arbitrary and or create a hardship for the individual attempting to develop their property. Rather these principals can be applied, required and result in a promotion of the general welfare and reduction in flood damage.

Conclusion and Recommendation

A copy of these comments should be distributed to each county and a meeting scheduled with the flood plain administrator and respective assistant. If the flood plain administrator cannot make the meeting the meeting should be rescheduled. The meeting will be to discuss the comments and solicit interest in establishing additional measures for the protection of the flood plain through the development process.

The other goal for these meetings will be to generate interest for each flood plain administrator to champion some revisions to their respective ordinances which will provide for a more stable and natural river.

Figure 1: Flood Plain Function

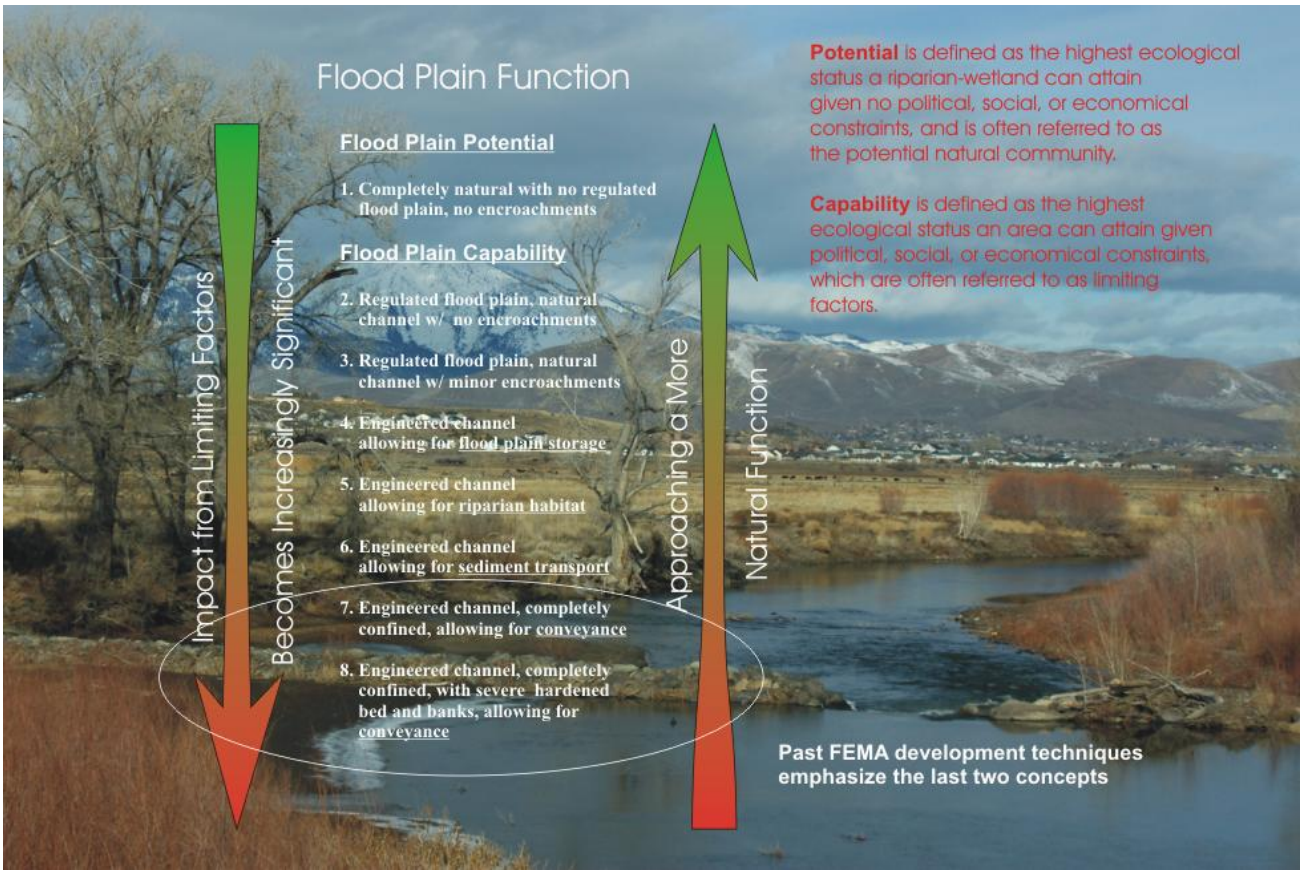


Figure 1: Flood Plain Function

Appendix D

County Flood Zones Maps

FEMA Flood Zones

LOW-TO-MODERATE RISK ZONES (Non-Special Flood Hazard Areas)

Zones B, C, and X

- Areas outside the 1% annual flood risk floodplain
- Areas of 1% annual shallow flooding risk where average depths are less than 1 foot
- Areas of 1% annual stream flooding risk where the contributing drainage area is less than 1 square mile
- Areas protected by levees from the 1% annual flood risk. Insurance purchase is not required in these zones.

HIGH-RISK ZONES (Special Flood Hazard Areas)

Zone A

Areas with a 1% annual flood risk and a 26% risk of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.

Zone AE and A1-A30

Areas subject to a 1% or greater annual chance of flooding in any given year. Base flood elevations are shown as derived from detailed analyses. (Zone AE is used on new and revised maps in place of Zones A1-A30).

Zone AH

Areas subject to a 1% or greater annual chance of shallow flooding in any given year. Flooding is usually in the form of ponding, with the average depths between one and three feet. Base flood elevations are shown as derived from detailed analyses.

Zone AO

River or stream flood hazard areas, and areas with a 1% or greater annual shallow flooding risk, with flooding usually in the form of sheet flow with average depths between one and three feet. Average flood depths are shown as derived from detailed analyses.

Zone AR

Areas subject to a 1% or greater annual chance of flooding in any given year, which results from a temporary increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam).

Zone A99

Areas subject to a 1% or greater annual chance of flooding in any given year, but which ultimately will be protected by completion of a flood protection system under construction. No base flood elevations or flood depths are shown.

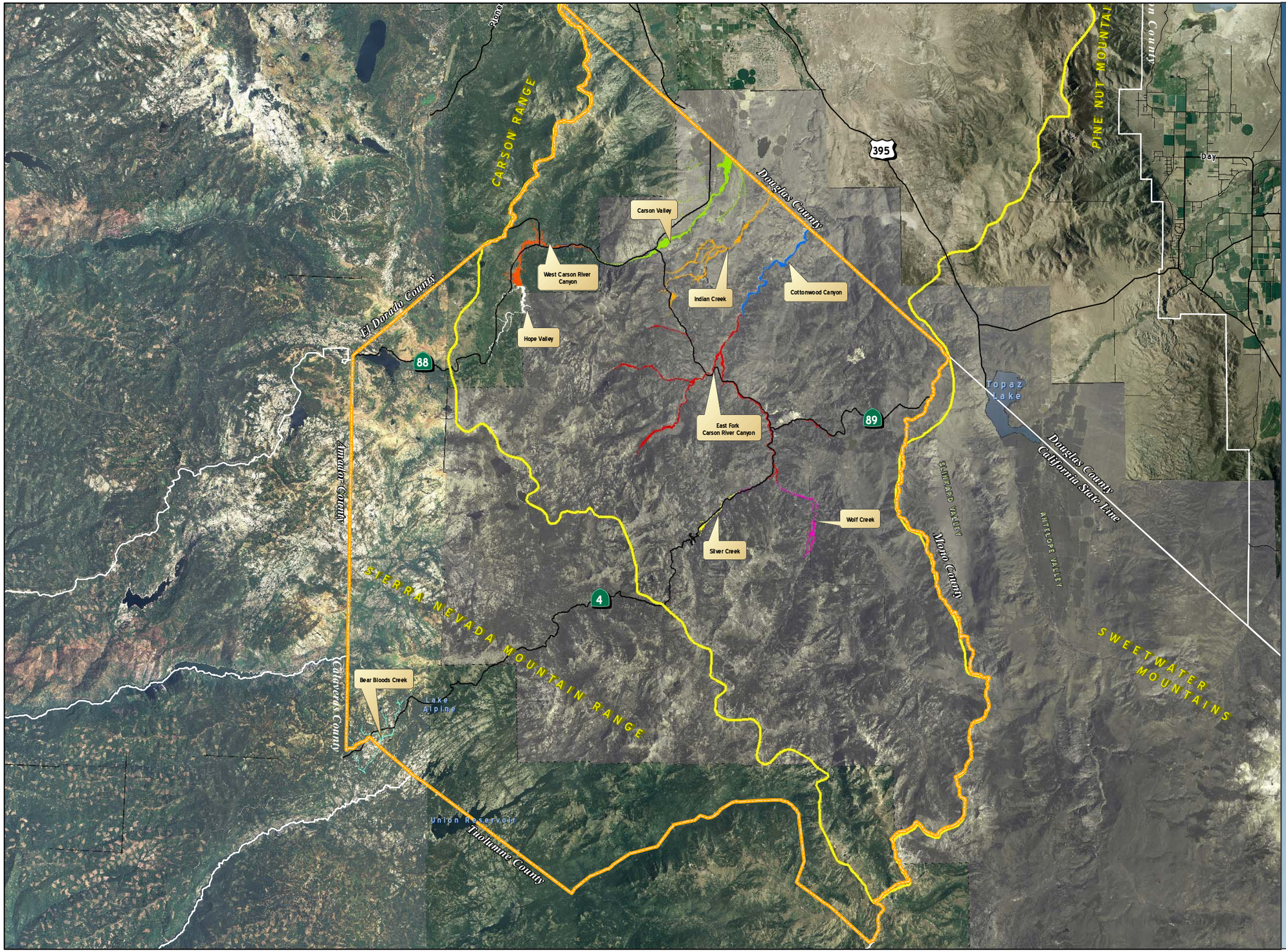
Zone VE and V1-30

Coastal areas with a 1% or greater flood risk and an additional hazard associated with storm waves. Base flood elevations are shown as derived from detailed analyses. (Zone AE is used on new and revised maps in place of Zones A1-A30).

UNDETERMINED-RISK ZONES

Zone D In areas of possible but undetermined flood risk, flood insurance rates reflect the uncertainty of the flood risk.

Flood Plains
Alpine County
September 2008

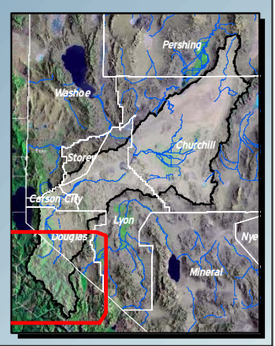


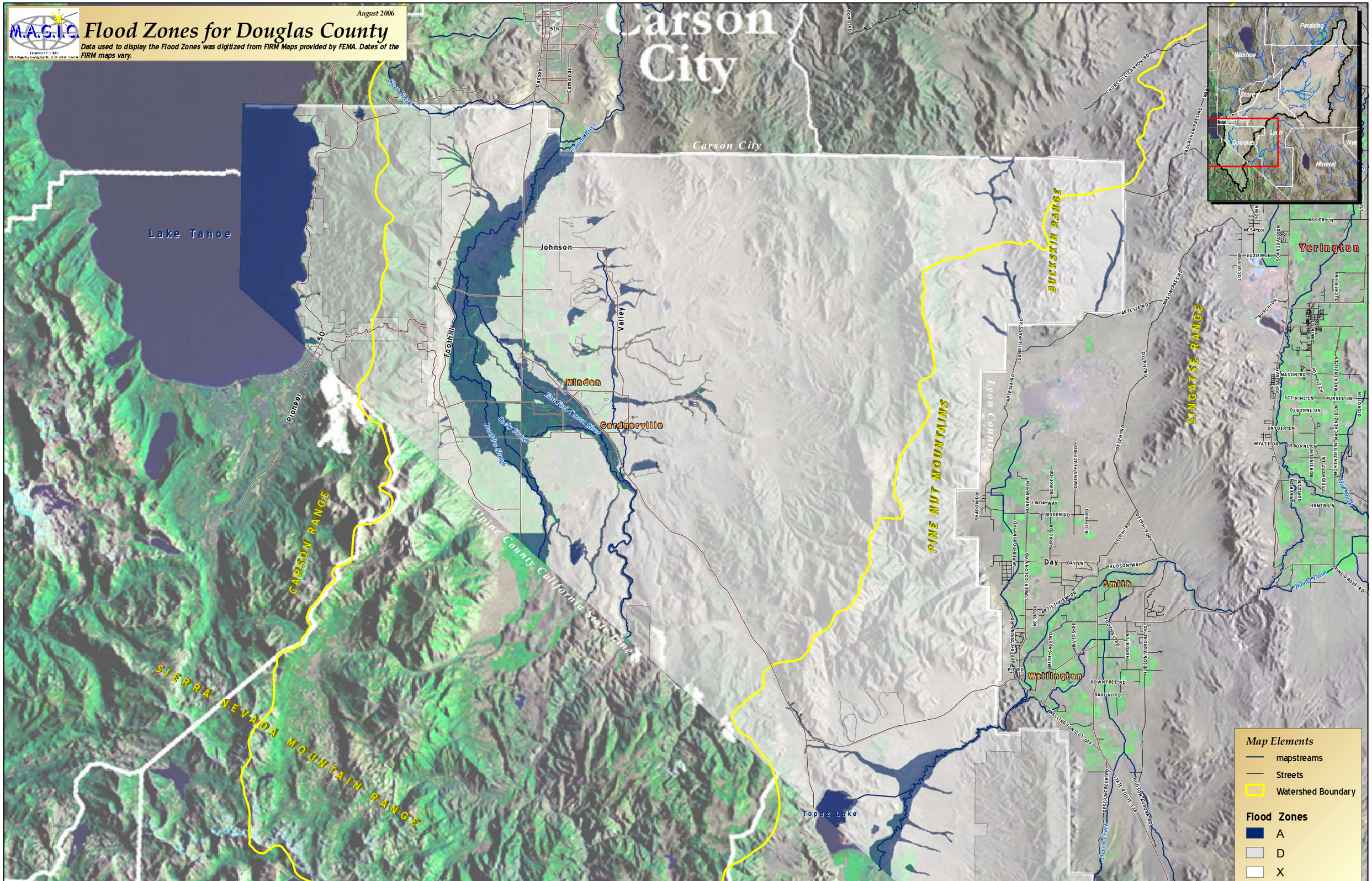
Map Elements

- Alpine County Boundaries
- Roads
- County Boundaries
- NV Counties
- Water Bodies
- Watershed Boundary

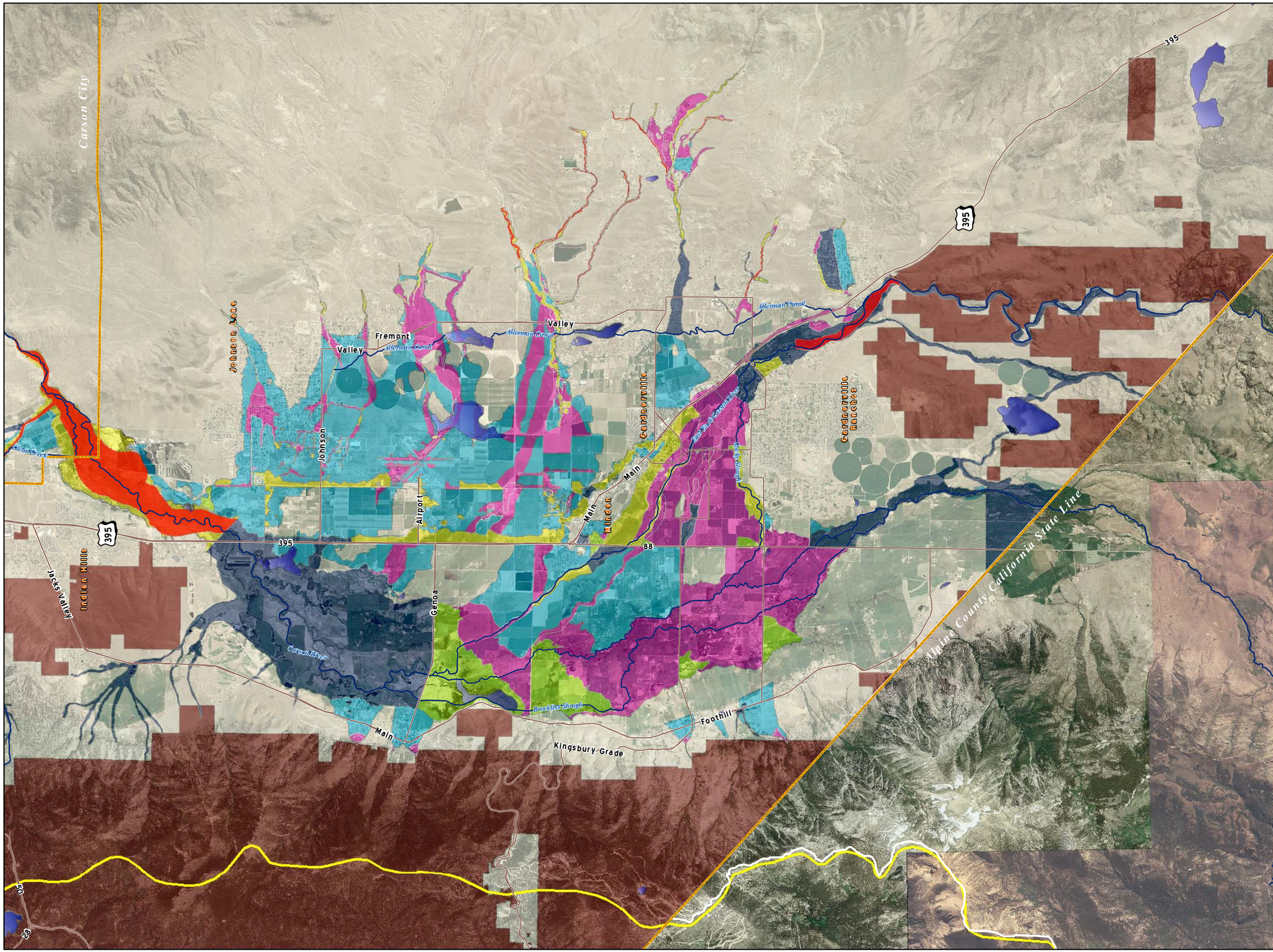
Flood Plains

- Bear Bloods Creek
- Carson Valley
- Cottonwood Canyon
- East Fork Carson River
- Hope Valley
- Indian Creek
- Silver Creek
- West Carson River Canyon
- Wolf Creek





August 2006
Flood Zones for Douglas County
Data used to display the Flood Zones was digitized from FIRM Maps provided by FEMA. Dates of the FIRM maps vary.
Carson City
Lake Tahoe
Johnson
Valley
Foothill
Minden
Gardnerville
Pioneer
Alpine County California State Line
CARSON RANGE
SIERRA NEVADA MOUNTAIN RANGE
PINE NUT MOUNTAINS
BUCKSKIN RANGE
SINGATSE RANGE
Lyon County
Yerington
Smith
Wellington
Topaz Lake
Pershing
Washoe
Storey
Douglas
Lyon
Mineral
Map Elements
mapstreams
Streets
Watershed Boundary
Flood Zones
A
D
X



Porposed Flood Zones Douglas County

June 2008

Data used to display the Flood Zones was digitized from the New 2008 FIRM Maps provided by FEMA.

N E S W

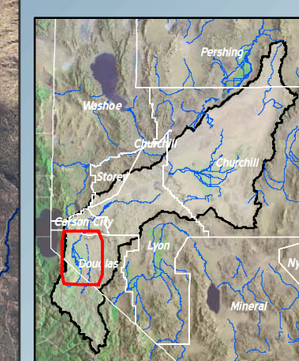
M.A.G.I.C.

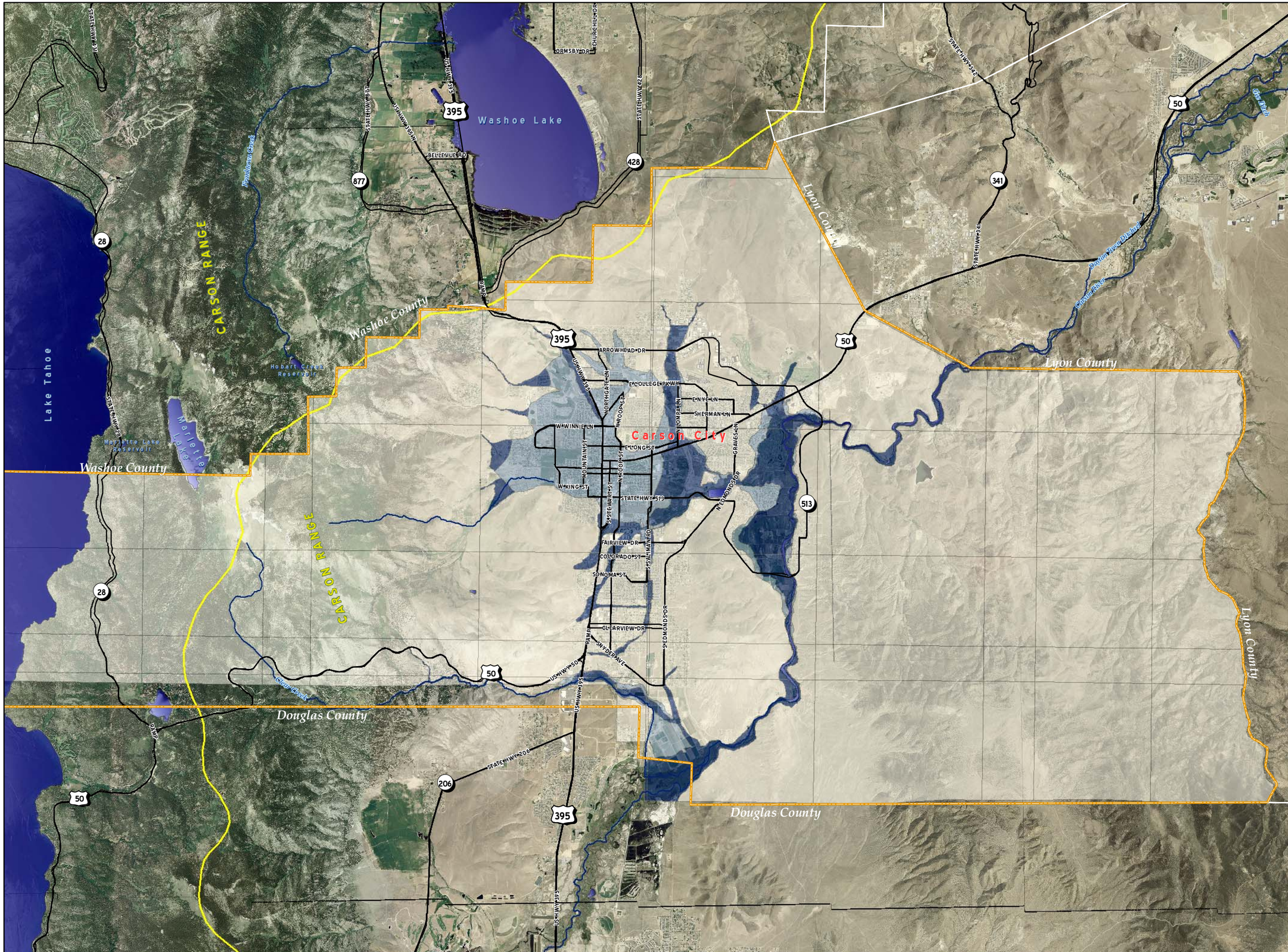
Map Elements

- Douglas County
- Streets
- NV Counties
- Water Bodies
- Watershed Boundary
- Floodways

Flood Zones

- 2% 500 year Flood
- 1% 100 year Contained in Channel
- A
- AE
- AH
- AO
- D
- X





Flood Zones
Carson City
May 2007

Data used to display the Flood Zones was digitized from FIRM Maps provided by FEMA. Dates of the FIRM maps vary.

N
W E
S

Map Elements

- Roads
- Carson City Boundaries
- NV Counties
- Water Bodies
- Watershed Boundary

Fema Flood 1983

- 100 Year
- 500 Year
- 500 Year (FIS)

Proposed Flood Zones Carson City

June 2008

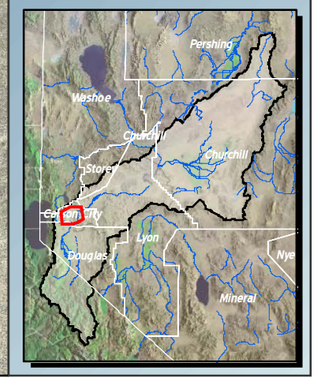
Data used to display the Flood Zones was digitized from the New 2008 FIRM Maps provided by FEMA.

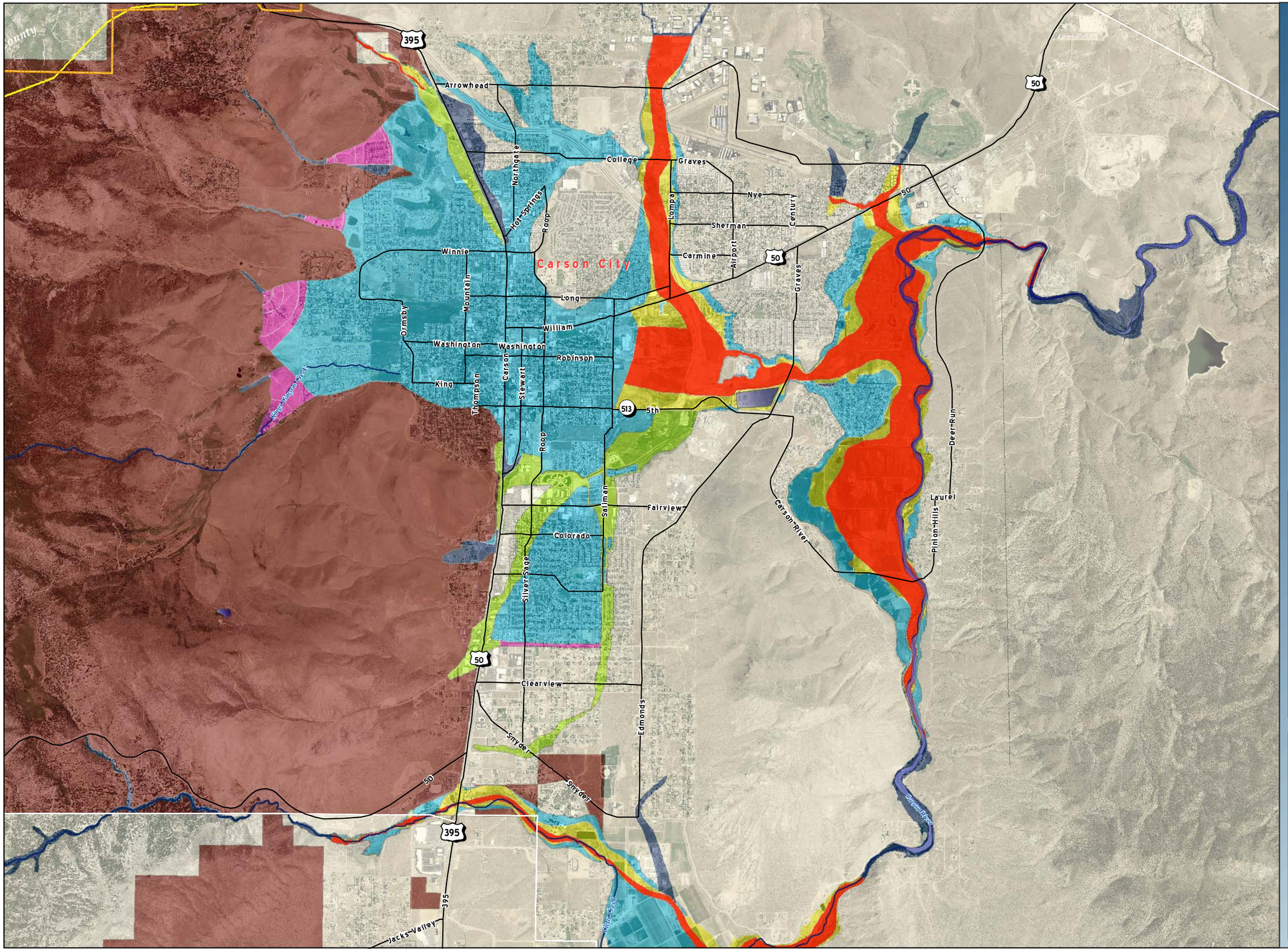
Map Elements

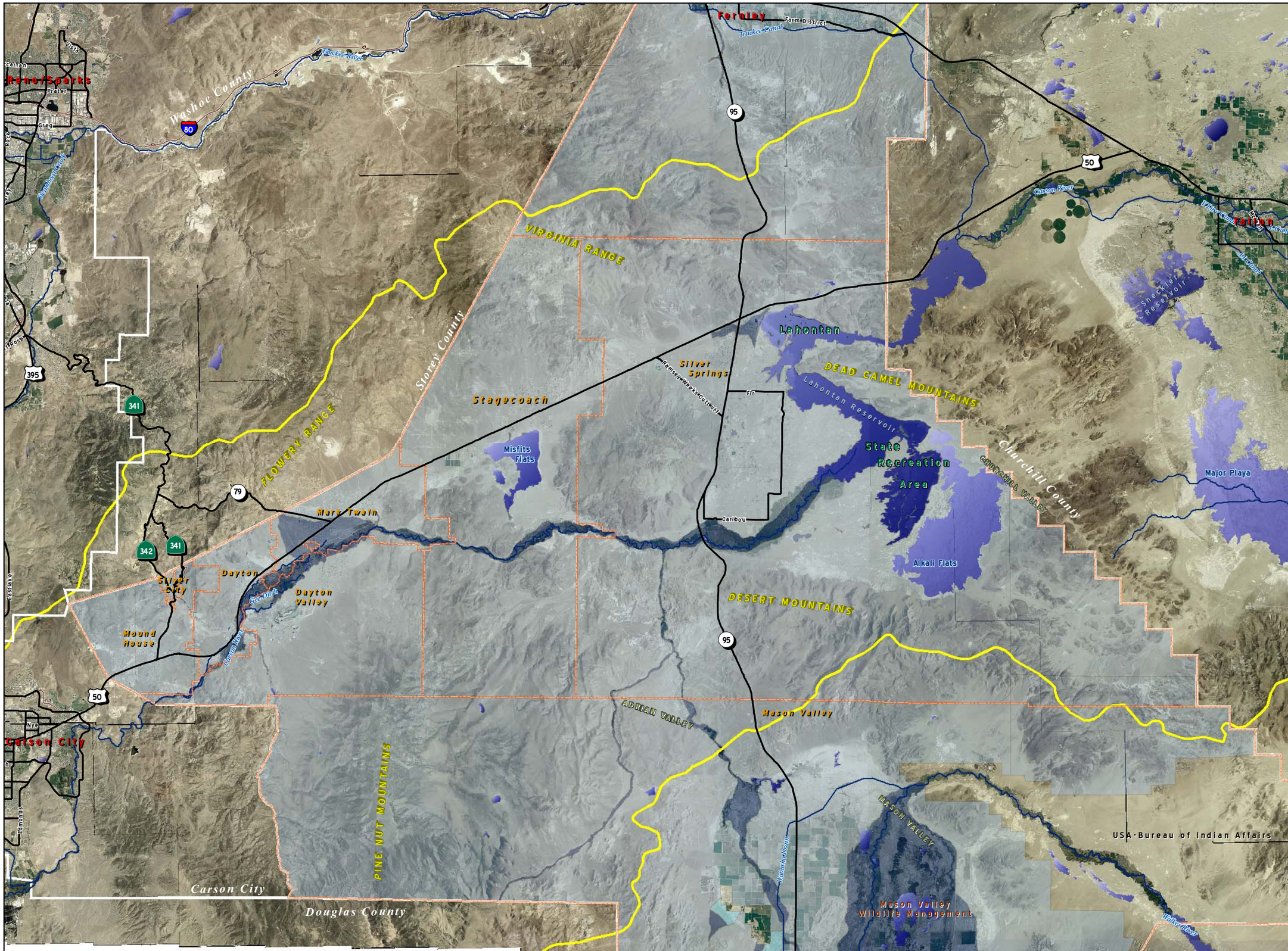
- Carson City Boundaries
- Roads
- NV Counties
- Water Bodies
- Watershed Boundary
- Flood Ways

Flood Zones

- 2% 500 year Flood
- 1% 100 year Contained in Channel
- A
- AE
- AH
- AO
- D
- X







Flood Zones for Lyon County

May 2007

Data used to display the Flood Zones was digitized from FIRM Maps provided by FEMA. Dates of the FIRM maps vary.

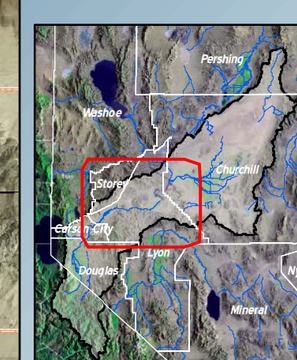
N
W E
S

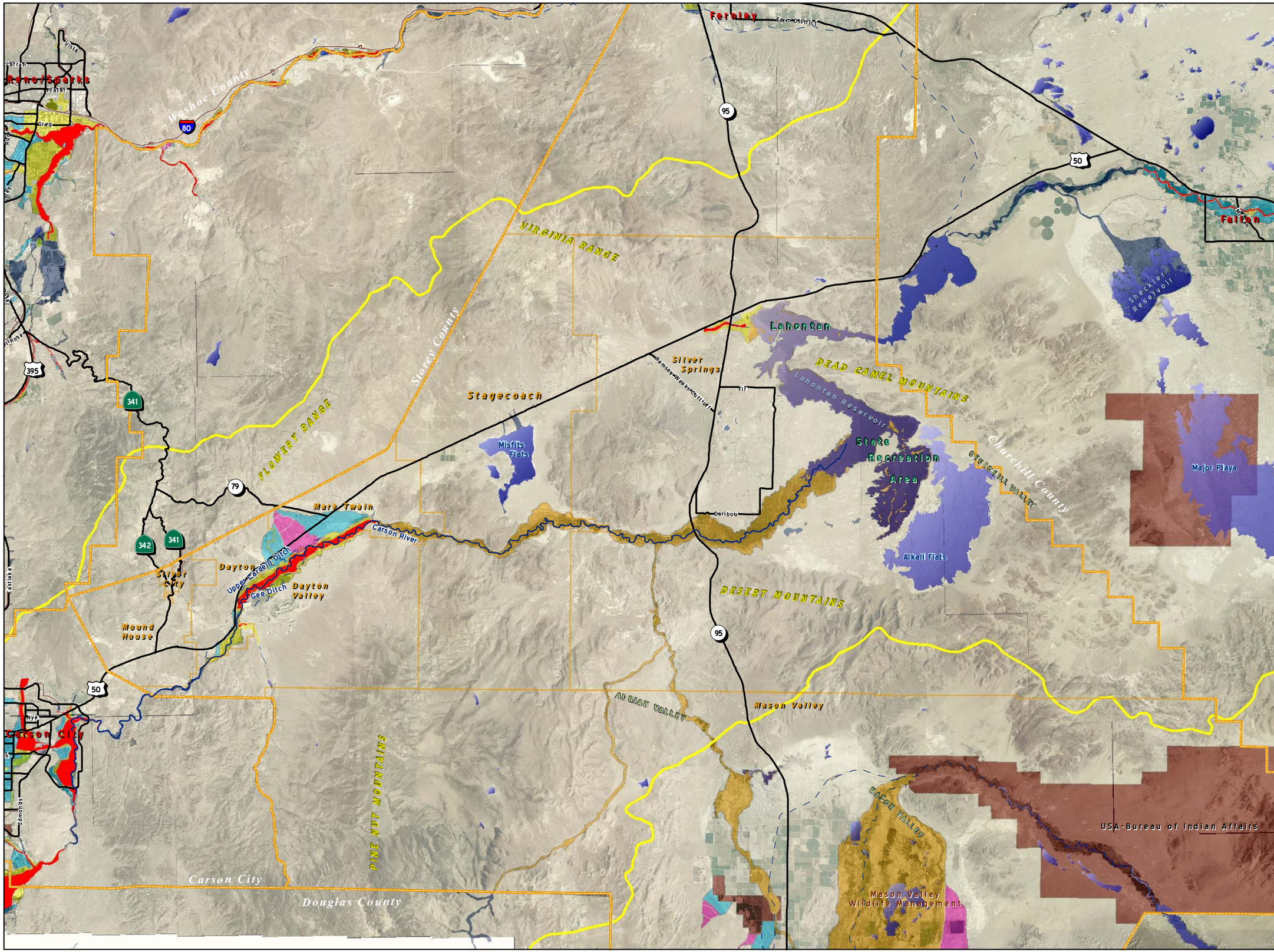
Map Elements

- Cities & Townsites
- NV Counties
- Watershed Boundary
- Water Bodies

Flood Zones

- A
- AE or A1-A30
- AO
- B or X500
- C or X
- D





Porposed Flood Zones Lyon County

September 2008

Data used to display the Flood Zones was digitized from the New 2008 FIRM Maps provided by FEMA.

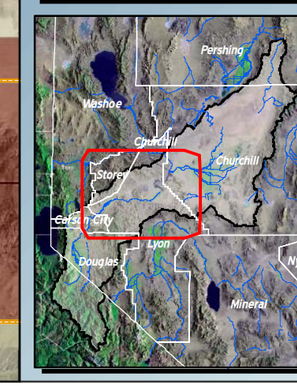
N
W E
S

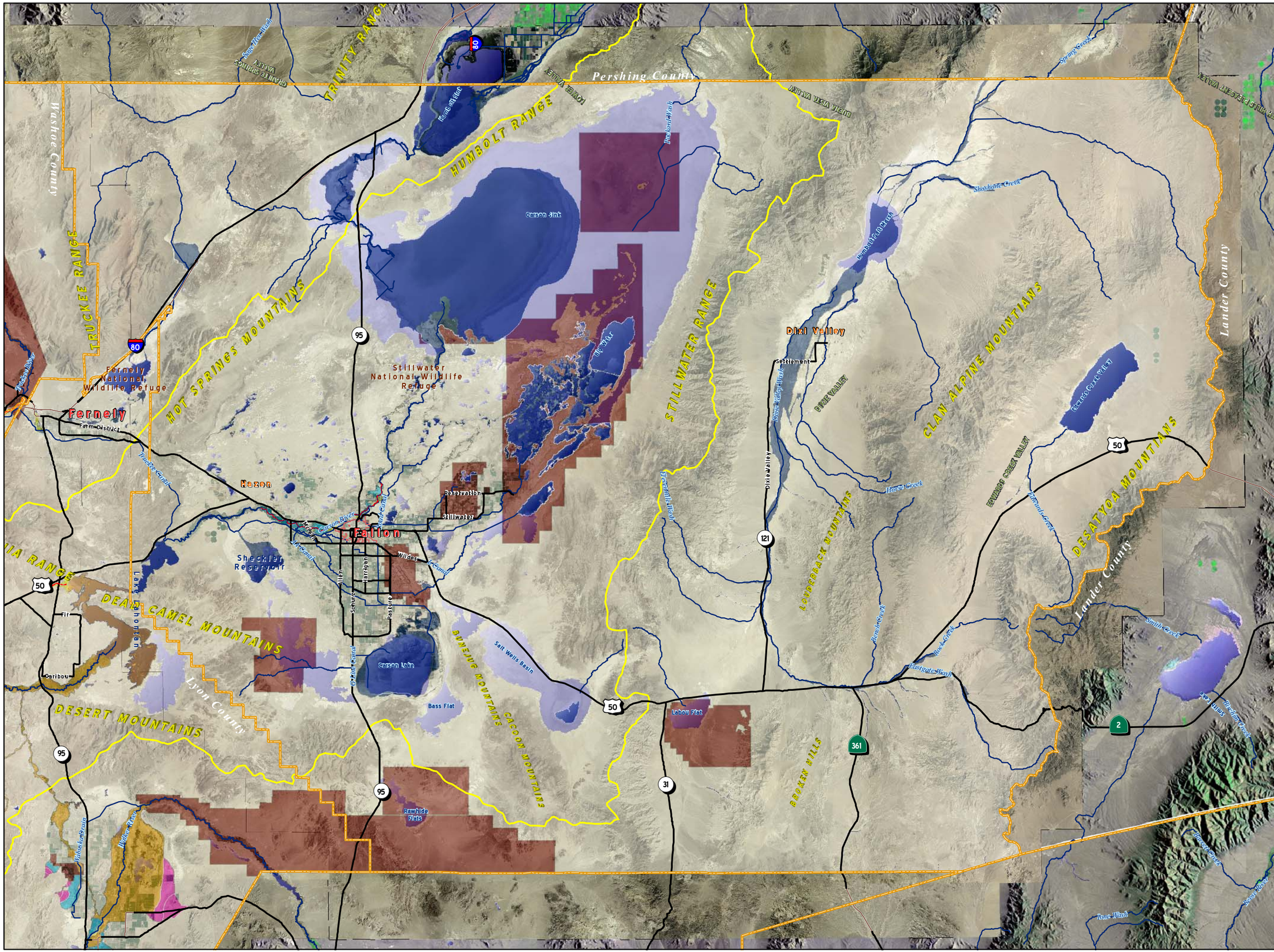
Map Elements

- Lyon County Boundaries
- Cities & Townsites
- NV Counties
- Watershed Boundary
- Water Bodies
- Floodways

Flood Zones

- 2% 500 year Flood
- 1% 100 year Contained in Channel
- A
- AE
- AH
- AO
- D
- X





Proposed Flood Zones Churchill County

June 2008

Data used to display the Flood Zones was digitized from the New 2008 FIRM Maps provided by FEMA.

N
W E
S

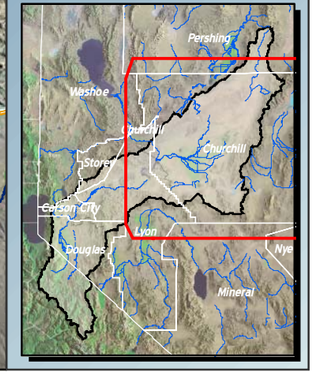
CHURCHILL COUNTY NEVADA

Map Elements

- Churchill County Boundary
- State Hwy
- MajorRoads
- Fallon City Limits
- Rivers, Ditches, Creeks, & Canals
- Churchill County
- NV Counties
- Watershed Boundary

Flood Zones

- 2% 500 year Flood
- 1% 100 year Contained in Channel
- A
- AE
- AH
- AO
- D
- X
- Water Bodies
- Flood Zones selection



Appendix E

Public Workshop Summary

Preliminary Draft Regional Floodplain Management Plan
Public Process Summary

Public Workshops Held:

All workshops were posted in many public locations of each county, as well as in local newspapers.

- Alpine/Douglas County (4/9/08) – 22 attendees
- Carson City (5/7/08) (Business Association of Western Nevada – BAWN invited) – 7 attendees
- Carson Valley Conservation District (4/1/08) (Farm Bureau and Water Conveyance Committee invited) – 17 attendees
- Carson River Coalition (4/23/08) – 30 attendees
- Churchill County (4/22/08) – 17 attendees
- Lower Carson Coordination Meeting (4/2/08) – 7 attendees
- Lyon County (4/17/08) – 10 attendees

Presentations given to the following groups:

- Northern Nevada Development Authority (3/26/08) - ~ 200 attendees
- Carson River Advisory Committee (4/2/08) - ~20 attendees
    - Approval and recommendation of county adoption received
- Carson City Open Space Committee (4/21/08) - ~15 attendees
    - Approval and recommendation of county adoption received
- Dayton Valley Conservation District (4/25/08) - ~15 attendees
- Carson City Planning Commission (5/28/08) - ~25 attendees
    - Approval and recommendation of county adoption received
- Alpine County Planning Commission (5/29/08) - ~ 15 attendees
    - Approval and recommendation of county adoption received
- Lyon County Planning Commission (6/10/08) - ~25 attendees
    - Approval and recommendation of county adoption received
- Douglas County Planning Commission (6/10/08) - ~33 attendees
    - Approval and recommendation of county adoption received
- Churchill County Planning Commission (6/11/08) - ~12 attendees
    - Approval and recommendation of county adoption received

Displays & Information:

- Carson Valley Trails Association – Hike for Health Event
- Fallon Paiute-Shoshone Earth Day Event
- Eagles and Agriculture Event

- Sierra Crest Academy (for preparation of festival with Carson Montessori School)

Media Coverage:

- News Carson City Television Station and Website
- Carson Access Television: Carson River Report
- Numerous press releases in local newspapers
- Articles in the Record-Courier and Reno Gazette Journal
- Draft plan available on CWSD website
- Regular updates and information sent via email to interested parties

Feedback Results Summary
Floodplain Management Plan Public Meetings
April/May 2008

We received a total of **71 feedback sheets** from all of the public meetings.

Question 1. What changes are needed for you to more fully support this regional floodplain plan?

66 of 71 responded

None, I fully support it	33
Don't know	12
I suggest the following:	21

- **Selected Comments:**
- Developer input so it doesn't end up in litigation
- Make clear what the next steps are so that plan is actively implemented
- Updating the hydraulic models and mapping of the updated floodplains should be one of the first implementation items
- "NO" adverse impact is a very high standard – perhaps "limits adverse" or "restricted" or no "substantial" adverse impact is more appropriate.
- Need to define footprints (size and impacts), INFRA structure elevation (roads), need hydraulic model.
- SA-6 /Replace No Adverse Impact with No Significant Adverse Impact
- Co-ordinate with other involved parties – e.g., BAWN, Local Engineering community, Minden, and Gardnerville
- More examples of Low Impact Development and potential ordinances that would steer the counties in the right direction.
- More specific actions would be more easily implemented.
- Create a mechanism to ensure forward momentum over time, i.e.: regular presentations and outreach, etc.
- Highly recommend this group develop sample ordinance language to jumpstart commission thinking.
- Establish additional canals for flood storage below Lahontan Reservoir
- Establish detention basins upstream of Lahontan Reservoir
- Help get cooperation for items such as emergency procedures and criteria
- Mitigation – 1:1 may not be realistic – developers will (or may) not agree. Possible resolution could be a mitigation bank. Each situation is unique.
- Put more teeth into plan
- Needs more regulation standards

Question 2. Are there any suggested actions you are strongly opposed to?

69 of 71 responded

Yes	9
No	53
Don't know	7

Selected Comments:

- One to one mitigation in a close proximity will pass better than a higher mitigation ratio.
- [Yes], SA-6 / Get rid of no adverse effect; add word significant
- SA-1, SA-6; Need to retain ability to clean debris and gravel bars out of river
- Permanent protection in a simple manner
- "No adverse impact" is illogical. Maybe "minimal" or "no substantial" – need wiggle room.

Question 3. Do you believe this regional plan will help communities within the Carson River Watershed be successful in saving floodplains?

70 of 71 responded

Yes	61
No	2
Don't Know	7

Selected Comments:

- [Yes], How about legislation – the governor/ state of Nevada proclaims the value of floodplains and the heritage of ranching and agriculture in Northern Nevada
- Counties are the key.
- If coordinated with all interests & money is available to establish floodplain data
- Help improve consistency thru-out watershed
- Needs Bureau of Reclamation cooperation
- If upstream builds out and increases water velocity to Lahontan Reservoir, it could blow Dam and have devastating effects.
- Education on cost of rebuilding your floodplain
- It needs to be widely distributed, with lots of media coverage to advocate the whole community.
- Funding and conservation easements, supported by the outreach to encourage support.
- However we need money to pay landowners to set aside land near the river, can't expect them to just give trust land for free to be managed by someone else.
- But need to sustain political support through implementation action
- Educating public is important
- Bridges on roads are inadequate during floods.
- If coupled with outreach and public awareness, could encourage Counties to write stronger ordinances.
- Analysis of cumulative impacts is a powerful tool for counties.
- Takes the heat off decision makers – a plan is in place.
- Consistent vision across jurisdictions.
- Regional approach equals less downstream impact.
- Regional approach helps development and engineering community – model can be run across counties and downstream.
- Developer Buy-In
- Be able to go to next steps! – i.e., ordinances, zoning changes, funding

- Help long-term planning
- Contain/Reduce Lawsuits
- Developer should be held accountable and liable financially
- Need serious public education
- Strength in numbers
- Protect citizens

Question 4. Would you recommend your county adopt this plan?

69 of 71 responded

Yes	56
No	2
Don't know	11

Selected Comments:

- [Yes], with some changes.
- Regional groups working together- can generate more funding
- Consistency is important for resource (utilization of)
- Needs teeth – a step in that direction
- No adverse impact approach is important

Question 5. Which one of these categories best describes your interest concerning the Carson River Watershed Regional Floodplain Management Plan?

The 71 respondents identified themselves as being part of one or more groups

Private citizen	22
Elected official	9
Land use planner or engineer	11
Environmental advocate	5
Agriculture producer	14
Public agency employee	20
Recreationist	2
Tribal Member	0
Educator	3
Realtor	0
Other	5
Blank	2