Risk Report

This Risk Report covers the Upper Spokane Watershed study area and is specific to Spokane County and its participating communities: the Cities of Spokane and Spokane Valley; the Town of Millwood; and Spokane County

April 2013

FEMA

RiskMAP
Increasing Resilience Together

Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides States, Tribes and local communities with flood risk information and tools that they can use to increase their resilience to hazards and better protect their citizens. By combining maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating risks.

This Risk Report provides non-regulatory information to help local or Tribal officials, floodplain managers, planners, emergency managers, and others better understand their risk, communicate those risks to their citizens and local businesses, and take steps to mitigate those risks.

Because the extent of a risk often extends beyond community limits, the Risk Report provides risk data for the entire study area as well as for each individual community when available. This also emphasizes that risk reduction activities may impact areas beyond jurisdictional boundaries.

The risk associated with hazards is always changing, and there may be other studies, reports, or other sources of information available that provide more comprehensive information. The Risk Report is not intended to be regulatory or the final authoritative source of all risk data in the project area. Rather, it should be used in conjunction with other data sources to provide a comprehensive picture of flood, seismic, wildfire, landslides, and severe weather risks and their effects within the project area.

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1. Introduction

1.1 About Flood Risk

Floods are naturally occurring events that can and do happen almost anywhere. In its most basic form, a flood is an accumulation of water over normally dry areas. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses.

Which picture below shows greater flood risk?

Even if you assume that the flood in both pictures was the same probability (e.g. a 10% annual-chance flood) the consequences in terms of property damage and potential injury as a result of the flood in the bottom picture are much more severe. Therefore, the flood risk in the area shown on the bottom picture is greater.

Whether an area might flood is one consideration. The extent to which it might flood adds a necessary dimension to that understanding.

Calculating Flood Risk

The most common method for determining flood risk, also referred to as vulnerability, is to identify the probability of flooding and the consequences of flooding:

Flood Risk (or Vulnerability) **= Probability x Consequences**; where

Probability = the likelihood of occurrence

Consequences = the estimated impacts associated with the occurrence

- The probability of a flood is the likelihood that a flood will occur. The probability of flooding can change based on physical, environmental, and/or engineering factors. Factors affecting the probability that a flood will impact an area vary due to changing weather patterns, land use decisions, and the existence of mitigation projects. The ability to assess the probability of a flood, and the level of accuracy for that assessment, is also influenced by modeling methodology advancements, better knowledge, and longer periods of record for the water body in question.

- The consequences of a flood are the estimated impacts associated with the flood occurrence. Consequences relate to humans activities within an area and how a flood impacts the natural and built environment.

Risk MAP Flood Risk Products

FEMA understands that flood risk is dynamic and that flooding does not stop at a line on a map, and provides the following flood risk products:

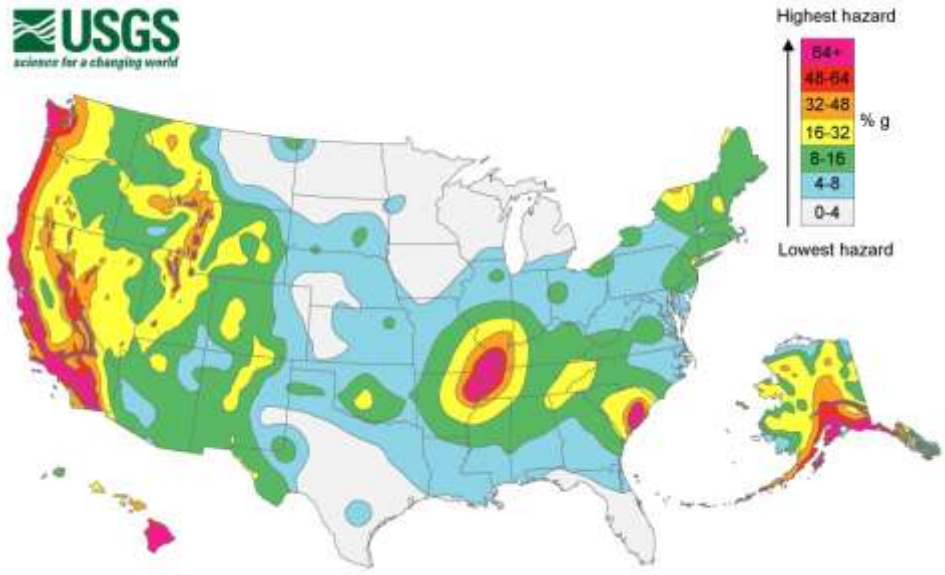
- A section in the Risk Report that describes key findings.
- A Flood Risk Map, found in Section 3.1 of this document, shows risk areas at risk and is provided as an exhibit within the Risk Report. Details about the data shown on the map can be found in Section 2.

- A Flood Risk Database houses the flood risk data developed during the course of the flood risk analysis to the raw flood risk data that can be used and updated by the community. After the Risk MAP study is complete, this data can be used in many ways to visualize and communicate flood risk within the study area.

1.2 About Earthquake Risk in Eastern Washington and Northwestern Idaho

Idaho and Washington have active faults that have produced a number of historic earthquakes.

The U.S. Geological Survey (USGS) National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. This is updated periodically to incorporate new findings on earthquake ground shaking, faults, seismicity, and geodesy. The resulting maps are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the frequency of exceeding a set of ground motions. Below is a figure of the 2008 USGS Hazard Map with a 2% in 50 year probability.



Examples of how FEMA data can be leveraged to identify and measure vulnerability.

Calculating Earthquake Risk

Earthquake risk is calculated based on location, extent, and magnitude. Location is determined by locations of faults and/or past locations of earthquakes. Extent and magnitude are measured in two ways:

- Magnitude (as measured by the Richter Scale) measures the energy that is released. Magnitude is calculated by seismologists from seismograph readings and is most useful to scientists comparing the power of earthquakes.
- Intensity (as measured by the Modified Mercalli Intensity Scale, MMI). The Modified Mercalli Intensity Scale is a subjective description of the physical effects of the shaking based on observations at the event site. Using this scale, a value of I is the least intense motion, and XII is the greatest ground shaking. Unlike magnitude, intensity can vary from place to place.

Modified Mercalli Intensity Scale (MMI)
I. Not felt except by a very few under especially favorable conditions
II. Felt only by a few persons at rest, especially on upper floors of buildings
III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX. Damage considerable in specially designed structures; well-designed frames structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI. Few, if any (masonry) structures remain standing. Bridges destroyed, Rails bent greatly.
XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Risk MAP Earthquake Risk Products

- A section in the Risk Report that describes key findings.
- A profile of available USGS ShakeMaps that may impact the study area.
- An Earthquake Risk Database that houses the earthquake risk data during the course of the risk assessment that can be used and updated by the community.

1.3 About Wildfire Risk

The Wildland/Urban Interface is a region identified in a community that is prone to wildfires or the rapid spread of wildfires under certain conditions. These factors generally include fuels, land slopes, and climate.

To asses these areas and designate areas with wildfire risk, the Community Wildfire Protection Plan was developed for Spokane County, Washington. The 2009 document is the result of analyses, professional cooperation and collaboration, assessments of wildfire risks and other factors. The intent of this document is to reduce the potential for wildfires that threaten people, structures, infrastructure, and the natural ecosystems in Spokane County.

The Federal Emergency Management Agency (FEMA) requires a Hazard Mitigation Plan for communities to be eligible for FEMA's Hazard Mitigation Grant Program and Pre-Disaster Mitigation Program. Managed by state emergency management agencies, these programs provide funding to support local mitigation planning and projects that reduce potential disaster damages.

The Spokane County Multi-Jurisdiction All Hazard Mitigation Plan expired in May 2012. The county is currently in the process of updating this plan. The Spokane County Community Wildfire Protection Plan (2009) fulfills all the requirements for the wildfire chapter in the all hazard mitigation plan.

In addition to following steps outlined in the Community Wildfire Protection Plan, multiple documents have been prepared by FEMA as single handouts to increase awareness of wildfire risk as needed. The following table lists handouts prepared by FEMA to assist in community outreach efforts and are located in Appendix X.

Wildfire Handout List		
Focus Group	**Document Title**	**Topics**
General Population	Wildfires	Local History; Action Items Before, During, and After
Developers	Developing a Home for Wildfires	Pre-Construction Design; Building Materials & Construction
Property Owners	Preparing your Home for Wildfire	Defensible Space; Action Items

The Spokane Conservation District involving the Spokane County region participates in Firewise, a national program that offers free risk assessments of your home site to evaluate its ability to survive a wildfire. This program attempts to lower wildfire risk by providing a personalized list of practical ways to lessen and individual property's risk. The main focus is to promote the effective use of defensible space. Additional information about the Firewise program can be found on the Spokane County Conservation District website, http://sccd.org/firewise.html.

1.4 About Severe Weather Risk

Spokane's weather is typified by a very warm, arid climate during the summer months and a cold, snowy, and moist climate during winter months. Spokane's location between the Cascade Mountains to the west and Rocky Mountains to the east and north, protects the area from typical weather patterns found in other regions of the Pacific Northwest. The area does experience ice storms and high wind storms that can impact the region for days to weeks. Typical storm damages include power outages, infrastructure collapse, and snowdrifts that block typical travel patterns.

Spokane County in collaboration with the National Weather Service and other state, federal and nonprofit agencies has developed weather forecasting websites that also include winter safety and preparedness information. The winter weather safety and preparedness tips report located on the Spokane County website reviews steps to prepare your home and car, includes a food, water, and safety checklist, a communications checklist and an emergency checklist. In addition to this information, an outreach handout has been prepared by FEMA and is available in Appendix XX of this report that discusses the local history of severe storms and steps residents can take before, during, and after a severe storm event.

1.5 Uses of this Report

The goal of this report is to help inform and enable communities to take action to reduce risk. State, local, and tribal officials can use the summary information provided in this report, in conjunction with the data in the Risk Database, to:

- **Update local hazard mitigation plans and community comprehensive plans** – Planners can use risk information in the development and/or update of hazard mitigation plans, comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes may be changed to better provide for appropriate land uses in high hazard areas.
- **Update emergency operations and response plans** – Emergency managers can identify low risk areas for potential evacuation and sheltering, and can assist first responders in avoidance of areas of high risk areas. Risk assessment results may show vulnerable areas, facilities and infrastructure for which planning for continuity of operations plans (COOP), continuity of government (COG) plans, and emergency operations plans (EOP) would be essential.
- **Communicate risk** – Local officials can use the information in this report to communicate with property owners, business owners, and other citizens about risks and what can be done about it.

- **Inform the modification of development standards** – Floodplain and emergency managers, planners and public works officials can use information in this report to support the adjustment of development standards for certain locations. For example, heavily developed areas tend to increase floodwater runoff because paved surfaces cannot absorb water, indicating a need to adopt or revise standards that provide for appropriate stormwater retention.

The risk products provided under Risk MAP are available and intended for community use. They are not tied to the regulatory development and insurance requirements of the National Flood Insurance Program nor are they required to be used.

Possible users of this report include

- Local Elected Officials
- Floodplain Managers
- Community Planners
- Emergency Managers
- Public Works Officials
- Other Special Interests (e.g., watershed conservation groups, environmental awareness organizations, etc.)

Flooding impacts non-populated areas too, such as agricultural lands and wildlife habitats.

State and Local Hazard Mitigation Plans are required to have a comprehensive all-hazard risk assessment. The risk analyses in the Risk Report, Risk Map, and Risk Database can inform of the hazards portion of a community's or state's risk assessment. Further, data in the risk database can be used to develop information which meets the requirements for risk assessments as it relates to the hazard of flood in hazard mitigation plans.

2. Risk Analysis

2.1 Flood Overview

Risk assessment is the systematic approach to identifying how a hazard impacts the environment. By defining the hazard, flood risk assessments enable informed decision making and form the basis for mitigation strategies and actions. To fully assess flood risk requires the following:

- Development of a complete profile of the flood hazard including location, historical occurrence and previous impacts
- Inventory of assets located in the identified flood hazard area
- Estimation of potential future flood losses caused by exposure to the area of flood hazard

Flood risk analysis can be done on a large scale (state, watershed) level and on a very small scale (parcel, census block). Large scale flood risk analysis can identify how actions and development in one community can affect areas up- and downstream. On the parcel or census block level, analysis can provide communities with actionable data to inform appropriate mitigation actions.

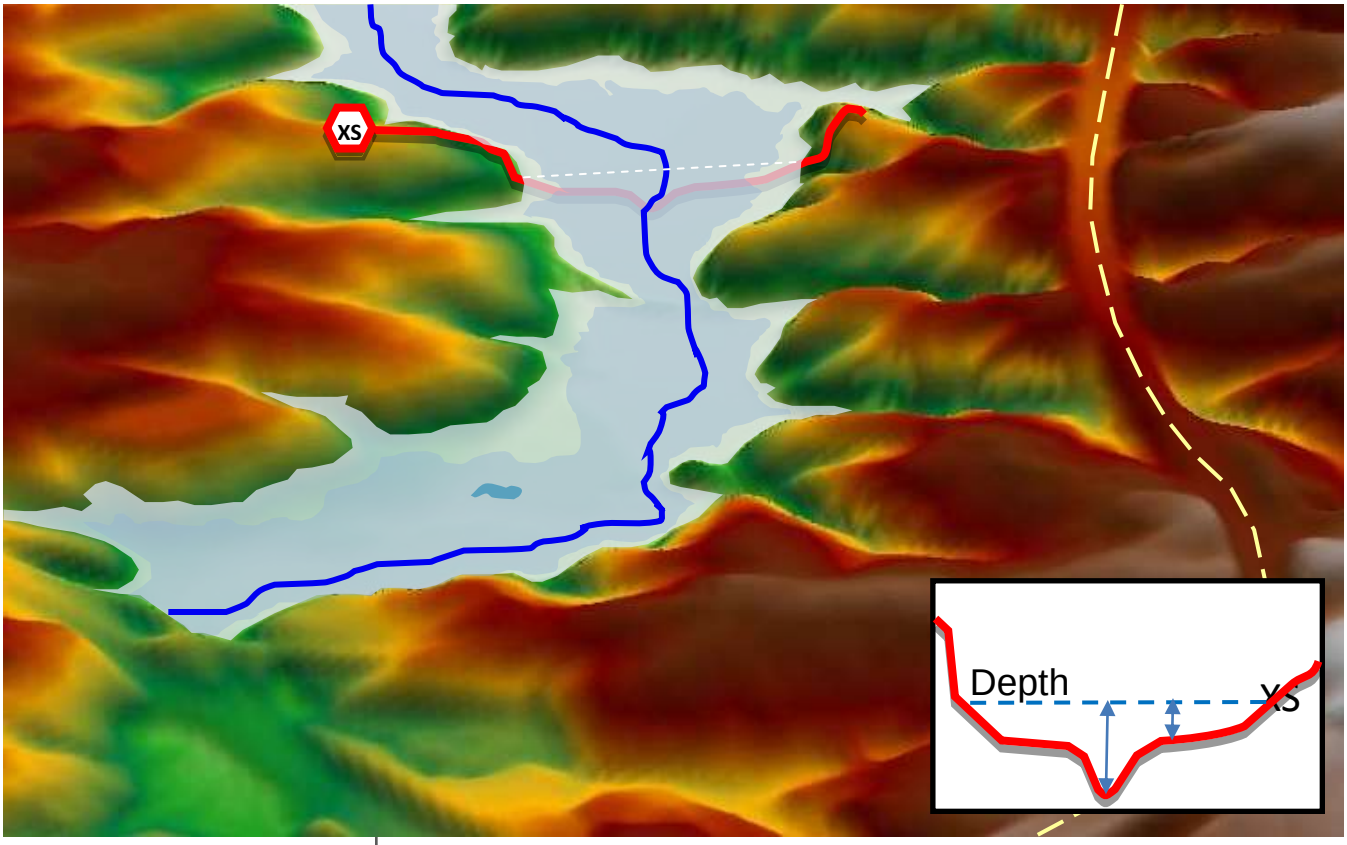
2.2 Analysis of Flood Risk

To assess potential community losses or the consequences portion of the "risk," equation, the following data was collected:

- Information about local assets or resources at risk of flooding
- Information about the physical features and human activities that contribute to that risk
- Information about location and severity of the hazard

The report, maps and database contain three general types of risk analysis to help describe and visualize the flood risk at the jurisdictional levels:

1. Water Surface, Flood Depth and Analysis Grids
2. Hazus Estimated Loss Information
3. Areas of Mitigation Interest



2.3 Flood Depth Grids

Depth grids are FEMA datasets provided in the Risk Report. Depth grids help to understand not only where the water will go but how deep it can get. These grids are intended to be used by communities for additional analysis, enhanced visualization, and communication of flood risks for hazard mitigation planning and emergency management. The 1-percent-annual-chance flood depth grid is provided in the Risk Report. The flood depth and analysis grid show depth which is calculated as the difference (in feet) between the water surface elevation and the ground. The depth grid is used to calculate potential flood losses.

2.4 Seismic Overview

Risk assessment is the systematic approach to identifying how a hazard impacts the environment. By defining the hazard, earthquake risk assessments enable informed decision making and form the basis for mitigation strategies and actions. To fully assess earthquake risk requires the following:

- Development of a complete profile of the seismic hazard including epicenter, depth, magnitude, shaking intensity, liquefaction and soil data.
- Inventory of assets located in the identified hazard area

- Estimation of potential future losses caused by exposure to the area of the hazard.

Earthquake analysis is done on a large scale (state, county, watershed) level. Large scale risk analysis can identify how infrastructure capabilities, capacity, and failures can affect neighboring and distant community's economy and response efforts.

2.5 Analysis of Seismic Risk

To assess potential community losses or the consequences portion of the "risk," equation, the following data was collected:

- Information about local assets or resources that may be damaged by lateral ground movement and/or liquefaction,
- Information about the physical features (i.e. bridges, overpasses, etc.),
- Human activities that contribute to that risk (i.e. shelter needs, etc.) and information about location and severity of the hazard. The report, maps, and database contain two general types of risk analysis to help describe and visualize earthquake risk at the watershed level:
    1. Shaking Intensity and liquefaction overlays
    2. Hazus Estimated Loss Information

2.6 ShakeMaps

A ShakeMap is created by regional seismic network operators in cooperation with the United Geologic Survey (USGS). ShakeMaps can provide near real-time maps of shaking intensity and ground motion following an earthquake. ShakeMaps can also be generated as "Earthquake Scenarios" where intensities and ground motions have been estimated. These are events on faults that have ruptured in the past or have a likelihood of rupturing in the future. The primary purpose of a ShakeMap is for emergency response exercises and planning as well as for understanding the potential consequences of future large earthquakes. This data can be used as hazard scenario input for a FEMA loss-estimation tool, Hazus, providing the software with seismic intensity and ground motions data for use in more accurately depicting losses.

Hazus-MH is a loss estimation methodology developed by FEMA for the flood, wind, and earthquake hazards. The methodology and data established by Hazus can also be used to study other hazards.

2.7 Hazus Estimated Loss Information

Loss estimates provided in the Risk Report were developed using a FEMA risk assessment tool, Hazus-MH. Hazus is a tool that can help to estimate losses to lives and property by combining information about the built environment with information about the location and magnitude of hazard. Hazus can provide risk assessment information for floods, earthquakes, and hurricane winds.

Loss estimates are based on best available data, and the methodologies applied result in an approximation of risk. These estimates should be used to understand relative risk and potential losses. Uncertainties are inherent in any loss estimation methodology, arising in part from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete inventories, demographics, or economic parameters).

Unreinforced masonry buildings are susceptible to shaking and create debris.

The Risk Report primarily uses specific flood and seismic risk analysis methods which are summarized below:

Scenario Loss Estimates:

- **Flood:** Scenario losses have been generated by Hazus for the 1-percent-annual-chance flood.
- **Seismic:** The 5.5M earthquake was inputted into Hazus using available liquefaction data for Spokane County.

This report contains Hazus estimated losses for the following:

- **Residential Asset Loss** – These include direct building losses (estimated costs to repair or replace the damage caused to the building) for all classes of residential structures including single family, multi-family, manufactured housing, group housing, and nursing homes. This value also includes content losses.
- **Commercial Asset Loss** –These include direct building losses for all classes of commercial buildings including retail, wholesale, repair, professional services, banks, hospitals, entertainment, and parking facilities. This value also includes content and inventory losses.
- **Other Asset Loss** –This includes losses for facilities categorized as industrial, agricultural, religious, government, and educational. This value also includes content and inventory losses.
- **Potential Impact to Essential Facilities** - including hospitals, fire stations, police stations, Emergency Operation Centers and schools
- **Shelter needs** - Projected number of people displaced from residence and/or in need of shelter
- **Debris** - Projected amount of debris generated in tons
- **Loss Ratio:** The loss ratio expresses the scenario losses divided by the total building value for a local jurisdiction. This can be a gage to determine overall community resilience as a result of a scenario event. For example, a loss ratio of 5% for a given scenario would indicate that a local jurisdiction would be more resilient and recover easier from a given event versus a loss ratio of 75% which would indicate widespread losses.
- **Hazus Flood Risk Value:** On the Flood Risk Map, relative flood risk is calculated at the community level and is expressed by the following three categories: low, medium, and high. It is based on the 1-percent-annual-chance flood.

2.8 Areas of Mitigation Interest (AOMI)

Many factors contribute to flooding and flood losses. Some are natural, some are not. In response to these risks there has been a focus by the Federal Government, State agencies, and local jurisdictions to avoid losses and mitigate properties against the impacts of flood hazards. AOMIs are important to identifying target areas and potential projects for flood hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce flood risk.

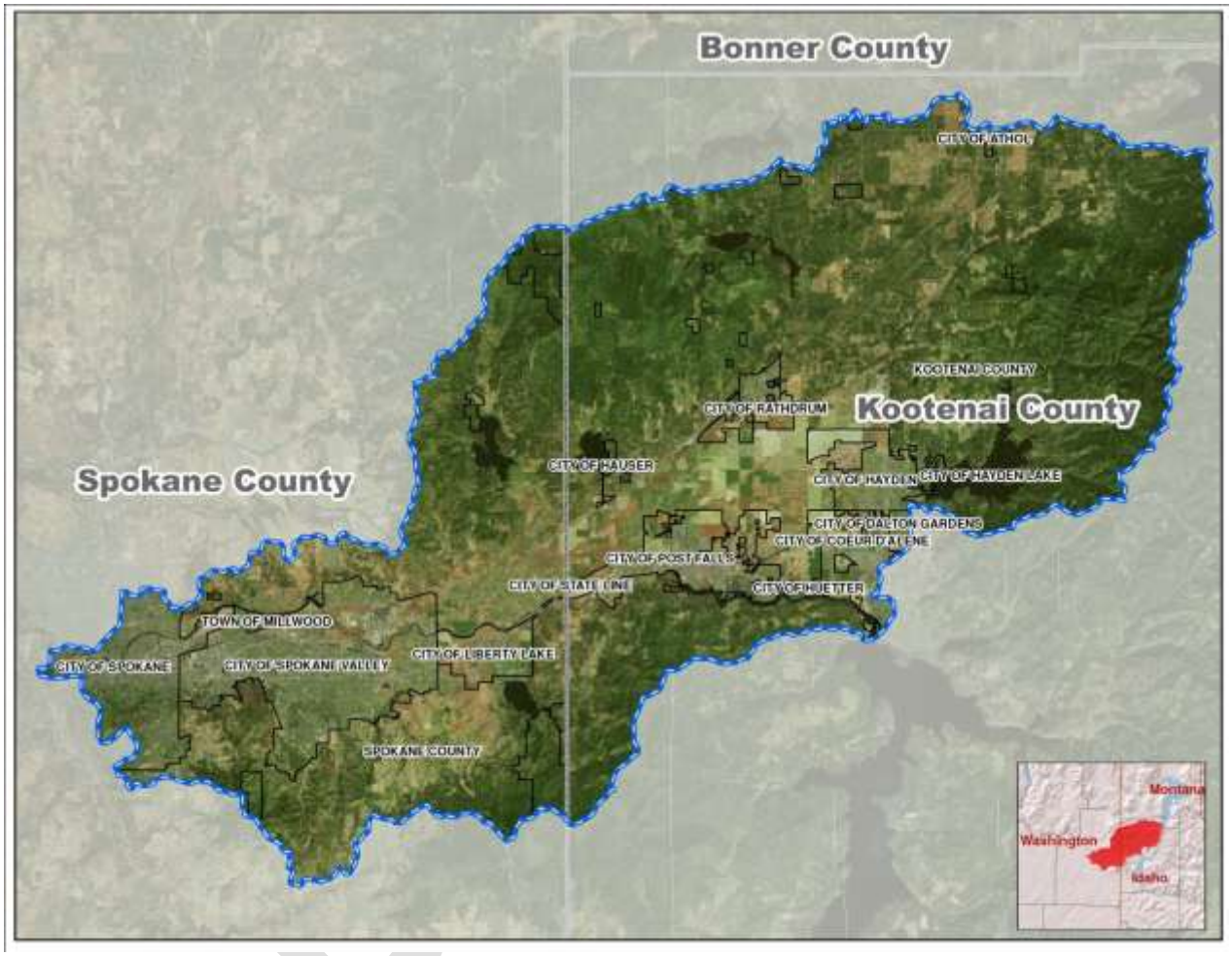
A list of hazard specific mitigation actions for each AOMI can be found in section 5.

3. Flood Risk Analysis Results

The following pages provide general risk assessment results of the analyses and identified areas of mitigation interest at the watershed level within Spokane County as well as detailed results at the community level.

3.1 Upper Spokane Watershed Summary

Figure 3.1: Watershed Overview Map



Spokane County, within the Upper Spokane Watershed, includes the following communities:

Community Name	CID	Total Community Population	Environmental Sensitive Issues	CRS Community	Flood Claims	Repetitive Loss Properties	Total Policies	Total Insurance Coverage
Spokane County	530174	208,916	Aquifer	N	0	0	278	$60,046,500
City of Spokane Valley	530183	89,755	Aquifer	N	Community not mapped	Community not mapped	34	$6,273,900
Town of Millwood	530180	1,786	Aquifer	N	0	0	1	$250,000
City of Spokane	530183	208,916	Aquifer	N	0	2	89	$18,431,300

The above table includes the current population, environmental concerns, flood claims, flood policies, and flood insurance total coverage purchased that is in effect for each community. Flood claims are indicative of past damage to structures. In general, unless a community has pursued mitigation measures, a greater number of flood claims suggest that there is a greater potential for future losses. Communities can use this information to identify mitigation opportunities.

The estimated Hazus Building Value Exposed is an estimate of the structure and content value within the entire community and does not differentiate between structures located within hazard areas and those located outside hazard areas. The Hazus analysis was completed with level 1 data, so parcel/assessors data were not included in this analysis. For this study, a county-wide depth grid was derived from LiDAR provided by Spokane County, which was input into Hazus. Losses from Hazus are provided below for the 1-percent-annual-chance flood event. Losses are shown for residential, commercial, and other buildings. The loss ratio is calculated using the losses for that event divided by estimate inventory value.

Note: Loss Ratios are a useful gage to determine overall community resiliency. The lower the loss ratio, the easier it will be for a community to recover from a given event.

3.2 City of Spokane Valley Summary (CID 530342)

Overview

The City of Spokane Valley is the second largest community located within Spokane County in the Upper Spokane Watershed that participated in the Discovery Process. The information below provides an overview of the community's floodplain management program information as of the date of this publication.

- Participating in National Flood Insurance Program (NFIP)
- Not Participating in NFIP Community Rating System (CRS)
- Included in the Hazard Mitigation Plan for Spokane County
- NFIP Policy Coverage (policies/value) = 34 policies totaling approximately $6,273,900
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized Severe Repetitive Loss properties = 0

Hazus-MH Estimated Loss Information

The City of Spokane Valley's flood risk analysis uses results from a FEMA performed Hazus-MH analysis which accounts for modeled areas in the study area. The analysis is based on the 1-percent-annual-chance-flood depth grid. Hazus results are also shown for impacted populations, debris generation, and essential facilities.

Estimated Potential Flood Losses City of Spokane Valley 1%-Annual-Chance (100-yr) Flood Event	
Building Losses	$2,935,000
Contents and Inventory	$2,957,000
Total	$5,892,000

Population & Debris Impacts City of Spokane Valley 1%-Annual-Chance (100-yr) Flood Event	
Shelter Needs	220
Displaced Population	426
Debris (in tons)	969

Source: Hazus analysis results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

Figure 3.2: Proximity of Effective 1%-Annual-Chance Flood and Critical Facilities

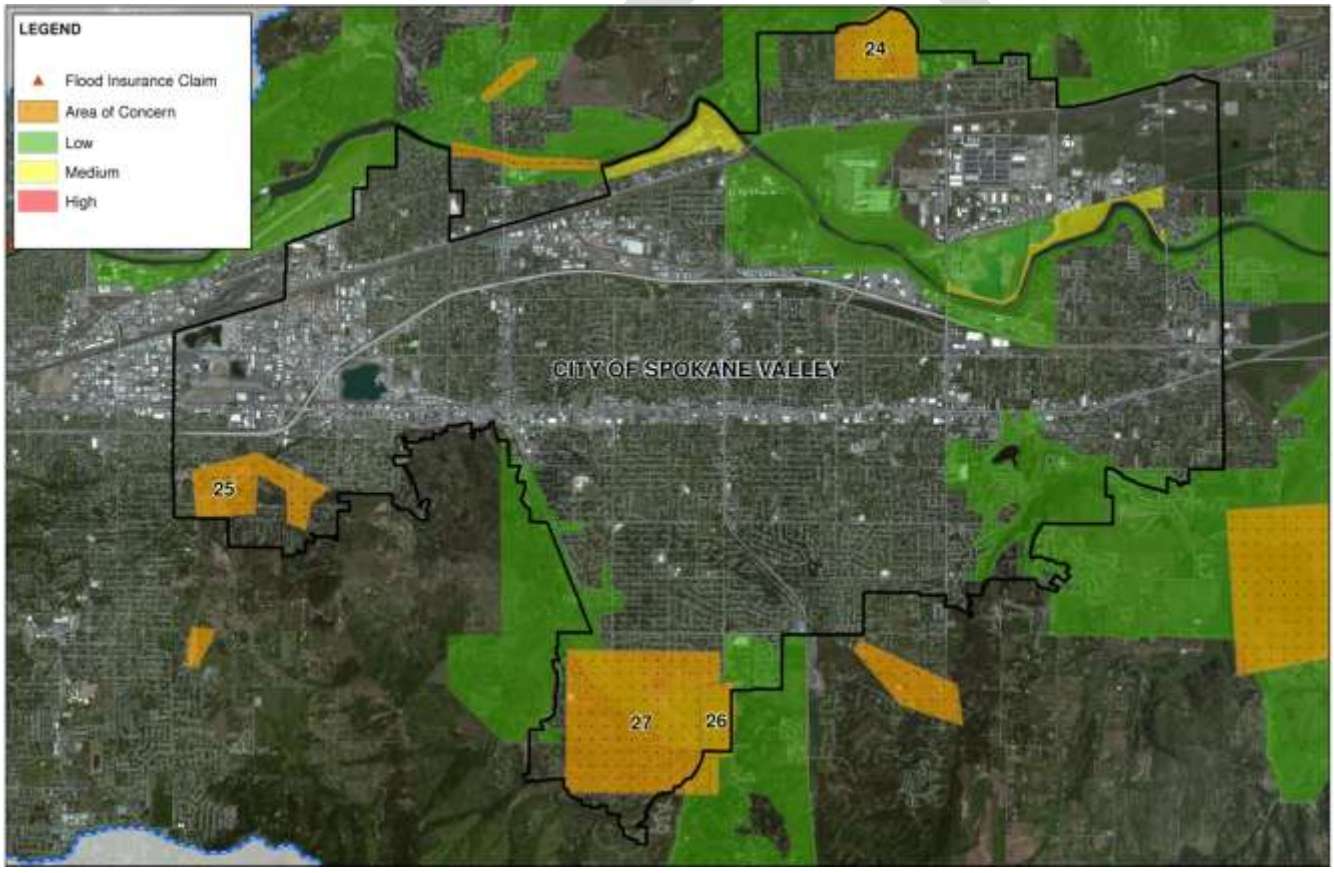
Hint: Hazus debris calculations from building loss can help communities plan for the resources needed to help with clean-up following a disaster.

Areas of Concern (AOC)

Areas of Concern are shown below which were identified by the community. These areas of concern identify flood prone areas and/or concerns. Please refer to section 5 on this report for potential mitigation actions for these areas of concern.

Mitigation Interest	Problem Statement	Map ID#
Flooding	Alluvial Fan flood risk isn't accurately represented on effective Flood Insurance Rate Map (FIRM). The City is currently restudying this area.	24
Flooding	There is development pressure in this area. A detailed floodplain study is desired in this location.	25
Flooding	Along the Golf Course, there is a trench and culvert issue which is restricting storm flows. An analysis of the culvert including the hydraulic capabilities can be conducted to assess the severity of the issue.	26
Wildfire	The Ponderosa Development has limited egress. Outreach activities will be advantageous in this region.	27

Figure 3.3: AOCs identified through the Discovery Process for Spokane Valley



This map was created using the effective 1%--annual-chance flood Hazus Study data.

3.3 Town of Millwood (CID 530180)

Overview

The Town of Millwood is one of three communities located within Spokane County in the Upper Spokane Watershed that participated in the Discovery Process. The information below provides an overview of the community's floodplain management program information as of the date of this publication.

- Participating in National Flood Insurance Program (NFIP)
- Not Participating in NFIP Community Rating System (CRS)
- Included in the Hazards Mitigation Plan for Spokane County
- NFIP Policy Coverage (policies/value) = 1 policies totaling approximately $250,000
- NFIP-recognized repetitive loss properties = 0
- NFIP-recognized Severe Repetitive Loss properties = 0

Hazus-MH Estimated Loss Information

Millwood's flood risk analysis uses results from a FEMA performed Hazus-MH analysis which accounts for modeled areas in the study area. The analysis is based on the 1-percent-annual-chance flood depth grid. Hazus results are also shown for impacted populations, debris generation, and essential facilities.

Estimated Potential Flood Losses Town of Millwood 1%-Annual-Chance (100-yr) Flood Event	
Building Losses	$146,000
Contents and Inventory	$351,000
Total	$497,000

Population & Debris Impacts Town of Millwood 1%-Annual-Chance (100-yr) Flood Event	
Shelter Needs	1
Displaced Population	7
Debris (in tons)	9

Figure 3.4: Proximity of Effective 1%-Annual-Chance Flood and Critical Facilities

Hint: Hazus debris calculations from building loss can help communities plan for the resources needed to help with clean up following a disaster.

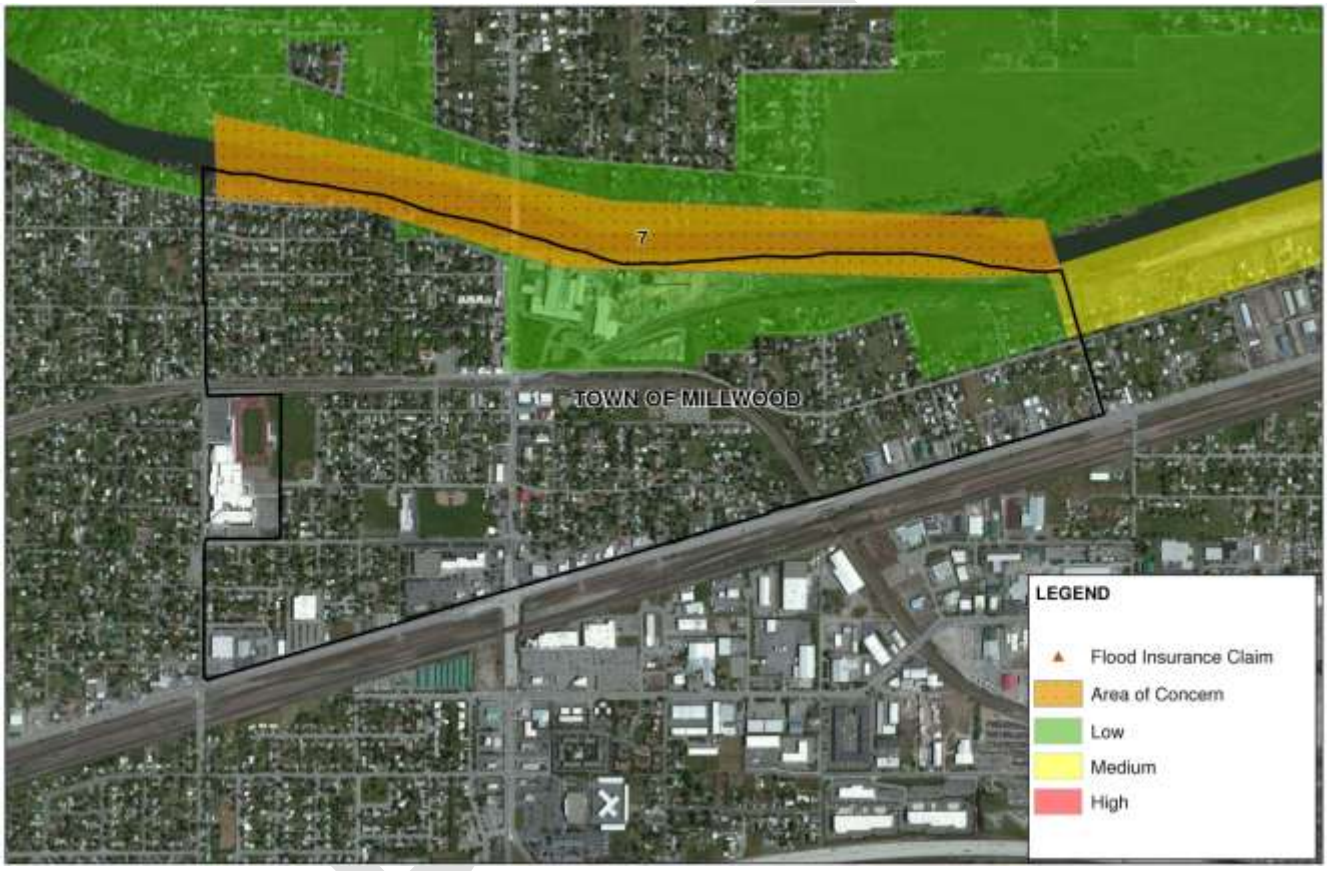
Emergency Managers and Planners can use information about population impacts to prepare and plan for future shelter needs. When planning for shelter needs it is important to consider locations outside of the hazard areas that are accessible to impacted population.

Areas of Concern (AOC)

Areas of Concern are shown below which were identified by the community. These areas of concern identify flood prone areas and/or concerns. Please refer to section 5 on this report for potential mitigation actions for these areas of concern.

Mitigation Interest	Problem Statement	Map ID#
Flood	Floodplain limits along the bank of the Spokane River don't accurately represent the flood hazard. When more detailed topography becomes available, this area should be considered for a redelineation study.	7

Figure 3.5: AOCs identified through the Discovery Process for the Town of Millwood



This map was created using the effective 1%--annual-chance flood Hazus Study data.

3.4 City of Spokane Summary (CID 530183)

Overview

City of Spokane is the largest community located within Spokane County. The information below provides an overview of the community's floodplain management program information as of the date of this publication.

- Participating in National Flood Insurance Program (NFIP)
- Not Participating in NFIP Community Rating System (CRS)
- Included in the Hazards Mitigation Plan for Spokane County
- NFIP Policy Coverage (policies/value) = 89 policies totaling approximately $18,431,300
- NFIP-recognized repetitive loss properties = 2
- NFIP-recognized Severe Repetitive Loss properties = 0

Hazus-MH Estimated Loss Information

Spokane's flood risk analysis uses results from a FEMA performed Hazus-MH analysis which accounts for modeled areas in the study area. The analysis is based on the 1-percent-annual-chance flood depth grid. Hazus results are also shown for impacted populations, debris generation, and essential facilities.

Estimated Potential Flood Losses City of Spokane 1%-Annual-Chance (100-yr) Flood Event	
Building Losses	$15,335,000
Contents and Inventory	$23,304,000
Total	$38,639,000

Population & Debris Impacts City of Spokane 1%-Annual-Chance (100-yr) Flood Event	
Shelter Needs	871
Displaced Population	975
Debris (in tons)	2337

Figure 3.6: Proximity of Effective 1%-Annual-Chance Flood and Critical Facilities

Hint: Identifying essential facilities in hazardous areas can be a helpful tool to prioritize mitigation measures.

Risk assessments for non-essential Infrastructure, such as cultural centers, museums, and structures of community significance, play an essential role in mitigation planning for risk reduction.

Areas of Concern (AOC)

Areas of Concern are shown below which were identified by the community. These areas of concern identify flood prone areas and/or concerns. Please refer to section 5 on this report for potential mitigation actions for these areas of concern.

Mitigation Interest	Problem Statement	Map ID #
Flood	There are channel migration issues in this region according to local officials.	Outside Watershed Boundary
Fire	There are higher fire risks in the northeast portion of the city. Outreach to home owners on fire prevention and defensible space may be of value.	Outside Watershed Boundary

3.5 Spokane County – Unincorporated Areas (CID 530174)

Overview

The information below provides an overview of the community's floodplain management program information as of the date of this publication.

- Participating in National Flood Insurance Program (NFIP)
- Not participating in NFIP Community Rating System (CRS)
- Included in the All-Hazards Mitigation Plan for Spokane County
- NFIP Policy Coverage (policies/value) = 278 policies totaling approximately $60,046,500
- NFIP-recognized repetitive loss properties = 2
- NFIP-recognized Severe Repetitive Loss properties = 0

Hazus-MH Estimated Loss Information

Spokane County's flood risk analysis uses results from a FEMA performed Hazus-MH analysis which accounts for modeled areas in the study area. The analysis is based on the 1-percent-annual-chance flood depth grid. Hazus results are also shown for impacted populations, debris generation, and essential facilities.

Estimated Potential Flood Losses Spokane County 1%-Annual-Chance (100-yr) Flood Event	
Building Losses	$6,888,000
Contents and Inventory	$5,171,000
Total	$12,059,000

Population & Debris Impacts Spokane County 1%-Annual-Chance (100-yr) Flood Event	
Shelter Needs	473
Displaced Population	692
Debris (in tons)	994

Figure 3.7: Proximity of Effective 1%-Annual-Chance Food and Critical Facilities

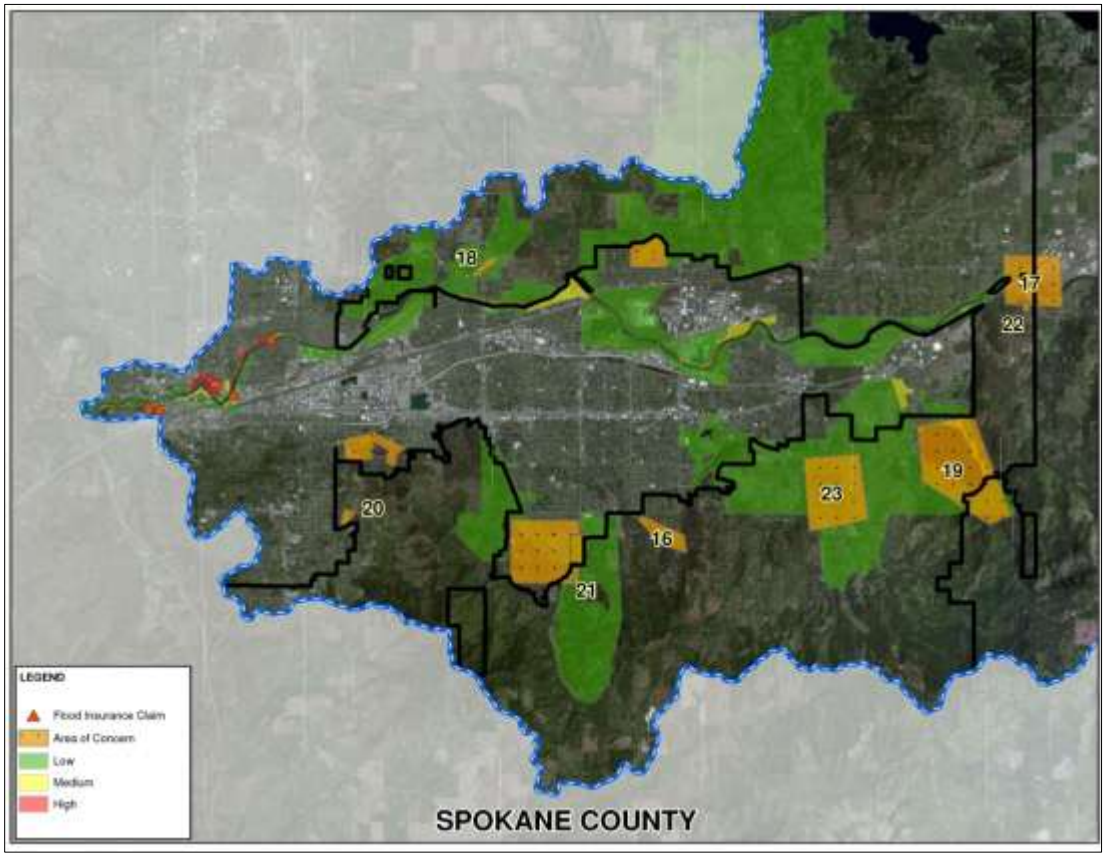
Hint: Essential facilities are often the lifelines of the community. They provide needed resources, care, and shelter to community members. When a community's lifelines are impacted by a disaster it is a threat to the life and safety of community members. It is beneficial to communities to place essential facilities located within high risk hazard zones as one of the top priorities for future mitigation.

Areas of Concern (AOC)

Areas of Concern are shown below which were identified by the community. These areas of concern identify flood prone areas and/or concerns. Please refer to section 5 on this report for potential mitigation actions for these areas of concern.

Mitigation Interest	Problem Statement	Map ID #
Fire	Wildfire evacuation routes are of concern within the county.	NA
Flood	Bell Terre Drainage flood risks are not accurately reflected on the effective maps.	16
Flood	The Washington/Idaho border has a BFE mismatch within the effective floodplain models.	17
Flood	A new development area exists, is not included in the previous restudy, and a LOMR has not been submitted.	18
Flood	Liberty Lake may need a FIS update. There is a stillwater elevation and datum conversion issue.	19
Flood	Glenrose Creek is a new development and a restudy in this area may be needed.	20
Flood	There is a possible culvert that is undersized. There is an overflow at this driveway.	21
Flood	Recent flooding has occurred outside the Special Flood Hazard Area.	22
Flood	The Saltese Flats restudy is currently underway.	23

Figure 3.8: AOCs identified through the Discovery Process for Spokane County.



This map was created using the effective 1%--annual-chance flood Hazus Study data.

4. Earthquake Risk Analysis Results

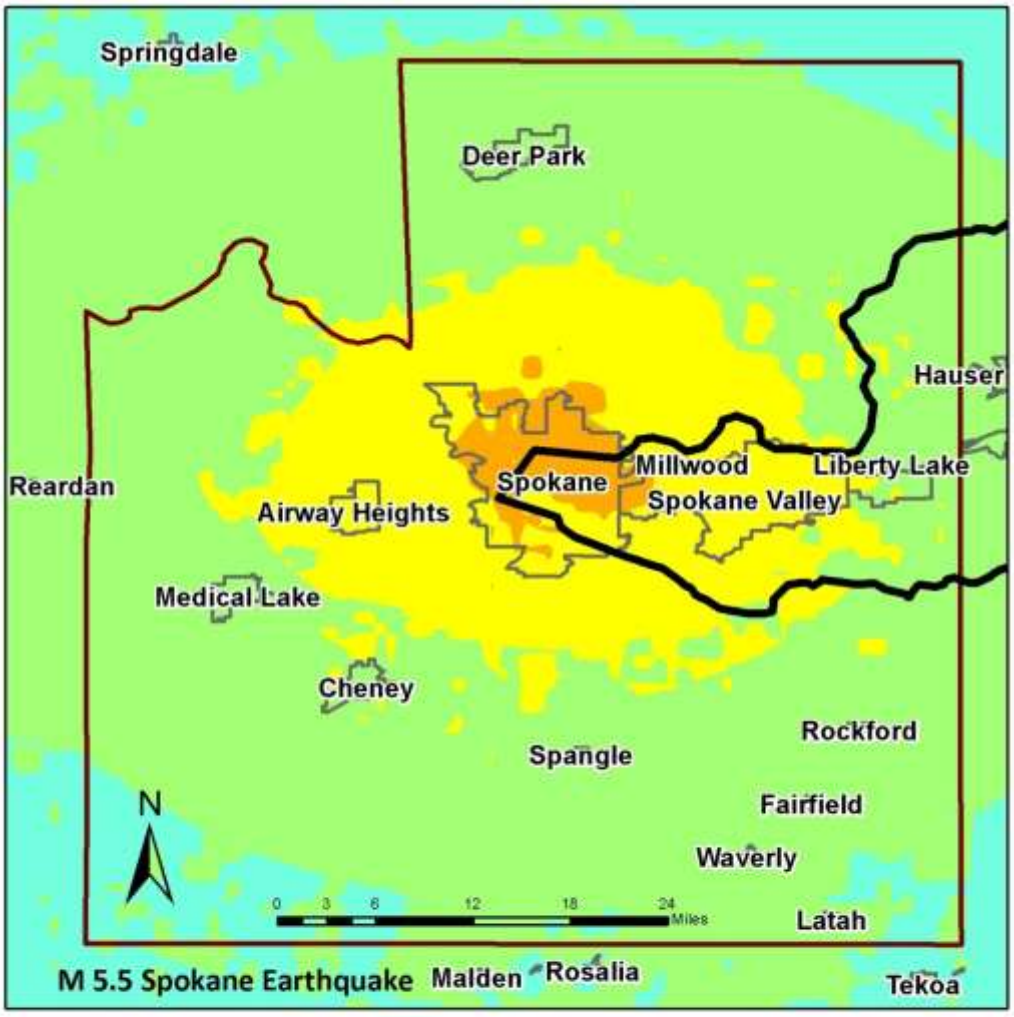
The following pages provide general risk assessment results of the analyses at the watershed level.

Upper Spokane Watershed Earthquake Summary

4.1 United States Geologic Survey (USGS) Scenario ShakeMap

Below is a USGS ShakeMap based on a scenario event for a 5.5M earthquake centered on Spokane County. Areas closer to the red spectrum have the highest intensity shaking. This ShakeMap was created by the USGS in 2009. The ShakeMap and liquefaction data were input into Hazus using Level 1 building data. The Hazus analysis was completed for all of Spokane County.

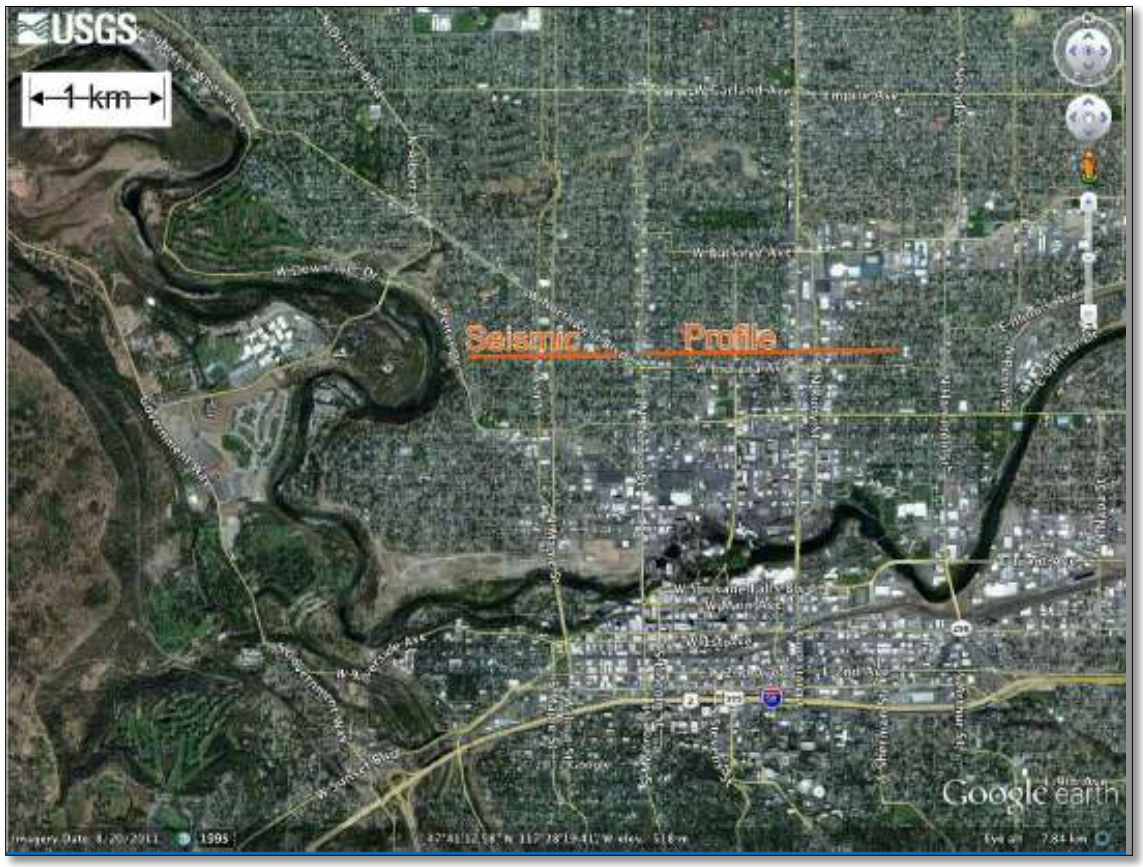
Figure 4.1: USGS Earthquake ShakeMap



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

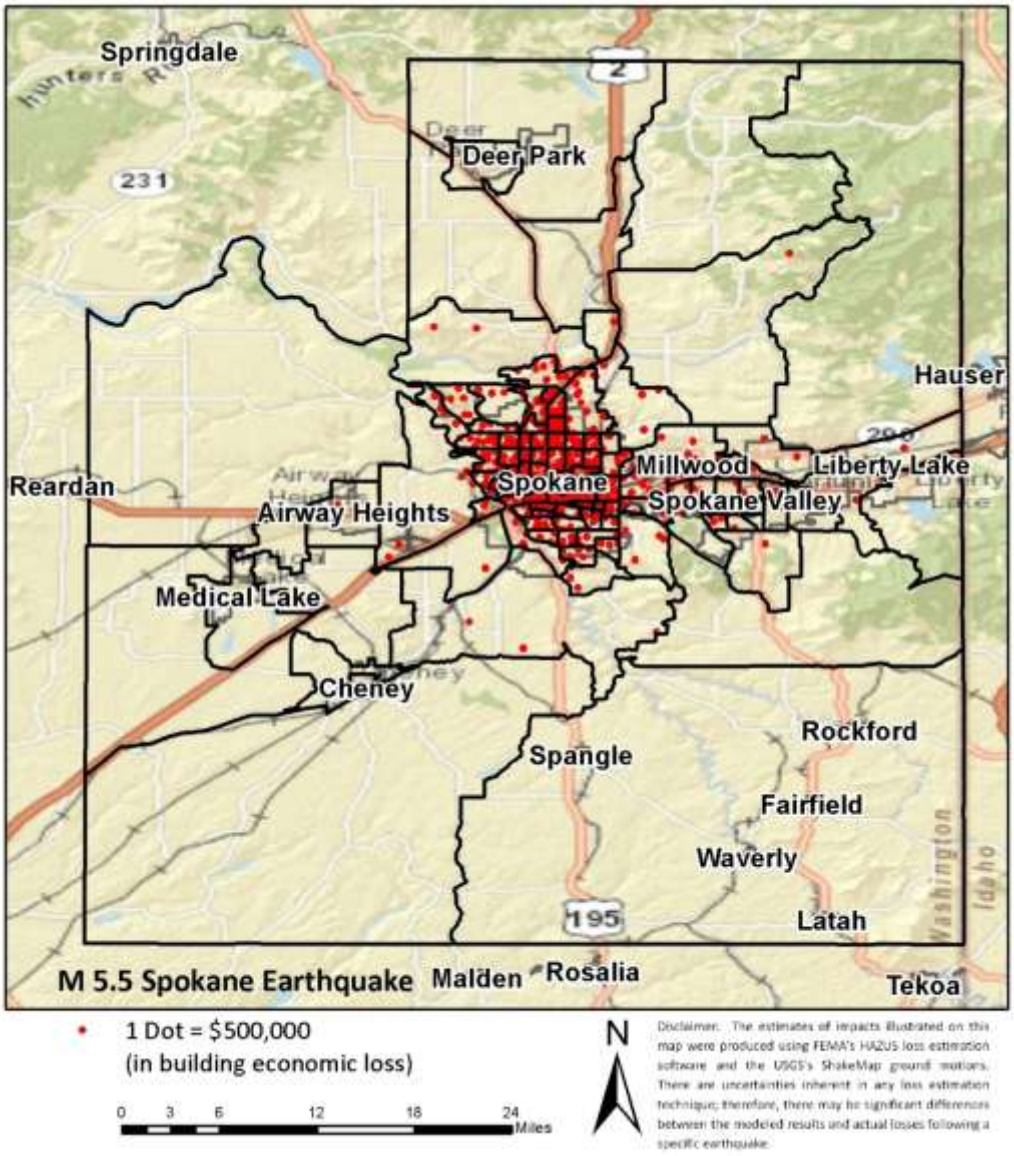
Currently, the USGS is conducting a study on a newly found fault north of Downtown Spokane, shown in the map below. Once this fault is studied and understood, a new Shakemap may be generated. The USGS is currently installing new seismometers in the area and will soon begin trenching for fault analysis.

Figure 4.2: Downtown Spokane New Fault Line Seismic Profile



4.2 Building Economic Loss

Figure 4.3: Economic Losses of Earthquake Event



The figure above shows direct building-related economic losses resulting from a 5.5M Spokane County Earthquake. The red dots represent building losses where each dot represents a loss of $500,000. The Hazus analysis is completed at the census tract level, so the dots are extrapolated across a census block and do not represent exact damage in that area. The total loss of buildings and contents from a 5.5 earthquake event is shown below.

Building-Related Economic Losses (building + contents)	
Spokane Watershed	$328,880,000

The expected building damage by occupancy table is shown below. The moderate damages buildings are those with 11-50% damage and the extensive damaged buildings are those with 51%-75% damage. There were no buildings with complete damage.

Expected Building Damage by Occupancy		
Type	**Moderate**	**Extensive**
Agriculture	6	0
Commercial	140	4
Education	3	0
Government	2	0
Industrial	45	1
Other Residential	355	5
Religion	6	0
Single Family	432	2
Total	989	12

4.3 Utility System Infrastructure

Hazus calculates impacts to utility systems. This analysis shown slight damage to potable water facilities, but no other facilities were impacted.

Utility System Lifeline Inventory		
System	**Inventory Value**	**Economic Loss**
Potable Water - Facilities	$36,600,000	$2,760,000

Note: Identifying utility system functionality can help response planning efforts. Potable water can be stockpiled, and generator and alternate communication needs can be identified. Knowing what your needs will be after a disaster is key to being adequately prepared.

4.4 Shelter Requirements

Earthquakes can cause loss of function or habitability of buildings that contain housing units, resulting in approximately predictable numbers of displaced households. Loss of habitability is calculated directly from damage to the residential occupancy inventory, and from loss of water and power.
Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters.

Needs	Total
Public Shelter Needs (individuals)	4
Displaced Households	6

Note: Hazus public shelter estimates help emergency managers plan for shelter location and size needs.

4.5 Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four severity levels that describe the extent of the injuries. The levels are described as follows:

Severity Level 1: Injuries will require medical attention but hospitalization is not needed

Severity Level 2: Injuries will require hospitalization but are not considered life-threatening

Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated

Severity Level 4: Victims are killed by the earthquake

The casualty estimates are provided for three times of day: 2:00AM, 2:00PM, and 5:00PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00AM estimate considers that the residential occupancy load is at a maximum, the 2:00PM estimate considers that the educational, commercial, and industrial sector loads are at a maximum, and 5:00PM represents the peak commute time.

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	7	0	0	0
	Single-Family	14	0	0	0
	Total	21	0	0	0
2 PM	Commercial	10	1	0	0
	Commuting	0	0	0	0
	Educational	2	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single-Family	3	0	0	0
	Total	17	1	0	0
5 PM	Commercial	8	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single-Family	5	0	0	0
	Total	16	1	0	0

Note: Hazus casualties are estimates and may be inaccurate.

4.6 Debris

The amount of debris generated by Hazus is calculated from debris due to buildings and their content, not from damages due to roads or utilities.

Total Debris: 0.02 Million Tons of debris will be generated

Total Truckloads: 960 (at 25 tons/truck) will be required to remove the debris

Additional debris may be generated due to fire following the earthquake. Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. For this scenario, Hazus estimates that there will be zero ignitions following this earthquake.

Figure 5.1: Before Mitigation and After Mitigation

Communities will need to prioritize projects as part of the planning process. FEMA can then help route federal mitigation dollars to fund these projects.

The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: To reduce flood losses, to facilitate accurate insurance rating; and to promote the awareness of flood insurance.

For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount (a Class 10 is not participating in the CRS and receives no discount).

5. Actions to Reduce Risk

5.1 Types of Mitigation Actions

Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events. This creates safer communities, and facilitates resiliency by enabling communities to return to normal function as quickly as possible after a hazard event. Once a community understands its risk, it is in a better position to identify potential mitigation actions that can reduce the risk to its people and property.

The mitigation plan requirements in 44 CFR Part 201 encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience. Mitigation actions generally fall into the following categories:

Preventive Measures
Preventive measures are intended to keep hazards from getting worse. They can reduce future vulnerability to flooding and/or the earthquake hazard, especially in areas where development has not yet occurred or where capital improvements have not been substantial.

- Comprehensive land use planning
- Zoning regulations
- Subdivision regulations
- Open space preservation
- Building codes
- Floodplain development regulations
- Stormwater management
- Purchase development rights or conservation easements
- Participation in the NFIP Community Rating System (CRS)

Property Protection Measures
Property protection measures protect existing buildings by modifying the building to withstand floods and/or earthquakes, or by removing buildings from hazardous locations.

- Building relocation
- Acquisition and clearance
- Building elevation
- Barrier installation
- Building retrofit

Natural Resource Protection Activities

Natural resource protection activities reduce the impact of floods by preserving or restoring natural areas such as floodplains, wetlands, and dunes and their natural functions. Examples include the following:

- Wetland protection
- Habitat protection
- Erosion and sedimentation control
- Best management practices (BMPs)
- Prevention of stream dumping activities (anti-litter campaigns)
- Improved forestry practices such as reforesting or selective timbering (extraction)

Structural Mitigation Projects

Structural mitigation refers to any physical construction to reduce or avoid possible impacts of hazards, which includes engineering measures and construction of hazard-resistant and protective structures and infrastructure. Structural protection such as upgrading dams/levees for already existing development and critical facilities may be a realistic alternative. However, citizens should be made aware of their residual risk.

- Reservoirs, retention, and detention basins
- Levees and floodwalls
- Channel modifications
- Channel maintenance
- Securing a structure's foundation
- Strengthening building frames, cripple walls, and facades

Public Education and Awareness Activities

Public education and awareness activities advise residents, business owners, potential property buyers, and visitors about floods, hazardous areas, and mitigation techniques that they can use to reduce risk to themselves and their property.

- Readily available and readable updated maps
- Outreach projects
- Library
- Technical assistance
- Real estate disclosure
- Environmental education
- Providing risk information via the nightly news

For more information regarding hazard mitigation techniques, best practices, and potential grant funding sources, visit www.fema.gov or contact your local floodplain manager, emergency manager, or State Hazard Mitigation Officer.

Emergency Services (ES) Measures

Although not typically considered a mitigation technique, emergency service measures minimize the impact of an event on people and property. These are actions commonly taken immediately prior to, during, or in response to a hazard event.

- Hazard warning system
- Emergency response plan
- COOP and COG planning
- Critical facilities protection
- Health and safety maintenance
- Post-event recovery planning

Table 5.1 Possible Mitigation Actions for Flooding Risks

AOMI	Possible Actions to Reduce Flood Risk
Dams	Engineering assessment Dam upgrades and strengthening Emergency Action Plan (EAPs) Dam removal Easement creation in impoundment and downstream inundation areas
Levees (accredited and non-accredited) and significant levee-like structures	Generally same as dams above Purchase of flood insurance for at-risk structures
Coastal Structures Jetties Groins Seawalls Other structures	Increase coastal setbacks for construction Habitat restoration programs Wetland restoration and mitigation banking programs
Stream Flow Pinch Point Undersized culverts or bridge openings	Engineering Analysis Replacement of structure pre- and post-disaster
Past Claims and IA/PA Hot Spots	Acquisition Elevation Relocation Floodproofing
Major Land Use Changes (past 5 years or next 5 years)	Higher regulatory standards, Stormwater BMPs, Transfer of Development rights, compensatory storage and equal conveyance standards, etc.
Key emergency routes overtopped during frequent flooding events	Elevation Creation of alternate routes Design as low water crossing
Areas of Significant Riverine or Coastal Erosion	Relocation of buildings and infrastructure, regulations and planning, natural vegetation, hardening
Drainage or Stormwater Based Flood Hazard Areas, or Areas not Identified as Floodprone on the FIRM but known to be Inundated	Identification of all flood hazard areas
Areas of Mitigation Success	N/A

AoMI	Possible Actions to Reduce Earthquake Risk
Building Assessments	Identify vulnerable structures within your community Engineering assessment Prioritizing building retrofits or seismic upgrades Retrofitting of structural and non-structural components of critical facilities
Building Codes	Adopting current building codes that include the most current seismic code. Implementing seismic code design for all new buildings
Liquefaction Mapping	Increase area liquefaction mapping Protect natural resources that might be impacted by the built environment (i.e. pipelines, roadways, etc.)
Soil Mapping	Increase knowledge of local soils for better design of buildings, roads, and bridges. Increase knowledge of how soils can impact areas by addressing setbacks of unstable soils and steep slopes, this will minimize the risk of the community.
Public Education & Safety	Education of K-12, citizens, elected officials, developers and businesses on earthquake safety and building codes. Maintain an earthquake response plan to account for secondary hazards, such as fire and hazardous material spills.

5.2 Identifying Specific Actions for your Community

As many mitigation actions are possible to lessen the impact of floods, how can a community decide which ones are appropriate to implement? There are many ways to identify specific actions most appropriate for a community. Some factors to consider may include the following:

- Political – Is there political support to implement the action? Have political leaders participated in the planning process?
- Site characteristics – Does the site present unique challenges (e.g., significant slopes, erosion potential)?
- Flood characteristics – Are the flood waters affecting the site fast or slow moving? Is there debris associated with the flow? How deep is the flooding?
- Social acceptance – Will the mitigation action be acceptable to the public? Does it cause social or cultural problems?
- Technical feasibility – Is the mitigation action technically feasible (e.g., making a building watertight to a reasonable depth)?
- Administrative feasibility – Is there administrative capability to implement the mitigation action?
- Legal – Does the mitigation action meet all applicable codes, regulations, and laws? Public officials may have a legal responsibility to act and inform citizens if a known hazard has been identified.

Refer to FEMA Mitigation Planning How To Guide #3 (FEMA 386-3) "Developing the Mitigation Plan - identifying mitigation actions and implementation strategies" for more information on how to identify specific mitigation actions to address hazard risk in your community.

FEMA, in collaboration with the American Planning Association, has released the publication, "Integrating Hazard Mitigation into Local Planning." This guide explains how hazard mitigation can be incorporated into several different types of local planning programs. For more information go to www.planning.org. or http://www.fema.gov/library.

- Economic — Is the mitigation action affordable? Is it eligible under grant or other funding programs? Can it be completed within existing budgets?

- Environmental – Does the mitigation action cause adverse impacts on the environment or can they be mitigated? Is it the most appropriate action among the possible alternatives?

Your local Hazard Mitigation Plan is a valuable place to identify and prioritize possible mitigation actions. The plan includes a mitigation strategy with mitigation actions that were developed through a public and open process. You can then add to or modify those actions based on what is learned during the course of the Risk MAP project and the information provided within this Risk Report.

5.3 Mitigation Programs and Assistance

Not all mitigation activities require funding (e.g., local policy actions such as strengthening a flood damage prevention ordinance), and those that do are not limited to outside funding sources (e.g. include in local capital improvements plan, etc.). For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

FEMA Mitigation Programs and Assistance

FEMA awards many mitigation grants each year to States and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 5.3 below.

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at http://www.fema.gov/government/grant/hma/index.shtm.

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduce or eliminate claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focuses on mitigation project and planning activities that address multiple natural hazards

Mitigation Grant Program	Authorization	Purpose
Repetitive Flood Claims (RFC)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduce flood claims against the NFIP through flood mitigation; properties must be currently NFIP insured and have had at least one NFIP claim
Severe Repetitive Loss (SRL)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduce or eliminate the long-term risk of flood damage to SRL residential structures currently insured under the NFIP

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA, RFC, and SRL programs focus funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations and under HMGP to the amount of FEMA disaster recovery assistance under a presidential major disaster declaration.

The Silver Jackets program, active in several states, is a partnership of the USACE, FEMA and state agencies. The Silver Jackets program provides a state-based strategy for an interagency approach to planning and implementing measures for risk reduction.

FEMA's HMA grants are awarded to eligible States, Tribes, and Territories (Applicant) that, in turn, provide subgrants to local governments and communities (subapplicant). The Applicant selects and prioritizes sub-applications developed and submitted to them by subapplicants and submits them to FEMA for consideration of funding. Prospective subapplicants should consult the office designated as their Applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers is available on the FEMA website.

Additional Mitigation Programs and Assistance

Several additional agencies including the US Army Corps of Engineers (USACE), Natural Resource Conservation Service (NRCS), US Geological Survey (USGS), and others have specialists and a lot of information hazard mitigation.

The State NFIP Coordinator and State Hazard Mitigation Officer are state level sources of information and assistance, which vary among different states.

Appendix A: Acronyms and Definitions

ACRONYMS

A

AAL	Average Annualized Loss
ALR	Annualized Loss Ratio

B

BCA	Benefit-Cost Analysis
BFE	Base Flood Elevation

C

CFR	Code of Federal Regulations
COG	Continuity of Government Plan
COOP	Continuity of Operations Plan
CRS	Community Rating System

D

DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000

E

EOP	Emergency Operations Plan

F

FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FRD	Flood Risk Database
FRM	Flood Risk Map
FRR	Flood Risk Report
FY	Fiscal Year

G

GIS	Geographic Information System

H

HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

N

NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service

P

PDM	Pre-Disaster Mitigation

R

RFC	Repetitive Flood Claims
Risk MAP	Mapping, Assessment, and Planning

S

SFHA	Special Flood Hazard Area
SHMO	State Hazard Mitigation Officer
SRL	Severe Repetitive Loss

U

USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

DEFINITIONS

1-percent-annual-chance flood – The flood elevation that has a 1-percent chance of being equaled or exceeded each year. Sometimes referred to as the 100-year flood.

0.2-percent-annual-chance flood – The flood elevation that has a 0.2-percent chance of being equaled or exceeded each year. Sometimes referred to as the 500-year flood.

Average Annualized Loss (AAL) – The estimated long-term weighted average value of losses to property in any single year in a specified geographic area

Annualized Loss Ratio (ALR) – expresses the annualized loss as a fraction of the value of the local inventory (total value/annualized loss).

Base Flood Elevation (BFE) – Elevation of the 1-percent-annual-chance flood. This elevation is the basis of the insurance and floodplain management requirements of the NFIP.

Berm – A small levee, typically built from fill dirt.

Cfs – Cubic feet per second, the unit by which discharges are measured (a cubic foot of water is about 7.5 gallons).

Consequence (of flood) – The estimated damages associated with a given flood occurrence.

Crest – The peak stage or elevation reached or expected to be reached by the floodwaters of a specific flood at a given location.

Dam – Any artificial barrier that impounds or diverts water and that: (1) is 25 feet or more in height from the natural bed of the stream or watercourse measured at the downstream toe of the barrier or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse, to the maximum water storage elevation or (2) has an impounding capacity at maximum water storage elevation of 50 acre-feet or more.

Design flood event – The greater of the following two flood events: (1) the base flood, affecting those areas identified as SFHAs on a community's FIRM; or (2) the flood corresponding to the area designated as a flood hazard area on a community's flood hazard map or otherwise legally designated.

Earthquake – The result of a sudden release of energy in the Earth's crust that creates seismic waves.

Epicenter – is the point on the Earth's surface that is directly above the point where the fault begins to rupture.

Erosion – Process by which floodwaters lower the ground surface in an area by removing upper layers of soil.

Essential facilities – Facilities that, if damaged, would present an immediate threat to life, public health, and safety. As categorized in Hazus-MH, essential facilities include hospitals, emergency operations centers, police stations, fire stations and schools.

Fault – A fracture or discontinuity in a volume of rock, across which there has been significant displacement along the fractures as a result of earth movement. Energy release associated with rapid movement on active faults is the cause of most earthquakes.

Flood – A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is your property) from: overflow of inland or tidal waters; unusual and rapid accumulation or runoff of surface waters from any source; mudflow; or collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

Flood Insurance Rate Map (FIRM) – An official map of a community, on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. See also Digital Flood Insurance Rate Map.

Flood Insurance Study (FIS) – Contains an examination, evaluation, and determination of the flood hazards of a community, and if appropriate, the corresponding water-surface elevations.

Flood risk – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. Sometimes referred to as vulnerability.

Floodborne debris impact – Floodwater moving at a moderate or high velocity can carry floodborne debris that can impact buildings and damage walls and foundations.

Floodwall – A long, narrow concrete or masonry wall built to protect land from flooding.

Floodway (regulatory)– The channel of a river or other watercourse and that portion of the adjacent floodplain that must remain unobstructed to permit passage of the base flood without cumulatively increasing the water surface elevation more than a designated height (usually 1 foot).

Floodway fringe – This is the portion of the SFHA that is outside of the floodway.

Flow pinch point – A point where a human-made structure constricts the flow of a river or stream.

Freeboard – The height above the base flood added to a structure to reduce the potential for flooding. The increased elevation of a building above the minimum design flood level to provide additional protection for flood levels higher than the 1-percent chance flood level and to compensate for inherent inaccuracies in flood hazard mapping.

Geodesy – The branch of science concerned with determining the exact position of geographical points and the shape and size of the earth.

Hazus-MH – A GIS-based risk assessment methodology and software application created by FEMA and the National Institute of Building Sciences for analyzing potential losses from floods, hurricane winds, and earthquakes.

High velocity flow – Typically comprised of floodwaters moving faster than 5 feet per second.

Hot Spot – A volcanic area that forms as a tectonic plate moves over a point heated deep within the Earth's mantle.

Intensity (of earthquake shaking) – based on the Modified Mercalli Intensity Scale, is a subjective description of the physical effects of the shaking based on observations at the event site. Using this scale, a value of I is the least intense motion, and XII is the creates ground shaking. Unlike magnitude, Intensity can vary from place to place.

Liquefaction – Soil liquefaction describes a phenomenon whereby a saturated soil substantially loses strength and stiffness in response to an applied stress, usually an earthquake, causing it to behave like a liquid.

Loss Ratio – expresses loss as a fraction of the value of the local inventory (total value/ loss).

Levee – A manmade structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

Magnitude – A scale used by seismologists to measure the size of earthquakes in terms of the energy released.

Mudflow – A river of liquid and flowing mud on the surfaces of normally dry land areas, as when earth is carried by a current of water.

Normal Fault – A fault where two blocks of rock are pulled apart, as be tension (as opposed to rock being pushed together, or slid horizontally)

Probability (of flood) – The likelihood that a flood will occur in a given area.

Risk MAP – The vision of this FEMA strategy is to work collaboratively with State, local, and tribal entities to deliver quality flood data that increases public awareness and leads to action that reduces risk to life and property.

Riverine – Of or produced by a river. Riverine floodplains have readily identifiable channels.

Special Flood Hazard Area (SFHA) – Portion of the floodplain subject to inundation by the base flood.

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. This Act constitutes the statutory authority for most federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stillwater – A rise in the normal level of a water body.

Vulnerability – Probability multiplied by consequence; the degree of probability that a loss or injury may occur as a result of flooding. Sometimes referred to as flood risk.

Appendix B: Additional Resources

For a more comprehensive picture of a community's flood risk, FEMA recommends that State and local officials use the information provided in this report in conjunction with other sources of flood risk data, such as those listed below.

- Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FISs). This information indicates areas with specific flood hazards by identifying the limit and extent of the 1-percent-annual-chance floodplain and the 0.2-percent-annual-chance floodplain. FIRMs and FISs do not identify all floodplains in a study area. The FIS includes summary information regarding other frequencies of flooding, as well as flood profiles for riverine sources of flooding. In rural areas, and areas for which flood hazard data are not available, the 1-percent-annual-chance floodplain may not be identified. In addition, the 1-percent-annual-chance floodplain may not be identified for flooding sources with very small drainage areas (less than 1 square mile).

- Flood or multi-hazard mitigation plans. Local hazard mitigation plans include risk assessments that contain flood risk information and mitigation strategies that identify community priorities and actions to reduce flood risk. This report was informed by any existing mitigation plans in the study area.

- Other risk assessment reports. Hazus-MH, a free risk assessment software application from FEMA, is the most widely used flood risk assessment tool available. Hazus-MH can run different scenario floods (riverine and coastal) to determine how much damage might occur as a result. Hazus-MH can also be used by community officials to evaluate flood damage that can occur based on new/proposed mitigation projects or future development patterns and practices. Hazus-MH can also run specialized risk assessments such as what happens when a dam or levee fails. Flood risk assessment tools are available through other agencies as well, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE). Other watershed reports may exist that have a different focus, such as water quality, but that may also contain flood risk and risk assessment information. See Appendix B for additional resources.

ASCE 7 – National design standard issued by the American Society of Civil Engineers, *Minimum Design Loads for Buildings and Other Structures*, which gives current requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, suitable for inclusion in building codes and other documents.

ASCE 24-05 – National design standard issued by the American Society of Civil Engineers, *Flood Resistant Design and Construction*, which outlines the requirements for flood resistant design and construction of structures in flood hazard areas.

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Appendix C: First Pass Analysis

Appendix D: Upper Spokane Watershed Outreach Handouts