Whitman County

Hazard Mitigation Plan Update
Volume 1: Planning-Area-Wide Elements

Draft

April 2020

Whitman County

HAZARD MITIGATION PLAN UPDATE
VOLUME 1: PLANNING-AREA-WIDE ELEMENTS

Draft

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Whitman County
Hazard Mitigation Plan Update;
Volume 1—Planning-Area-Wide Elements

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EXECUTIVE SUMMARY

The Disaster Mitigation Act (DMA) is federal legislation that requires proactive, pre-disaster planning as a prerequisite for some funding available under the Robert T. Stafford Act. The DMA encourages state and local authorities to work together on pre-disaster planning. The enhanced planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

Hazard mitigation is the use of long- and short-term strategies to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards. It is impossible to predict exactly when and where disasters will occur or the extent to which they will impact an area, but with careful planning and collaboration among public agencies, stakeholders and citizens, it is possible to minimize losses that disasters can cause. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state and federal government.

Whitman County and a partnership of local governments within the County have developed and maintained a hazard mitigation plan to reduce risks from natural disasters and to comply with the DMA.

PLAN UPDATE

Title 44 of the Code of Federal Regulations (44 CFR) stipulates that hazard mitigation plans must present a schedule for monitoring, evaluating and updating the plan. This provides an opportunity to reevaluate recommendations, monitor the impacts of actions that have been accomplished, and determine if there is a need to change the focus of mitigation strategies. A jurisdiction covered by a plan that has expired is not able to pursue elements of federal funding under the Robert T. Stafford Act for which a current hazard mitigation plan is a prerequisite.

Initial Response to DMA in Whitman County

Whitman County has a tradition of proactive planning and preparedness for all phases of emergency management. In 2004, Whitman County Emergency Management led a multi-jurisdictional planning effort to fulfill the requirements of the DMA and Chapter 44 of the Code of Federal Regulations (44 CFR). The Whitman County Natural Hazards Mitigation Plan was adopted by the County and 20 planning partners in April 2006. The Plan was approved by FEMA Region X on May 23, 2006, establishing compliance with the DMA for the County and its planning partners. The plan addressed six hazards of concern: drought, earthquake, flood, severe weather, volcano and wildfire. The partnership has achieved numerous objectives identified in the initial plan. Since completion of the 2006 Whitman County Natural Hazard Mitigation Plan, the County again updated the plan, which was approved in August 2013.

While the performance of the various editions of the plan were a success, the planning team again felt an update was needed, and in so doing, identified enhancements that would enable the plan to better support local needs:

- Use of best available data to update the risk assessment portion of the plan;
- Use of available tools to enhance the risk assessment to better support future grant applications and local emergency management programs;
- Re-engaging the public to see if the perception of risk within the planning area has changed since the initial effort; and

- Re-energizing and educating the participating partners on the funding opportunities the plan can enable.

Updating the plan consisted of the following five (5) phases:

- **Phase 1: Organize Resources**— Under this phase, the initial effort entailed securing grant funding to fund the effort. Once secure, a planning team was assembled to help develop the plan. The planning team consists of previous and new planning partners, staff, citizens, and other stakeholders in the planning area. Coordination with other county, state and federal agencies involved in hazard mitigation occurred throughout the plan update process. This phase included a comprehensive review of the existing plan, the Washington State Hazard Mitigation Plan, and existing programs that may support or enhance hazard mitigation actions.
- **Phase 2: Update the Risk Assessment**—Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. This process assesses the vulnerability of people, buildings and infrastructure to natural hazards. All facets of the risk assessment of the plan were re-visited by the planning team and as appropriate, updated with the best available data and technology. For this update, the planning team determined that the use of the existing critical facilities list was appropriate as no new critical structures had been built since the last plan update. Any structures under development or planned development were identified as such, and taken into consideration during the risk assessment. In addition, the building layer previously utilized was determined valid for two primary reasons: very limited construction has occurred in the planning area since the last plan was completed, the primary of which were residential structures; and there remains the lack of available digital parcel data for the planning area. The County is in the process of remedying the lack of parcel data, but determined that for this effort, it's limited resources were more wisely spent on increasing the number of planning partners rather than attempting to dedicate resources to increase structure and parcel data as the potential change in out-put did not support such effort. The lack of such data has been identified as a strategy, and the county is undergoing efforts to remedy those deficiencies.

  Update of the risk assessment included the following:

  - Hazard identification and profiling
  - Assessment of the impact of hazards on physical, social and economic assets
  - Vulnerability identification
  - Estimates of the cost of potential damage.
- **Phase 3: Engage the Public**—A public involvement strategy developed by the planning team. which included public meetings to present the risk assessment as well as the draft plan, distribution of a hazard mitigation survey, a County-sponsored website for the plan update, and multiple media releases.
- **Phase 4: Assemble the Updated Plan**—The planning team assembled key information into a document to meet the DMA requirements for all planning partners. The updated plan contains two volumes. Volume 1 contains components that apply to all partners and the broader planning area. Volume 2 contains all components that are jurisdiction-specific. Each planning partner has a dedicated chapter in Volume 2.
- **Phase 5: Plan Adoption/Implementation**—Once pre-adoption approval has been granted by Washington's Emergency Management Division and FEMA Region X, the final adoption phase will begin. Each planning partner will individually adopt the updated plan. The plan maintenance process includes a schedule for monitoring and evaluating the plan's progress

annually and producing a plan revision every 5 years. Throughout the life of this plan, a Planning Team representative of the original committee will provide a consistent source of guidance and oversight.

The 2020 Whitman County Plan Update - What has changed?

44 CFR Section 201.6(d)(3) requires that plan updates be revised to reflect changes in development that occurred within the planning area during the past performance period of the plan. The plan must describe changes in development that have occurred in hazard prone areas and increased or decreased the vulnerability of each jurisdiction since the last plan was approved. If no changes in development impacted the jurisdiction's overall vulnerability, plan updates may validate the information in the previously approved plan. The intent of this requirement is to ensure that the mitigation strategy continues to address the risk and vulnerabilities to existing and potential development, and takes into consideration possible future conditions that can impact the vulnerability of the community.

In meeting the above requirement, the Planning Team conducted a complete review of all hazard profiles and loss data presented. However, limitations continue to exist with respect to parcel-based data in a GIS format for the planning area. This was a limiting factor which restricted the Planning Team's ability to complete an in-depth analysis based on jurisdiction-specific building stock information and potential vulnerability. In some instances, the Planning Team determined that utilizing Hazus default data for some of the hazards of concern which was previously conducted during the 2013 plan update remained the most viable option for use, and in such cases, that is indicated within the specific profiles. In many instances, there is also no new data available on which to conduct any additional analysis (e.g., no new flood studies or shake maps, etc.).

Additional changes within the 2020 Whitman County Hazard Mitigation Plan Update include:

- Volume 1 of the Whitman County Hazard Mitigation Plan now also serves as the County's plan as the information contained within the volume incorporates information countywide (incorporated and unincorporated areas). As such, no separate annex for Whitman County is maintained as the information was redundant. County-specific strategies have been incorporated into Volume 1, along with the prioritization of those strategies.
- The 2020 update followed the same basic planning process as was used for the 2013 effort. The concept of a *Steering Committee* was changed to more accurately reflect a *Planning Team*. That team was once again the critical planning component in the process.
- For the 2020 update, there were some major changes to the plan's format and function, with redundant information removed. Chapters were reorganized to allow for a better flow of information.
- The hazard profiles were modified to reduce and consolidate information for ease in future updates, and to remove redundant language. With respect to the flood profile, information concerning each jurisdiction was moved and placed into the specific jurisdiction's annex for ease in citizen review by allowing all jurisdiction-specific information to be contained within their profile, rather than split between Volume 1 and Volume 2.
- All hazard-specific data with respect to identification of events occurring since the 2013 plan was completed were updated, with new events included where appropriate.
- Where available, the plan has been updated using new data and technology where applicable and as indicated. Where no new data existed, the profiles reference such fact.

- For the Landslide and Wildfire hazards, different methodologies as defined within the profiles were utilized.
- Data within tables and charts were confirmed to be the most accurate, or updated with current information.

In addition to the above, the 2020 updated plan differs from previous plan editions for the following reasons:

- Updated guidance on what is required to meet the intent of the DMA.
- Further expansion of the scope of the plan to include additional Special Purpose District planning partners not involved in previous editions. These planning partners are true stakeholders in mitigation within the planning area.
- Integration of new studies and reports for the various hazards of concern as appropriate.
- All maps, charts, and census data information have been updated as appropriate.
- As appropriate, the risk assessment has again been prepared to better support future grant applications by providing risk and vulnerability information that will directly support the measurement of "cost-effectiveness" required under FEMA mitigation grant programs.
- The plan identifies mitigation action items which meet multiple objectives that are measurable, so that each planning partner can measure the effectiveness of their mitigation actions. Previous action items have been updated to their current status, and new action items developed for this update process.

THE PLANNING PARTNERSHIP

The planning partnership assembled for this plan was expanded to again include all cities and towns, but also several of the special purpose districts as defined as "local governments" under the Disaster Mitigation Act. Jurisdictional annexes for those partners are included in Volume 2 of the plan. Jurisdictions not covered by this process can link to this plan at a future date by following the linkage procedures identified in Volume 2 of this plan.

MITIGATION GUIDING PRINCIPLE, GOALS AND OBJECTIVES

Mitigation goals and objectives were again reviewed and updated as part of this process. Those items are identified in Chapter 14, but remain consistent with previous plans.

MITIGATION INITIATIVES

For the purposes of this document, mitigation initiatives are defined as activities designed to reduce or eliminate losses resulting from natural hazards. The mitigation initiatives are the key element of the hazard mitigation plan. It is through the implementation of these initiatives that the planning partners can strive to become disaster-resistant through sustainable hazard mitigation.

Although one of the driving influences for preparing this plan was grant funding eligibility, its purpose is more than just access to federal funding. It was important to the planning partnership to look at initiatives that will work through all phases of emergency management. Some of the initiatives outlined in this plan are not grant eligible; grant eligibility was not the primary focus of the selection. Rather, the focus was the initiatives' effectiveness in achieving the goals of the plan and whether they are within each entities'

capabilities. This planning process resulted in the identification of mitigation actions to be targeted for implementation by individual planning partners, as well as county initiatives.

IMPLEMENTATION

Full implementation of the recommendations of this plan will require time and resources. The measure of the plan's success will be its ability to adapt to the changing climate of hazard mitigation. Funding resources are always evolving, as are state and federal mandates. Whitman County and its planning partners will assume responsibility for adopting the recommendations of this plan and committing resources toward implementation. The framework established by this plan commits all planning partners to pursue initiatives when the benefits of a project exceed its costs. The planning partnership developed this plan with extensive public input, and public support of the actions identified in this plan will help ensure the plan's success.

Chapter 1.
INTRODUCTION

Hazard mitigation is defined as a way to reduce or alleviate the loss of life, personal injury and property damage that can result from a disaster through long- and short-term strategies. It involves strategies such as planning, policy changes, programs, projects and other activities that can mitigate the impacts of hazards. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state and federal government.

1.1 AUTHORITY

The federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) required state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. Prior to 2000, federal disaster funding focused on disaster relief and recovery, with limited funding for hazard mitigation planning. The DMA increased the emphasis on planning for disasters before they occur.

The DMA encourages state and local authorities to work together on pre-disaster planning, and it promotes sustainability for disaster resistance. "Sustainable hazard mitigation" includes the sound management of natural resources and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

The Whitman County 2020 Multi-Jurisdiction Hazard Mitigation Plan has been developed pursuant to the requirements of 44 CFR 201.6. The plan meets FEMA's guidance for multi-jurisdictional and tribal mitigation planning.

1.2 PURPOSE OF HAZARD MITIGATION PLANNING

This hazard mitigation plan update identifies resources, information and strategies for reducing risk from natural hazards. Elements and strategies in the plan were selected because they meet a program requirement and because they best meet the needs of the planning partners and their citizens. One of the benefits of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. The Federal Emergency Management Agency (FEMA) encourages multi-jurisdictional planning under its guidance for the DMA. The plan will help guide and coordinate mitigation activities throughout Whitman County. The plan was developed to meet the following objectives:

- Meet or exceed requirements of the DMA.
- Enable all planning partners to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of each planning partner as well as state and federal requirements.
- Create a risk assessment that focuses on Whitman County hazards of concern.
- Create a single planning document that integrates all planning partners into a framework that supports partnerships within the County, and puts all partners on the same planning cycle for future updates.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.

All citizens and businesses of Whitman County are the ultimate beneficiaries of this hazard mitigation plan update. The plan reduces risk for those who live in, work in, and visit the County. It provides a viable planning framework for all foreseeable natural hazards that may impact the County. Participation in development of the plan by key stakeholders in the County helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable countywide, and the plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.3 PLAN ADOPTION

44 CFR 201.6(c)(5) requires documentation that a hazard mitigation plan has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. This plan will be submitted for a pre-adoption review to the Washington State Division of Emergency Management and FEMA prior to adoption. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. All partners understand that DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting the plan as well as the FEMA approval letter can be found in Appendix D of this volume.

1.4 SCOPE AND PLAN ORGANIZATION

The process followed to update the Whitman County 2020 Multi-Jurisdiction Hazard Mitigation Plan included the following:

- Review and prioritize disaster events that are most probable and destructive. For planning purposes, this plan covers those incidents and information which have occurred since the previous plan was developed (2013) through December 31, 2018. Future updates shall begin assimilation of data beginning January 1, 2019.
- Confirm critical facilities.
- Review and update areas within the community that are most vulnerable.
- Review and update goals for reducing the effects of a disaster event.
- Review and update new projects to be implemented for each goal.
- Review and identify new procedures for monitoring progress and updating the hazard mitigation plan.
- Review the draft hazard mitigation plan.
- Adopt the updated hazard mitigation plan.

This plan has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole planning area:

- **Volume 1**—Volume 1 includes all federally required elements of a disaster mitigation plan that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, goals and objectives, countywide hazard risk assessment, county mitigation initiatives, and a plan maintenance strategy. Volume 1, in addition to maintaining all common elements which apply to all planning partners, serves as the County's plan.
- **Volume 2**—Volume 2 includes all federally required jurisdiction-specific elements, in annexes for each participating jurisdiction. It includes a description of the participation requirements established by the Planning Team, as well as instructions and templates that the partners used

to complete their annexes. Volume 2 also includes "linkage" procedures for eligible jurisdictions that did not participate in development of this plan but wish to adopt it in the future.

All planning partners will adopt Volume 1 in its entirety and at least the following parts of Volume 2: Part 1; each partner's jurisdiction-specific annex; and the appendices.

The following appendices provided at the end of Volume 1 include information or explanations to support the main content of the plan:

- Appendix A — A glossary of acronyms and definitions.
- Appendix B —The hazard mitigation questionnaire. A summary has been included within the plan.
- Appendix C — A template for progress reports to be completed as this plan is implemented.
- Appendix D — Plan Adoption Resolutions from Planning Partners.

Chapter 2.
PLAN METHODOLOGY

To develop the Whitman County Hazard Mitigation Plan Update, the County followed a process that had the following primary objectives:

- Secure grant funding
- Form a planning team
- Establish a planning partnership
- Define the planning area
- Coordinate with other agencies
- Review existing programs
- Engage the public.

These objectives are discussed in the following sections.

2.1 GRANT FUNDING

This planning effort was supplemented by a grant from Washington Emergency Management Division. Whitman County Emergency Management was the applicant for the grant. The grant was originally applied for in 2016, and funding was appropriated in 2019. It covered 75 percent of the cost for development of this plan; the County and its planning partners covered the balance through in-kind contributions.

2.2 DEFINING THE PLANNING AREA

The defined planning area for this effort is contiguous with the Whitman County boundary. All partners to this plan have jurisdictional authority within this planning area.

2.3 FORMATION OF THE CORE PLANNING TEAM

Whitman County hired Bridgeview Consulting, LLC to assist with development and implementation of the plan update. The Bridgeview Consulting project manager assumed the role of the lead planner, reporting directly to a County-designated project manager. A core planning team was formed to lead the planning effort, made up of the following members:

- Bill Tensfeld, Whitman County Emergency Management—County project manager
- Robin Cocking, Whitman County Emergency Management
- Beverly O'Dea, Bridgeview Consulting— Project Manager
- David O'Dea, Bridgeview Consulting— Strategic Analyst and Lead Planner

2.4 ESTABLISHMENT OF THE PLANNING PARTNERSHIP

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A planning team was formed to oversee all phases of the plan. The members of this team included key planning partner staff, citizens and other stakeholders from within the planning area.

Whitman County opened this planning effort to all eligible local governments within the County. The kick-off meeting was held on October 2, 2019, during which Consultant introduced the mitigation planning process. Key meeting objectives were as follows:

- Provide an overview of the Disaster Mitigation Act.
- Describe the reasons for a plan.
- Outline the County work plan.
- Outline planning partner expectations.
- Seek commitment to the planning partnership.

Prior to the kick-off meeting, each jurisdiction wishing to join the planning partnership was asked to provide a "letter of intent to participate" that designated a point of contact for the jurisdiction and confirmed the jurisdiction's commitment to the process and understanding of expectations. Linkage procedures have been established (see Volume 2 of this plan) for any jurisdiction wishing to link to the Whitman County plan in the future.

The planning partners covered under this Plan are shown in Table 2-1. The Planning Team met throughout the process as needed to facility the plan development. Meeting agendas, notes and attendance logs are available for review upon request. In addition, the core planning team also conducted (almost) weekly information-gathering sessions, which allowed for plan development. Due to the fact that the County's plan expired while awaiting funding, an expedited method was used to develop the plan, allowing for plan adoption and grant eligibility by the planning partners.

All meetings were open to the public and agendas and meeting notes were posted to the hazard mitigation plan website (see Section 2.8).

Table 2-1.
Planning Partners

County, City, Town or Entity Represented	Primary Point of Contact	Alternate Point(s) of Contact	Date of Previous Plan	Letter of Participation	Kick-Off Meeting	Completed Risk Ranking	Completed Annex Template	Draft Plan Review	Final Plan Review	Adoption Month
County	Bill Tensfeld	Director of Emergency Management	2013		X	X		X	X	
County	Robin Cocking	Deputy Director of Emergency Management	2013		X	X		X	X	

Table 2-1.
Planning Partners

County, City, Town or Entity Represented	Primary Point of Contact	Alternate Point(s) of Contact	Date of Previous Plan	Letter of Participation	Kick-Off Meeting	Completed Risk Ranking	Completed Annex Template	Draft Plan Review	Final Plan Review	Adoption Month
Municipalities										
City of Pullman	Kevin Gardes, PE Gary Jenkins	Director of Public Works Police Chief	2013	8/28/19	X	X	X	X	X	
Town of Colton	Jenni Straughan	Steve Bremer (+8)	2013	9/25/19	X	X	X	X	X	
Town of Endicott	Frederick Tribble Laura Jones	 Town Clerk	2013	9/20/19	X	X	X	X	X	
Town of Oakesdale	Dennis Palmer Mary DeGon	Mayor City Clerk/Treasurer	2013	8/26/19	X	X	X	X	X	
Special Purpose Districts and Stakeholders										
Whitman Hospital and Medical Center (Hospital District #3)	Bruce Haley	Facilities Manager/Safety Officer	2013		X	X	X	X	X	
Consultants and Planning Team Facilitator										
Bridgeview Consulting, LLC Beverly O'Dea, Project Manager and Planner David O'Dea, Strategic Analyst, Lead Planner										

2.5 COORDINATION WITH OTHER AGENCIES

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.6(b)(2)). This task was accomplished by the planning team as follows:

- **Planning Team Involvement**—Agency representatives were invited to participate on the Planning Team.
- **Agency Notification**—The following agencies were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones:
  - Federal Emergency Management Agency (FEMA) Region X
  - Washington Department of Emergency Management
  - Washington Department of Ecology
  - Washington State Homeland Security Region IX (Chandra Fox, Spokane County Emergency Management)

  These agencies supported the effort by attending meetings or providing feedback on issues.
- **Pre-Adoption Review**—All the agencies listed above were provided an opportunity to review and comment on this plan, primarily through the hazard mitigation plan website.

2.6 REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.6(b)(3)). Chapter 14of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation initiatives. In addition, the following programs can affect mitigation within the planning area:

- Whitman County Emergency Response Plan—This is an emergency support function-based plan that directs emergency response actions in the planning area.
- Whitman County Comprehensive Plan—Amended last on December 15, 2014, this plan directs land use policy in Whitman County.
- Washington Department of Transportation 6-Year Transportation Improvement Program (2013-2018) for Whitman County
- City of Pullman Comprehensive Flood Hazard Management Plan—Adopted in 2003, this plan was developed to provide the City of Pullman with direction and strategies for mitigating flooding problems in the community.
- City of Palouse Flood Mitigation Plan—Adopted in 1996, this plan identifies flood hazard mitigation strategies for the City of Palouse that affirms the city's goals for flood planning.
- Palouse Regional Transportation Planning Organization 2018 – 2023 Transportation Improvement Plan – Adopted in March 2018, its purpose is to outline the region's transportation projects and financing plans based on demonstrated consistency between project implementation and regional planning goals.

An assessment of all planning partners' regulatory, technical and financial capabilities to implement hazard mitigation initiatives is presented in Chapter and in the individual jurisdiction-specific annexes in Volume 2. Many of these relevant plans, studies and regulations are cited in the capability assessment.

2.7 PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

Table 2-2 summarizes important milestones in the development of the plan.

Table 2-2.
Plan Development Milestones

Date	Event	Description	Attendance
2016			
11/1	Grant application submittal	County submits planning grant application	N/A
2019			
	County receives notice of grant award	Funding secured.	N/A
May	County initiates contractor procurement	Seek a planning expert to facilitate the process	N/A
June	Procurement	County selects Bridgeview Consulting to facilitate plan development	N/A
Aug	Letters of Intent	Solicitation for planning partner involvement was sent out with draft Letters of Intent to municipalities, special purpose district, and previous planning partners	
Sept	Planning Team formed	Planning partners nominated potential committee members. The planning team received commitments from 15 members, finalizing the formation of the Planning Team.	N/A
Oct	Planning Team Workshop	Initial meeting with planning partners. Attendees were advised of planning partner expectations and asked to formally commit to the process. Review purposes for update: • Organize planning team; • Plan review; • Risk assessment – confirm hazards of concern and RA update; • Public involvement strategy identified; • Confirm critical facilities inventory maintained through plan maintenance section; • Goals and objectives confirmed; • Public outreach update; LEPC meetings, various established meetings, safety fair, etc. • Review of risk ranking process and completion of annex template	9
Oct	Jurisdictional Annex workshop	Mandatory session for planning partners. Workshop focused on how to complete the jurisdictional annex template.	10
Nov 21	Planning Team /LEPC Meeting	Preliminary risk maps and posters presented at LEPC meeting by project Chair.	20
12/23	Draft Plan	Internal review of draft provided by planning team.	N/A
2020			
1/21	Public Comment Period	Initial public comment period of draft plan opened, and remained open until February 11, 2020. The draft plan was posted on the County's website with a press release notifying public of plan availability. Emergency Management Director Bill Tensfeld also discussed the plan during the Commissioner's Study Session, during which the public and news media were in attendance.	N/A
Feb 14	Plan Submission	Plan submitted to State and FEMA for review	

Table 2-2.
Plan Development Milestones

Date	Event	Description	Attendance
3/1	Plan approval	Final draft plan submitted to Washington Emergency Management Division for review and approval	N/A
March	Adoption	Adoption window for final plan opens	N/A
April	Plan Approval	Approval granted by FEMA Region X	N/A

2.8 PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the Planning Team.
- Use a questionnaire to determine if the public's perception of risk and support of hazard mitigation has changed since the initial planning process.
- Attempt to reach as many planning area citizens as possible using multiple media.
- Identify and involve planning area stakeholders.

Stakeholders and the Planning Team

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan, including planning partners. All planning partners are stakeholders in the process. The diversity brought to the table by special purpose districts and private non-profit entities creates an opportunity to forge partnerships between entities that typically do not work together in the field of hazard mitigation. All members of the Planning Team live or work within the planning area. The Planning Team met throughout the course of the plan's development, and all meetings were open to the public. Protocols for handling public comments were established in the ground rules developed by the Planning Team.

Opportunity for Public Comment

Public Meetings

All meetings were open to the public, with notice provided to the public to encourage attendance. Several meetings were held throughout this process, including in conjunction with a Local Emergency Planning Committee meeting in Colfax on November 21, 2019. Figures 2-1 through Figure 2-5 are illustrations of the public outreach sessions and meetings, and the type of information distributed.

The purpose of the meetings varied, but included presentation of the risk assessment findings. The meeting format allowed attendees to examine maps and handouts and have direct conversations with project staff. Reasons for planning and information generated for the risk assessment were shared with attendees via a digital slide presentation. Planning team members were present to answer questions. Each attendee was

given an opportunity to provide comments to the Planning Team, which were captured if applicable. Local media outlets were informed of the open houses by a press release from the County.

Figure 2-1 Whitman County Planning Team Meeting

Survey

A Hazard Mitigation Survey was developed by the Planning Team Members. The survey, distributed throughout the planning area, was designed to help identify vulnerable areas; to gauge household preparedness, and to identify the level of knowledge of tools and techniques that assist in reducing risk and loss from hazards. The answers helped guide the Planning Team in selecting goals, objectives, and mitigation strategies. The survey was disseminated throughout the planning area by multiple means, including hard-copy distribution of the surveys at various meetings. Additionally, a web-based version of the survey was made available on the hazard mitigation plan website (see Figure 2-6). The complete questionnaire can be found in Appendix B of this volume.

Minimal responses were received to the survey; however, of those that responded:

- The majority had lived in Whitman County for more than 10+ years;
- The hazards of greatest concern were severe weather, including ice storms;
- One additional hazard not identified in the planning process was a potential Hanford Nuclear Facility release or accident;
- Approximately 67 percent of respondents had previously experienced an earthquake, which is the same percentage of individuals having previously experienced a severe weather event;
- 33 percent of respondents had experienced flood, landslide, and wildland fire events during their lifetime;
- 50 percent of respondents indicated that they were “somewhat” prepared for a disaster event, while 33 percent indicated that they were “adequately” prepared. No respondents indicated that they were well prepared, but 17 percent of respondents indicated that they were not prepared at all.
- Of those responding, consensus was that workshops, city/county newsletters, and the internet provided the best means of distributing information concerning hazards of concern in the area. These are the same sources utilized by the planning team members to distribute the information concerning the mitigation plan, and the results of the risk assessment.

Press Releases

Press releases were distributed over the course of the plan's development as key milestones were achieved, including at the onset to announce the project to the local community, and on completion of the draft plan, to advise citizens of its availability for review.

Internet

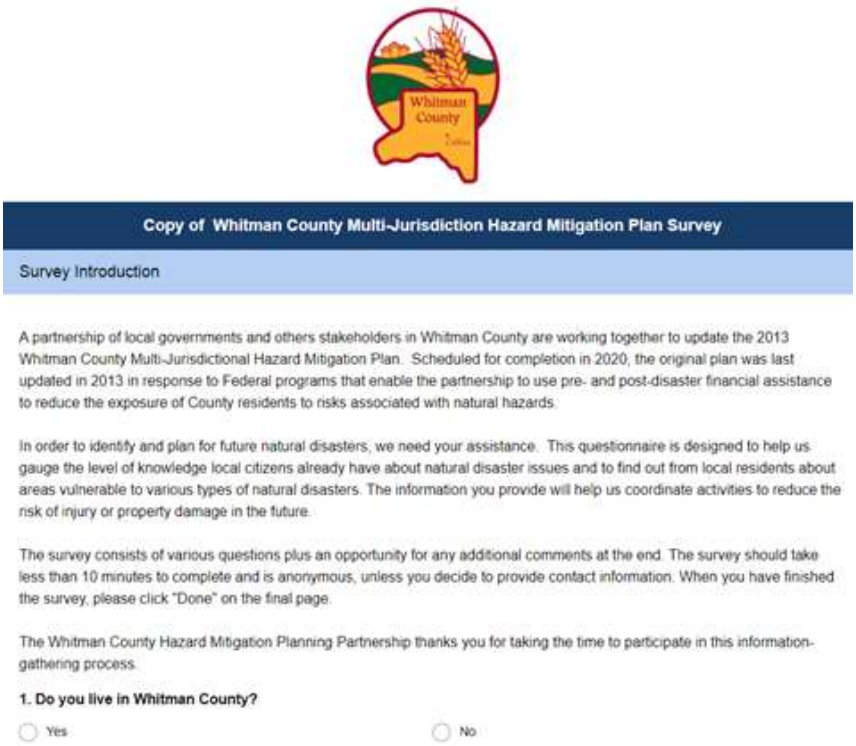
At the beginning of the plan development process, a website was created to keep the public informed on plan development milestones and to solicit relevant input (see Figure 2-7). The site's address (listed below) was publicized in all press releases, mailings, questionnaires and public meetings. Information on the plan development process, the Planning Team , the questionnaire and phased drafts of the plan was made available to the public on the site throughout the process. The County intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates. http://www.whitmancounty.org/Page.aspx?pn=Emergency+Management

Figure 2-2 Presentation of Risk Assessment

Figure 2-3 LEPC Meeting and Risk Posters

Figure 2-4 Hazard Posters Erected in City Hall Public Conference Room

Figure 2-5 Hazard Posters Erected in City Hall



Copy of Whitman County Multi-Jurisdiction Hazard Mitigation Plan Survey

Survey Introduction

A partnership of local governments and others stakeholders in Whitman County are working together to update the 2013 Whitman County Multi-Jurisdictional Hazard Mitigation Plan. Scheduled for completion in 2020, the original plan was last updated in 2013 in response to Federal programs that enable the partnership to use pre- and post-disaster financial assistance to reduce the exposure of County residents to risks associated with natural hazards.

In order to identify and plan for future natural disasters, we need your assistance. This questionnaire is designed to help us gauge the level of knowledge local citizens already have about natural disaster issues and to find out from local residents about areas vulnerable to various types of natural disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

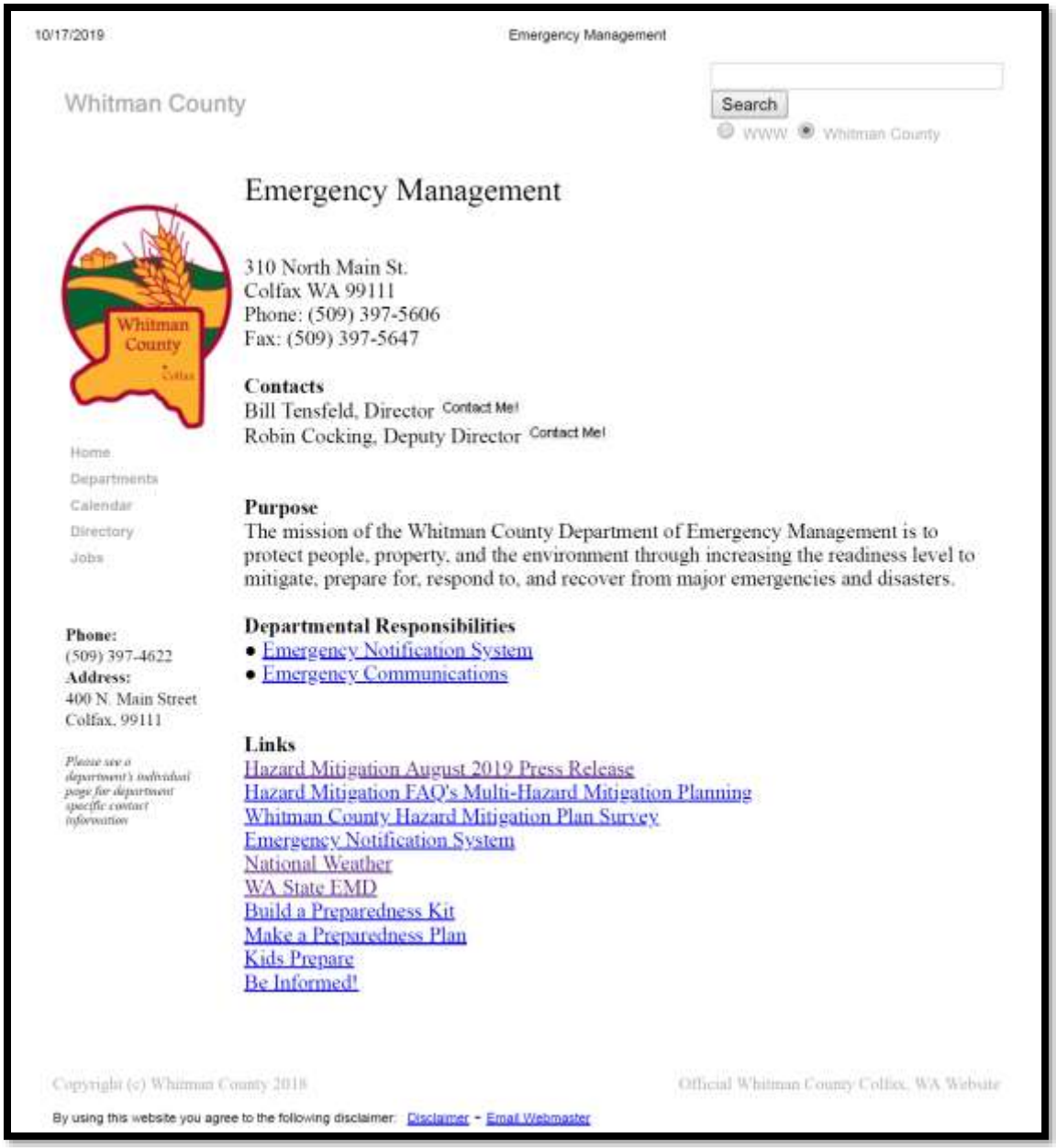
The survey consists of various questions plus an opportunity for any additional comments at the end. The survey should take less than 10 minutes to complete and is anonymous, unless you decide to provide contact information. When you have finished the survey, please click "Done" on the final page.

The Whitman County Hazard Mitigation Planning Partnership thanks you for taking the time to participate in this information-gathering process.

1. Do you live in Whitman County?

Yes No

Figure 2-6. Sample Page from the 2020 Hazard Mitigation Plan Update Questionnaire



10/17/2019 Emergency Management

Whitman County

Search

WWW Whitman County

Emergency Management

310 North Main St.
Colfax WA 99111
Phone: (509) 397-5606
Fax: (509) 397-5647

Contacts
Bill Tensfeld, Director Contact Me!
Robin Cocking, Deputy Director Contact Me!

Home
Departments
Calendar
Directory
Jobs

Purpose
The mission of the Whitman County Department of Emergency Management is to protect people, property, and the environment through increasing the readiness level to mitigate, prepare for, respond to, and recover from major emergencies and disasters.

Phone:
(509) 397-4622
Address:
400 N. Main Street
Colfax, 99111

Please see a department's individual page for department specific contact information

Departmental Responsibilities
- Emergency Notification System
- Emergency Communications

Links
Hazard Mitigation August 2019 Press Release
Hazard Mitigation FAQ's Multi-Hazard Mitigation Planning
Whitman County Hazard Mitigation Plan Survey
Emergency Notification System
National Weather
WA State EMD
Build a Preparedness Kit
Make a Preparedness Plan
Kids Prepare
Be Informed!

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Figure 2-7. Sample Page from Hazard Mitigation Plan Web Site

2.8.1 Public Involvement Results

By engaging the public through the public involvement strategy, the concept of mitigation was introduced to the public, and the Planning Team received feedback that was used in developing the components of the plan. Comments received were incorporated as appropriate after review by the Planning Team.

Chapter 3.
WHITMAN COUNTY PROFILE

3.1 JURISDICTIONS AND FEATURES

Whitman County covers 2,159 square miles along the Washington-Idaho border. It is the 23rd most populous county in the state and the 10th largest in area. The City of Colfax is the county seat. On the Washington side, Whitman County is bordered to the north by Spokane County, to the west by Adams County and a small part of Franklin County, and to the south by Columbia, Garfield and Asotin Counties. The County has 16 incorporated cities and towns. It is also home to Washington State University, located in Pullman, the second largest university in the state.

The southern border is defined by the Snake River. The Snake River Canyon cuts a 2,000-foot-deep swath through the Palouse Hills. The County's largest body of water is Rock Lake, in the northwest corner, which is a remnant of the Missoula floods that formed the scablands of this region. The major river is the Palouse River, which drains to the Snake River, and its two branches. Among the Palouse River's major tributaries are Rock Creek, Pine Creek, Pleasant Valley Creek, Rebel Flat Creek and Union Flat Creek. In the summer, about 75 percent of the smaller creeks run dry. The rivers of the County originate in the east, in the Moscow Mountains in Idaho, and generally flow east to west. Hangman Creek, flowing through the northeast corner of the County near Tekoa, drains to the Spokane River.

Whitman County's topography slopes to the west and southwest with rolling hills (Palouse Hills) and channeled scablands (primarily in the northwest portion of the County), with very little timber. Elevations in the region range from 1,100 to 3,400 feet above sea level. At the higher elevations are Tekoa Mountain and a number of prominent rock formations such as Bald Butte, Steptoe Butte and Kamiak Butte. Various forms of bunchgrass constitute the native vegetation, though most of the dryland has since been converted into a productive wheat farming region. Whitman County is one of the most productive farming areas in the United States, exporting wheat, barley, peas and lentils to worldwide markets.

3.2 HISTORICAL OVERVIEW

Since the middle of the last century, the area that is now Whitman County has been settled and developed by immigrants from eastern United States and Europe who were attracted to the region by its agricultural opportunities. The economic history of the County is characterized by a change from an early emphasis on livestock production to the present dominance of commercial wheat farming.

The area has had human settlement for over 10,000 years. In modern times, the area was inhabited by the Palouse Indians, who were related to the Nez Perce or Noon Nee-Mee-Poo Indians. The Appaloosa horse was bred by the tribe.

The first recorded European/Americans in the region were Lewis and Clark, who passed down the Snake River in October 1805. American settlement did not begin until the 1860s, when the flatlands along the Palouse River and Union Creek began to be claimed and settled. At first the tall bunchgrass-filled land was used mainly for grazing, but by the 1870s and 1880s, Eastern European immigrants, who were used to similarly dry conditions, began to cultivate winter wheat and other field crops.

Whitman County was organized by the territorial legislature on November 29, 1871 by partitioning what was then Stevens County—a huge area covering what are now 13 eastern Washington counties, all of Northern Idaho, and much of western Montana. Whitman County at the time of that partitioning covered

what are now the counties of Whitman, Franklin and Adams. The County was named in honor of Dr. Marcus Whitman and his wife Narcissa, missionaries living near Walla Walla.

In the 1870s, sawmills became an early local industry, supplying building materials for new settlers and producing flour. Many young towns had water-powered sawmills on its small rivers and creeks, although few, if any, exist today. The 1880s saw the arrival of railroads, which helped further the economic development of the County. In 1890, the State Agricultural College of Washington was founded as a land grant college at Pullman. This college evolved into what is now Washington State University.

Today, Whitman County is still focused on agriculture and the university.

3.3 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Whitman County has experienced 13 events since 1963 for which presidential disaster declarations were issued. These events are listed in Table 3-1.

Review of these events helps identify targets for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern.

Table 3-1.
Presidential Disaster Declarations
for Hazard Events Affecting Whitman County

Disaster Declaration Number	Type of Event	Incident Date
DR-146	Flooding	March 1963
DR-185	Heavy Rains/ Flood	December 1964
DR-322	Severe Storms/Flooding	February 1972
DR-414	Severe Storms/Snowmelt/Flooding	January 1974
Emerg-3037	Drought	March 1977
DR-545	Severe Storms/Flooding	December 1977
DR-623	Volcano/Mount St. Helens Eruption	May 1980
DR-822	Heavy Rains/Sheet Flooding	March 1989
DR-922	"Firestorm 91"/Wind	October 1991
DR-1100	Flooding	January 1996
DR-1159	Ice, Wind, Snow, Landslide, Flood	Dec 1996 – Feb 1997
DR-1825	Severe Winter Storm, near record snowfall	December 2008
DR-4249	Severe Storm, Straight-line winds, Flooding, Landslides	November 2015

3.4 PHYSICAL SETTING

3.4.1 Geology

Whitman County lies on the eastern end of the Columbia Plateau, one of the seven major physiographic regions of Washington State (See Figure 3-1). The Columbia Plateau is generally composed of basalt from volcanic lava floods that erupted during the Miocene Epoch from 17 million to 6 million years ago and have since cooled. Eruptions from fissures in the earth's crust eventually led to the lava being hundreds of feet thick in some locations. The only remnants of the pre-Miocene geology are the buttes, such as Steptoe Butte, which are the severely eroded exposed peaks of high mountains covered in basalt. In between basalt eruptions, sand and gravel deposits left by rivers from the erosion of nearby mountains contributed to the geology of the Palouse region. The fractured basalt and its interbeds are where most of Whitman County's potable water is found.

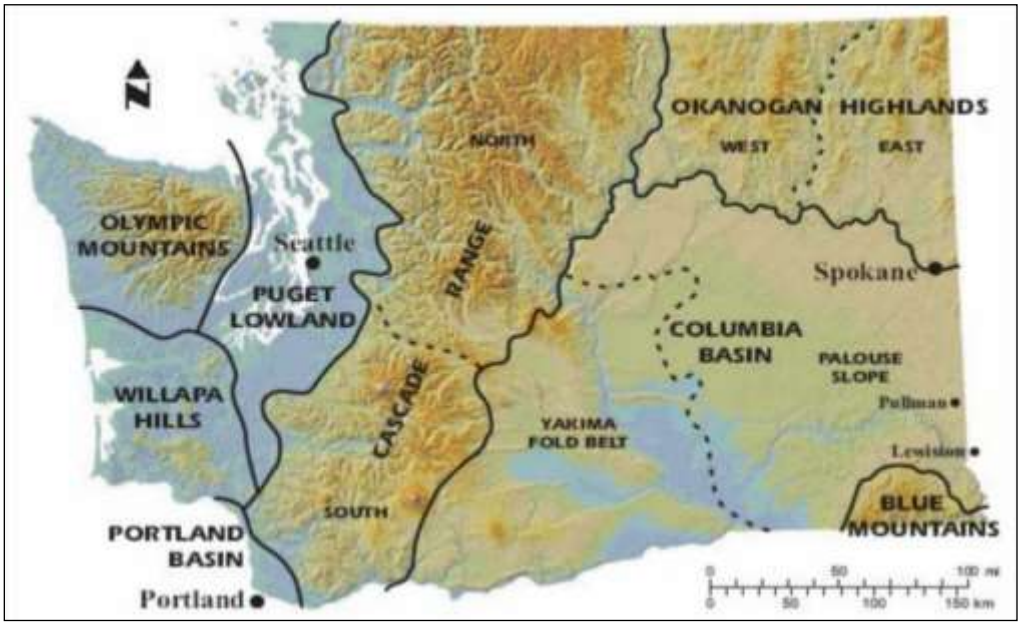


Figure 3-1. Physiographic Regions of Washington

The present landscape of Whitman County was formed relatively recently, beginning during the end of the last ice age about 15,000 years ago. The Palouse region's rich, dark, porous, moisture-retentive soil is composed of loess and volcanic ash overlaying basalt. Figure 3-2 shows general geology of Whitman County. Loess blown in as fine silt and dust during the end of the ice age settled on the basalt outcrops and formed as rolling hills resembling large dunes. The hills have a distinct look: gentle south facing slopes and steep north facing slopes aligned parallel to the prevailing southwesterly winds. In some places, the loess can be up to 100 feet deep. The fine-grained loess is highly erodible, and scientists believe that much of the loess deposited during the Holocene Epoch (the last 11,000 years of geological time) has been lost.

3.4.2 Scablands

Between 13,000 and 15,000 years ago, melting glaciers across the northwest United States and southern Canada filled a huge lake held back by a glacial dam and covering a large area of what is now western Montana. At its largest volume, Glacial Lake Missoula held over 520 cubic miles of water, covered over 3,000 square miles, and was over 2,000 feet deep at the edge of the glacial dam.

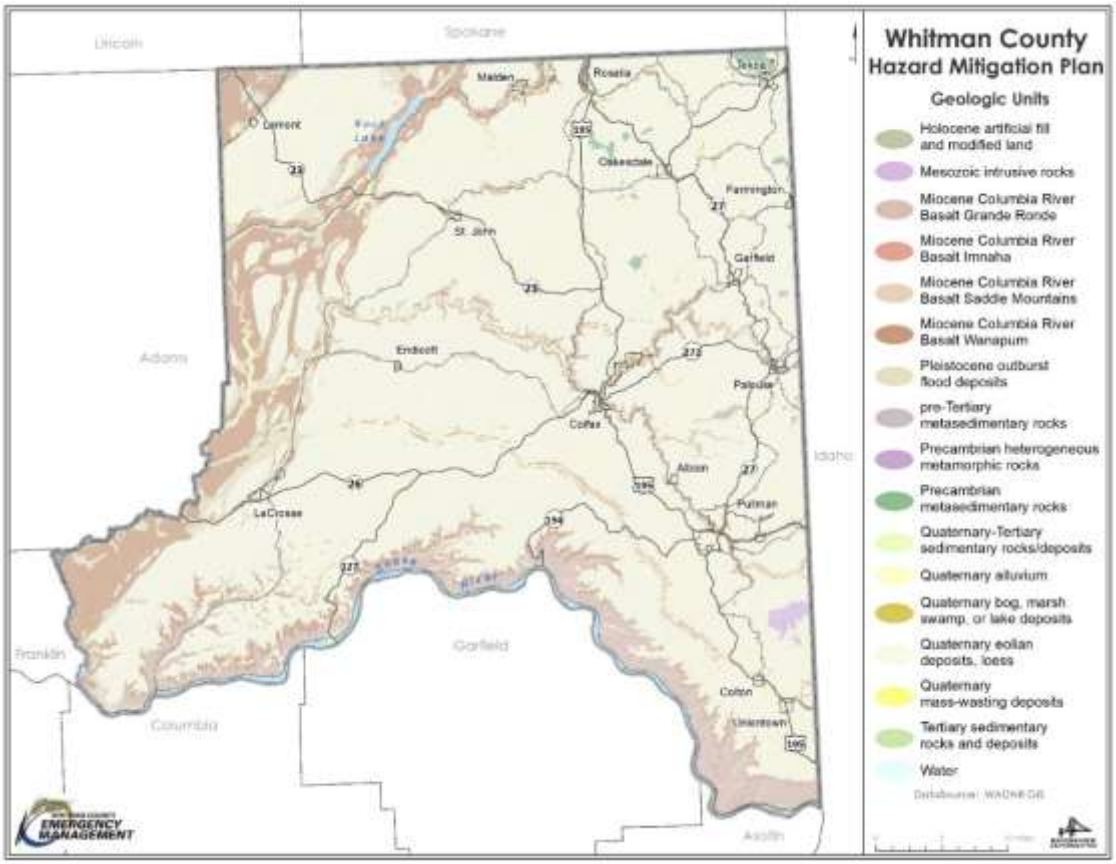


Figure 3-2. Whitman County Geology

Eventually the water cut underneath the glacial wall and the dam of ice collapsed over an expanse of about 100 miles. The water rushed over the ice and onto the land with great force. In about two days the water of Glacial Lake Missoula emptied through the breached dam. The amount of escaping water was equal to 10 times the discharge of all the Earth's rivers today. Water several hundred feet deep flooded the region and ripped up hundreds of feet of soil and rock. The flood cut channels and carved islands, leaving behind the scarred landscape now called the channeled scablands. A dramatic example of this is Palouse Falls, where water falls over 200 feet into a cirque surrounded by sheer basaltic canyons (see Figure 3-3). Similar canyon walls are frequent throughout Whitman County. The scablands can be found in the northwest part of Whitman County, where State Route (SR) 23 passes through the area.

The channeled scablands show evidence of repeated Missoula Floods. Some sedimentary deposits are stacked layer upon layer, indicating that dozens of floods escaped from Glacial Lake Missoula. Thin layers of volcanic ash help geologists gauge the approximate time of the floods. Between 17,000 and 13,000 years ago, the region was probably flooded every few years. Figure 3-4 shows the extent of Glacial Lake Missoula and the area swept by the Missoula Flood.[1]

[1] Source: Topinka, USGS/CVO, 2002

Figure 3-3. Palouse Falls

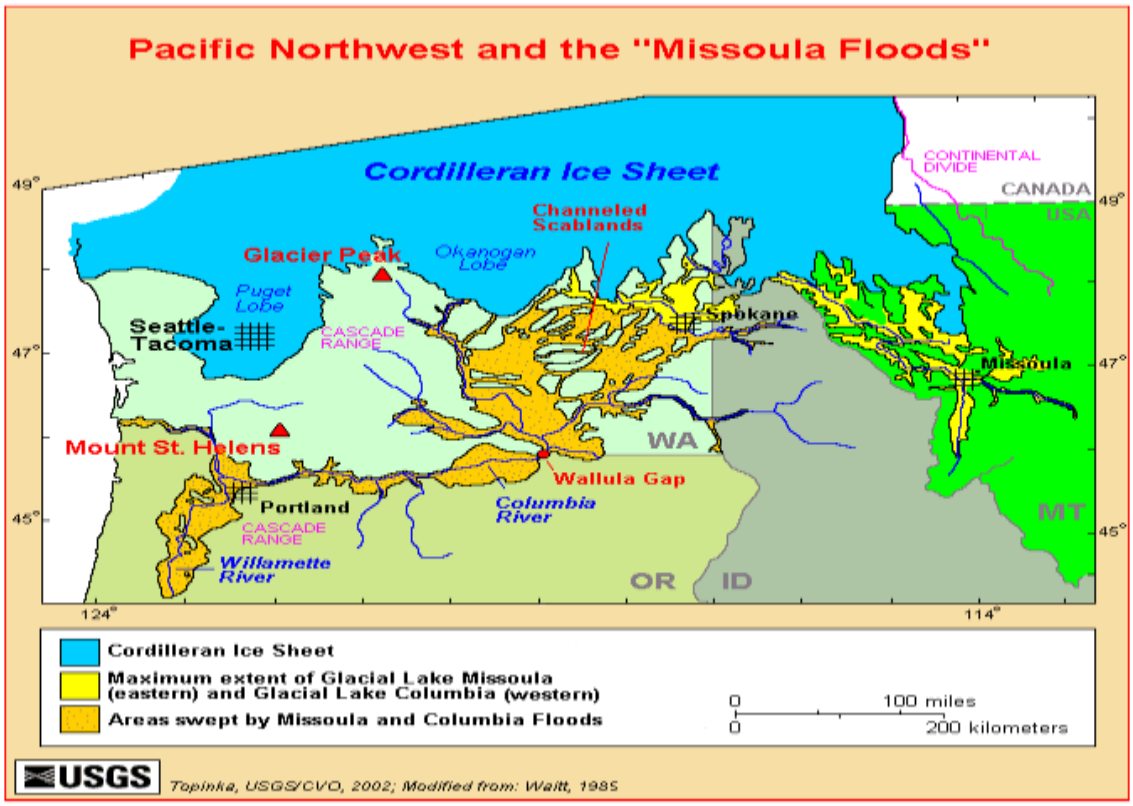


Figure 3-4. Missoula Flood Path

3.4.3 Soils

Most of Whitman County consists of good farming land and soils of better than average fertility. The best soils are largely found in the eastern and west-central parts of the County. The major soil series are the Ritzville, Walla Walla, Athena and Palouse series (see Table 3-2). All of these soils are rich in calcium and other soluble materials. They were deposited in this area by wind action and formed under semi-arid grassland conditions.

Table 3-2.
Soil Series in Whitman County

Series	Regional Location	Description
Athena	Central Whitman County, from Rosalia to the Snake River.	Fine in texture, dark brown in color and well suited for wheat farming. Similar to Walla Walla soils except they are older and deeper and were formed under heavier grass cover and rainfall
Palouse	North to south in a wide belt along the Whitman County-Idaho border	Soil dark in color, deposited by wind in deep, large dunes which became rounded and grass covered under an annual precipitation of about 20 inches.
Ritzville	Class IV lands along the lower Palouse River.	Wind deposited, desert type, light brown in color, loams. Slightly alkaline soils suited for dry farming and grazing.
Walla Walla	Western edge of the Palouse Hills in Class II land	Fine in texture, dark brown in color and well suited for wheat farming. Similar to Athena soils except they are newer and more shallow soils

The wind-deposited soils of Whitman County are deep, moisture-absorbent and free of gravel, stones and clay. The topsoil zone is deep and fertile and has a high mineral content. The major problem with this soil is wind and water erosion on steeper slopes when slopes are tilled for farming. Prior to active farming in the region, the sod of the original grassland was sufficient to prevent erosion by rain and wind.

3.4.4 Climate

The climate in Whitman County is influenced by marine and continental weather patterns. The marine influence is most noticeable in winter when the prevailing westerly winds are strongest and most persistent. The County generally experiences seasonable weather patterns characteristic of eastern Washington. Warm, dry summers are usually experienced, although heavy rain and hail infrequently accompany thunderstorm activity. Mid-summer temperatures range in the middle and upper 80s°F; winter highs are usually in the 30s°F. Extreme temperatures can range from 110°F to –30°F. Snow, the dominant form of precipitation due to winter coinciding with the rainy season, accumulates to a depth of 10 to 15 inches and remains on the ground from December through February. Annual average precipitation increases from west to east, with the western portion of the County receiving less than 12 inches and the eastern part receiving over 24 inches (see Figure 3-5). The average amount of snowfall that Whitman County receives annually is about 28 inches. The climate pattern in the County is related to a gradual increase in elevation from west to east. The County lies between the Rocky Mountains on the east, the Cascade Mountains on the west, mountains near the Canadian border on the north and Blue Mountains on the south.

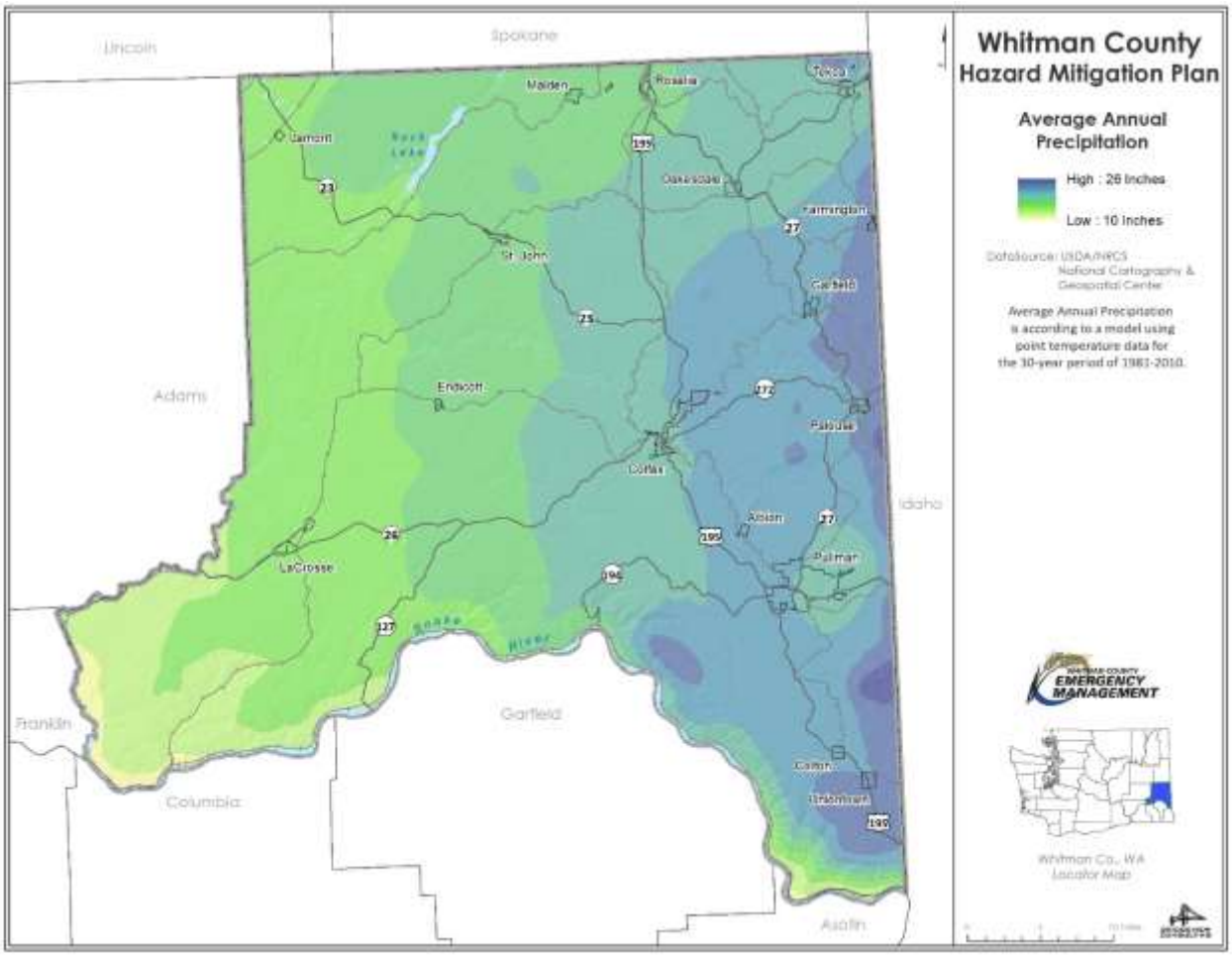


Figure 3-5. Average Precipitation Distribution Countywide

3.5 CRITICAL FACILITIES AND INFRASTRUCTURE

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. Critical facilities typically include police and fire stations, schools and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need, and the utilities that provide water, electricity and communication services to the community. Also included are "Tier II" facilities and railroads, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event.

Through a facilitated exercise, the Planning Team reviewed the definitions of critical facilities established for the initial plan and amended the definition to read as follows:

> Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event. Critical facilities include:
>
> – Structures or facilities that produce, use or store highly volatile, flammable, explosive, toxic or water-reactive materials
>
> – Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event

- Police stations, fire stations, vehicle and equipment storage facilities and emergency operations centers that are needed for disaster response before, during and after hazard events
- Public and private utilities, infrastructure and transportation systems that are vital to maintaining or restoring normal services to areas damaged by hazard events
- Public gathering places that could be used as evacuation centers during large-scale disasters
- Government and educational facilities central to governance and quality of life along with response and recovery actions taken as a result of a hazard event.

Figure 3-6 identifies critical facilities countywide, inclusive of all municipalities. Due to the sensitivity of this information, a detailed list of facilities is not provided. The list is on file with each planning partner. Table 3-3 and Table 3-4 provide summaries of the general types of critical facilities and infrastructure, respectively, in each municipality and unincorporated county areas. All critical facilities/infrastructure were analyzed to help rank risk and identify mitigation actions.

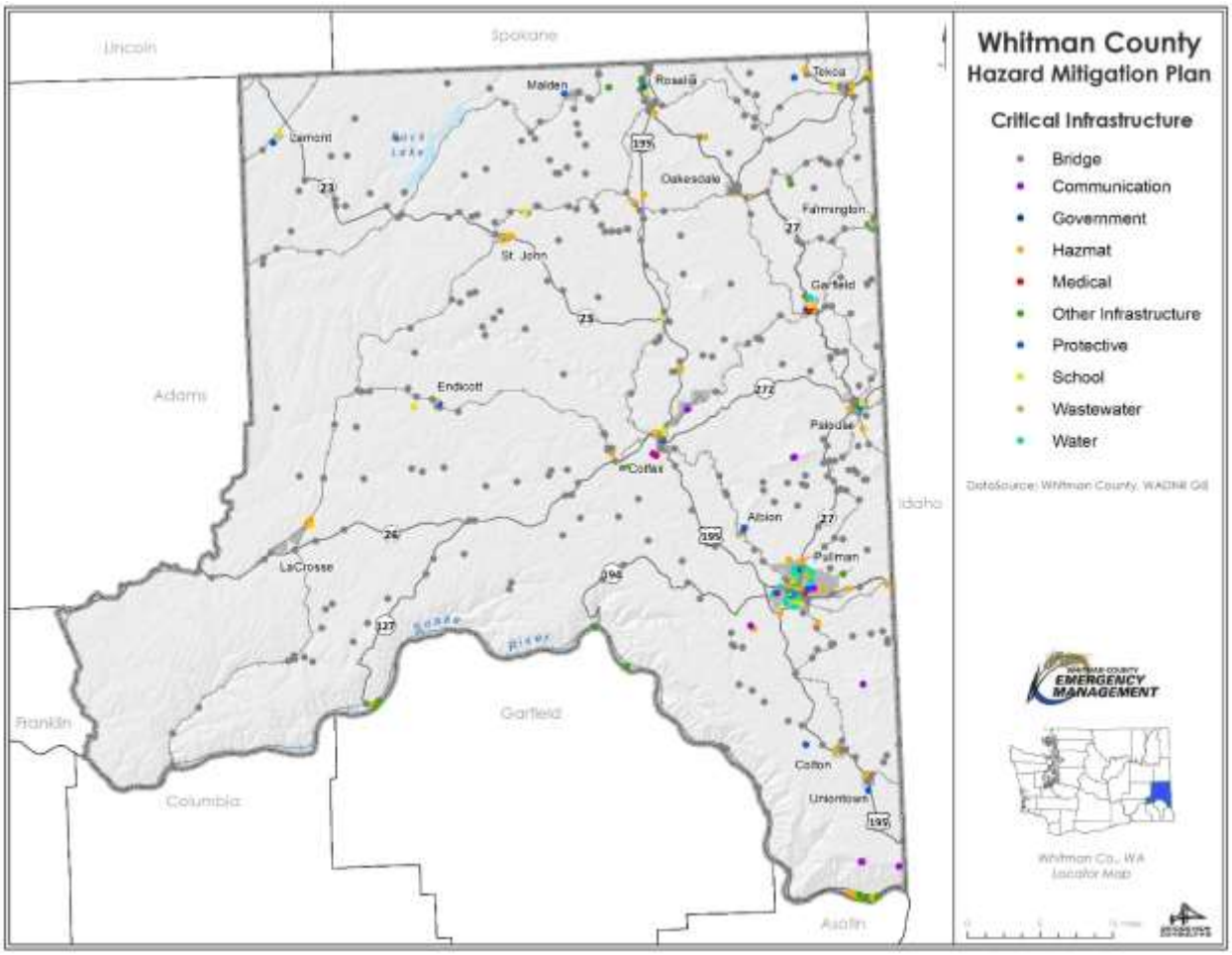


Figure 3-6. Countywide Critical Facilities

3.6 DEMOGRAPHICS

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Research has shown that people living near or below the poverty line, the elderly (especially older single

men), the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would assist the County in extending focused public outreach and education to these most vulnerable citizens.

Table 3-3.
Whitman County Critical Facilities

City	Medical and Health	Government Functions	Protective Functions	Schools	Hazmat	Other Critical Functions	**Total**
Albion	0	0	1	0	0	0	**1**
Colfax	1	0	4	2	2	0	**9**
Colton	0	0	0	2	1	0	**3**
Endicott	0	0	1	0	1	0	**2**
Farmington	0	1	0	1	0	0	**2**
Garfield	3	2	2	1	2	0	**10**
LaCrosse	0	0	0	2	2	0	**4**
Lamont	0	0	0	1	0	0	**1**
Malden	0	0	0	0	0	0	**0**
Oakesdale	0	0	1	2	3	0	**6**
Palouse	1	1	2	3	2	0	**9**
Pullman	2	0	6	8	8	0	**24**
Rosalia	0	0	3	1	0	0	**4**
St. John	0	0	1	1	1	0	**3**
Tekoa	0	0	1	1	3	0	**5**
Uniontown	0	0	0	0	2	0	**2**
Unincorporated	0	0	7	4	29	0	**40**
Total	**7**	**4**	**29**	**29**	**56**	**0**	**125**

Table 3-4.
Whitman County Critical Infrastructure

City	Bridges	Water Supply	Wastewater	Power	Communications	Other	**Total**
Albion	1	0	1	0	0	0	**2**
Colfax	7	0	0	0	1	0	**8**
Colton	2	0	1	0	0	0	**3**
Endicott	2	0	0	0	0	0	**2**
Farmington	5	2	1	0	0	0	**8**
Garfield	1	0	1	0	0	0	**2**
LaCrosse	0	0	0	0	0	0	**0**
Lamont	0	0	0	0	0	0	**0**
Malden	2	0	0	0	0	0	**2**
Oakesdale	8	0	0	0	0	0	**8**
Palouse	2	2	1	0	0	0	**5**

Table 3-4.
Whitman County Critical Infrastructure

City	Bridges	Water Supply	Wastewater	Power	Communications	Other	**Total**
Pullman	14	25	1	0	2	1	**43**
Rosalia	1	0	0	0	0	1	**2**
St. John	1	0	1	0	0	0	**2**
Tekoa	5	0	1	0	0	0	**6**
Uniontown	0	0	0	0	0	0	**0**
Unincorporated	349	2	4	0	10	18	**383**
Total	**400**	**31**	**12**	**0**	**13**	**20**	**476**

3.6.1 Population Characteristics

Knowledge of the composition of the population and how it has changed in the past and how it may change in the future is needed for making informed decisions about the future. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Whitman County is the 22nd largest of Washington's 39 counties. The U.S. Census Bureau estimates Whitman County's population at 49,791 as of July 2018. (U. S. Census Bureau, 2019).

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline. Between 2010 and 2018, Washington's population grew by 12.1 percent (1.34 percent per year) while Whitman County's population increased by 11.2 percent (1.24 percent per year) (U. S. Census Bureau, 2019). According to the Washington State Office of Financial Management (OFM), 68.42 percent (up ~3 percent from the 2013 plan), or nearly two-thirds, of the County's residents, live in Pullman.

Table 3-5 shows the population of incorporated municipalities and the combined unincorporated areas in Whitman County. In 2017, 13.0 percent of Whitman County's residents lived outside incorporated areas; that percentage fell from 15.7 in 2010.

3.6.2 Income

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decisions on evacuation. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on U.S. Census Bureau estimates, per capita income in Whitman County for the period from 2013 to 2017 was $22,154, and the median household income in 2018 was $41,574. In 2018, 21.4% of the population in Whitman County was living below the poverty level (U.S. Census, 2019).

3.6.3 Age Distribution

As a group, the elderly are more apt to lack the physical and economic resources for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing and/or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as "critical facilities" by emergency managers because they require extra notice to implement evacuation.

Table 3-5.
City and County Population Data

	Population		Growth Rate	
	2010[a]	2017[b]	7-Year	Annual Average
Albion	579	540	-6.74%	-0.96%
Colfax	2,805	2795	-0.36%	-0..05%
Colton	418	435	4.067%	0.58%
Endicott	289	295	-3.12%	0.45%
Farmington	146	155	6.16%	0.88%
Garfield	597	600	0.50%	0.07%
LaCrosse	313	310	-0.96%	-0.14%
Lamont	81	80	-1.23%	-0.18%
Malden	203	200	-1.48%	-0.21%
Oakesdale	422	425	0.71%	0.10%
Palouse	998	1,050	5.21%	0.74%
Pullman	29,799	33,280	0.12%	0.02%
Rosalia	550	560	1.82%	0.26%
St. John	543	505	-7.00%	-1.00%
Tekoa	778	770	-1.03%	-0.15%
Uniontown	294	340	15.65%	2.24%
Incorporated Total	***38,815***	***42,340***	***9.08%***	***1.30%***
Unincorporated	5,961	6,300	5.70%	0.81%
Whitman County Total	**44,776**	**48,640**	**8.63%**	**1.23%**

a. 2010 population data for incorporated areas from OFM, 2017a. County total from Census, 2017a.
b. 2010 population data from OFM, 2017b.

Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness;

this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

Census estimates for Whitman County's overall age distribution for 2013 – 2017 are shown in Figure 3-7. Based on these estimates, 10.4 percent of Whitman County's population is 65 or older, compared to the state average of 15.4 percent. The estimates show that 6.9 percent of the County's over-65 population has income below the poverty line. Of the County's children under 18, 14.6 percent are below the poverty level. It is estimated that 12.8 percent of the County's population is 14 or younger, compared to the state average of 19.7 percent. (U.S. Census, 2019).

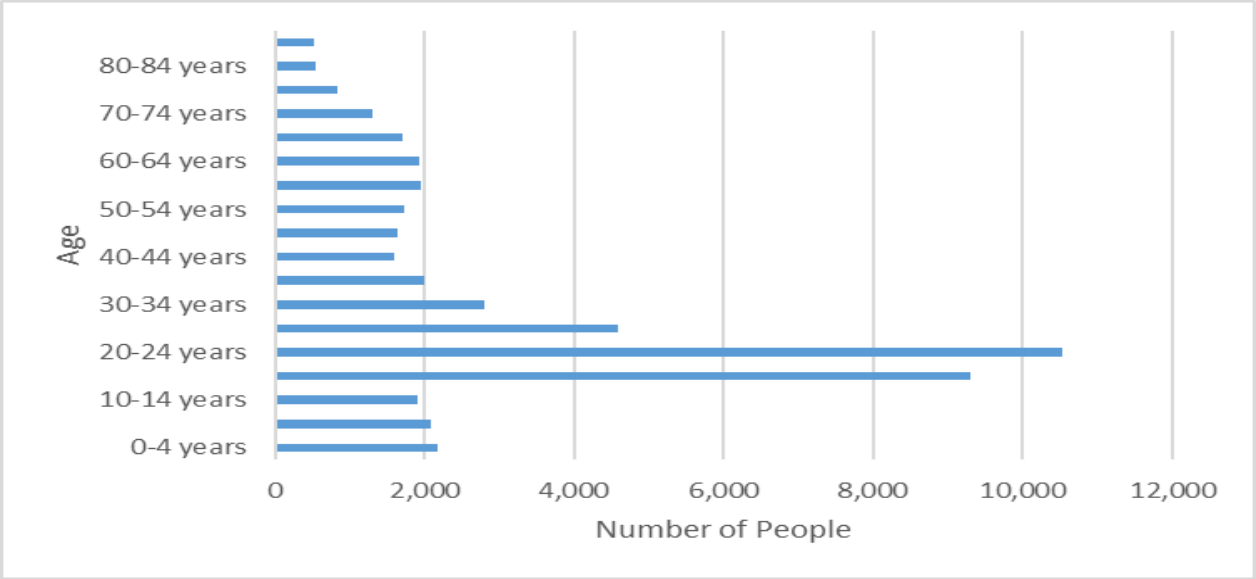


Figure 3-7. Whitman County Age Distribution

3.6.4 Race, Ethnicity and Language

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the U.S. Census, the racial composition of Whitman County is predominantly white, at 83.9 percent. The largest minority population is Asian, at 8.4 percent. Figure 3-8 shows the racial distribution in Whitman County (US Census Bureau, 2019).

Whitman County has a 10.4-percent foreign-born population. Other than English, the most commonly spoken languages in Whitman County are Asian and Pacific Islander languages. The census estimates a language other than English is spoken in 14.4 percent of the county's homes.

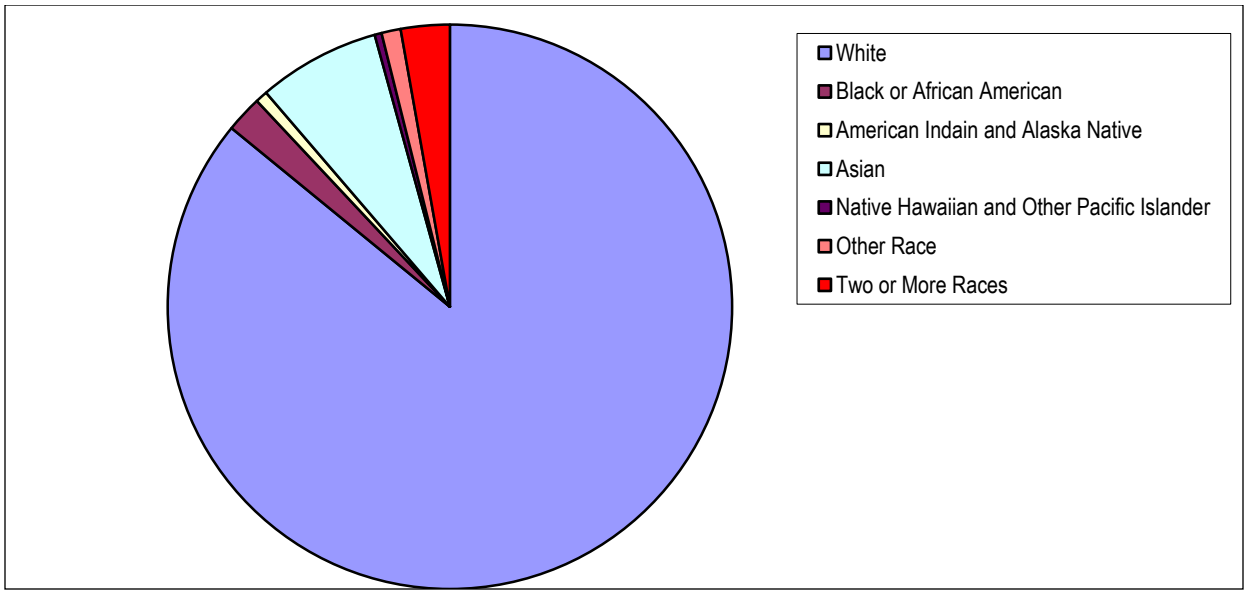


Figure 3-8. Whitman County Race Distribution

3.7 ECONOMY

3.7.1 Industry, Businesses and Institutions

The Census-defined industry with the highest employment in Whitman County is education/health care/social assistance (47 percent of civilian employed population over 16), followed by retail trade (10 percent) and arts/entertainment/recreation/accommodation/food service (9 percent). The industries with the smallest percentages of employment are wholesale trade (1.1 percent) and information (1.7 percent). Figure 3-9 shows the breakdown of industry types in Whitman County (U.S. Census, 2019).

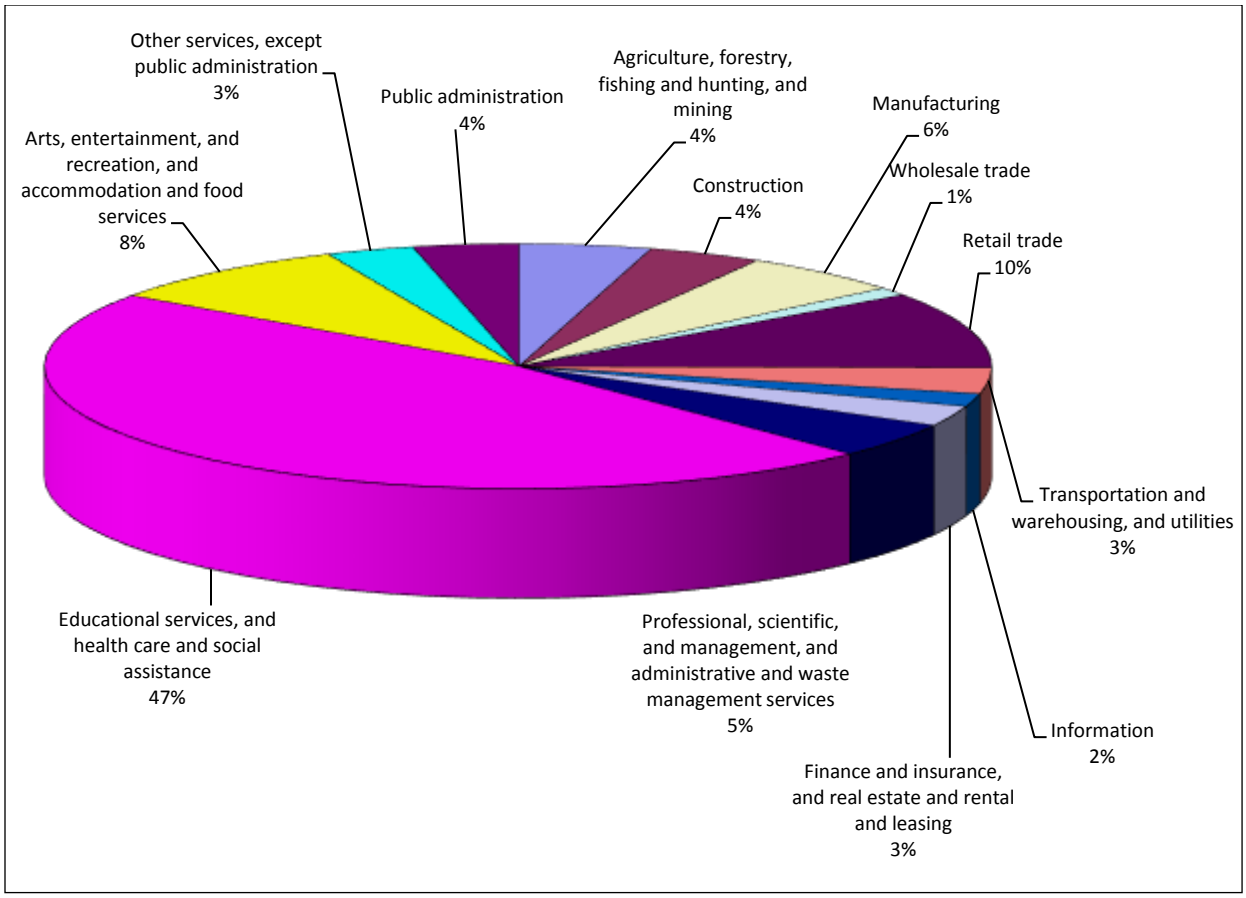


Figure 3-9. Industry in Whitman County

According to the Southeast Washington Economic Development Association, major employers in the county include Washington State University, Schweitzer Engineering, The McGregor Company, Pullman Regional Hospital, Whitman County, Wal-Mart, City of Pullman, Decagon Devices, The Bookie, and Safeway. Washington State University in Pullman is the only major educational institution in the County.

3.7.2 Employment Trends and Occupations

According to the American Community Survey, 58.7 percent of Whitman County's population is in the labor force (U.S. Census, 2019) (see Figure 3-10) .

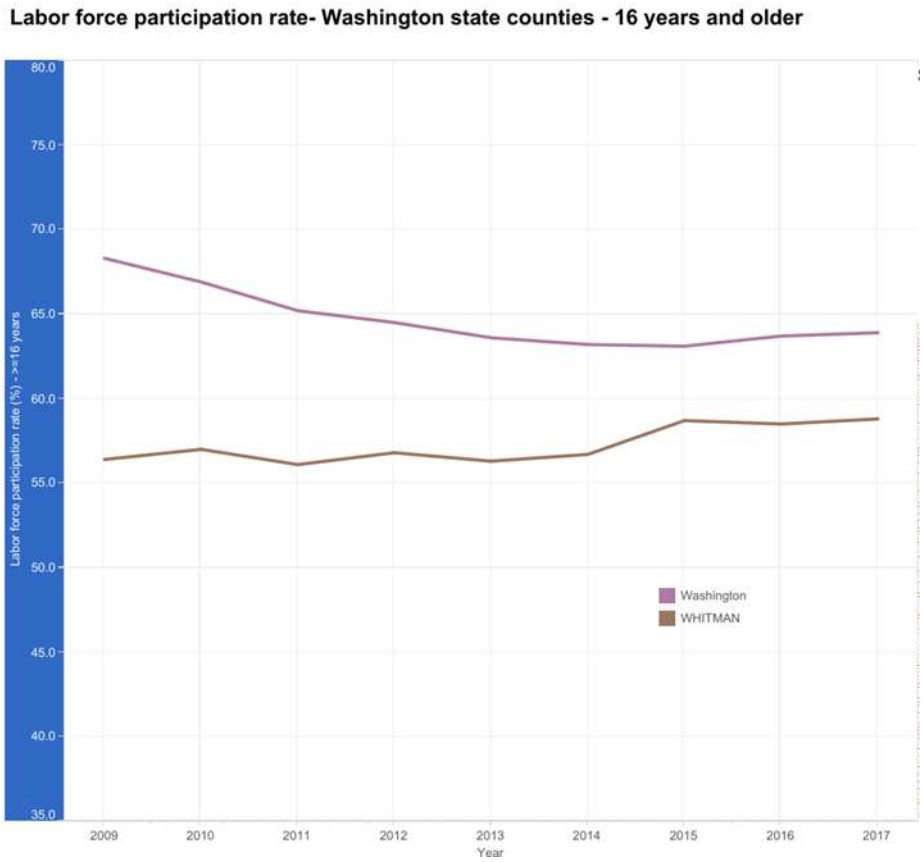
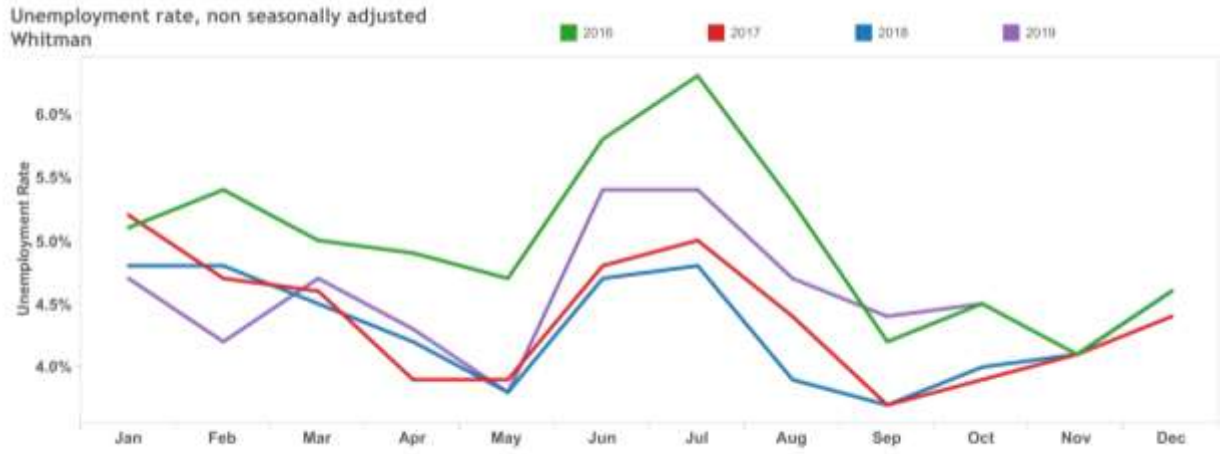


Figure 3-10. Labor Force Participation

Figure 3-11 compares Washington's and Whitman County's unemployment trends from 2009 through 2017 (Employment Security Department, 2019) Whitman County's unemployment rate was at 3.6 percent in May 2019, the lowest in three years. County unemployment rates have been consistently lower than the statewide rates.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	5.1%	5.4%	5.0%	4.9%	4.7%	5.8%	6.3%	5.3%	4.2%	4.5%	4.1%	4.6%
2017	5.2%	4.7%	4.6%	3.9%	3.9%	4.8%	5.0%	4.4%	3.7%	3.9%	4.1%	4.4%
2018	4.8%	4.8%	4.5%	4.2%	3.8%	4.7%	4.8%	3.9%	3.7%	4.0%	4.1%	4.6%
2019	4.7%	4.2%	4.7%	4.3%	3.8%	5.4%	5.4%	4.7%	4.4%	4.5%		

Employment and unemployment, not seasonally adjusted
Whitman

	2019		2018	2017
	September	October	October	October
Civilian Labor Force	24,649	25,137	24,754	24,101
Employment	23,572	24,009	23,752	23,171
Unemployment	1,077	1,128	1,002	930
Unemployment Rate	4.4%	4.5%	4.0%	3.9%

Figure 3-11. Washington and Whitman County Unemployment Rate

Source: Employment Security Department Washington State

The U.S. Census estimates that 60.7 percent of Whitman County workers commute alone by car, truck or van to work and that mean travel time to work is 15.3 minutes (the state average is 27.1 minutes) (U. S. Census Bureau, 2019).

The economic base of Whitman County has historically consisted mostly of agriculture and education. Although tax revenue from agricultural land has continued to increase, the responsibilities of regional (County) government have also grown, due to state legislative mandates and changed public expectations. This rise in the cost of providing County government services can no longer be borne by the agricultural sector alone.

Whitman County seeks opportunity for more diverse sources of tax revenue if County services to the public are to be continued at a level expected by all County residents. Because SR 270 links two university communities, which are becoming necessarily more interdependent, the South Pullman – Moscow Corridor now presents a distinct opportunity for economic development.

Whitman County and the following cities and towns have adopted comprehensive plans pursuant to the state Growth Management Act that dictate land use for their jurisdictions:

- Town of Albion
- City of Colfax
- Town of Farmington

- Town of Garfield
- Town of Oakesdale
- City of Palouse
- City of Pullman
- Town of Rosalia
- Town of St. John
- Town of Tekoa
- Town of Uniontown.

All of these comprehensive plans include policies for preserving agricultural land use in the County. Whitman County's dry-land farms have long produced some of the highest yields in the United States. Since 1954, the number of separate family farms in Whitman County has decreased by over 25 percent due to economic conditions requiring larger farm and ranch management units for successful operation. Uncoordinated non-agricultural development has serious impacts on the ability of farmers in Whitman County to maintain access to their many crop fields; the ability to carry out farm practices without threat of restriction; and the ability to lease and buy additional land necessary to continue economically feasible farming. These comprehensive plans promote urban and suburban development within incorporated areas, to preserve the agricultural uses of unincorporated areas.

Agriculture employment is expected to continue its very slow growth in terms of jobs, as wheat production continues to become more mechanized. In 2018, wheat production was high but prices dropped, which has farmers concerned for the economic future. In addition, as farmers age, finding replacement workers will be a challenge.

Export-related manufacturing and technical educational services are a source of positive growth for the county's economy. Unlike agriculture, as overall economic conditions change around the world, the types of products manufactured and education (WSU) in Whitman County are somewhat resistant to down cycles, which gives the county greater strength and diversity in its economy. (Employment Security Department Washington State, 2019)

Building codes represent the primary mechanism for ensuring that new development has a factor of safety for potential damage from natural hazards. The State of Washington mandates adoption of the International Building Code (IBC) as of July 1, 2004. Uniform implementation and enforcement of the standards specified under the IBC should be sufficient to ensure that new development is protected from the impacts of earthquakes. All municipal planning partners have adopted appropriate building codes pursuant to state mandates.

3.8 FUTURE LAND USE

As indicated, the County has experienced a slow increase in population; however, future land use development includes a number of new, large projects which will be underway during the life cycle of this plan. Those include a farm equipment, parts and service facility, new grain pads, and some additional structures for the Port of Wilma. In addition, the City of Pullman anticipates construction of a 15,000 commercial facility, as well as four large condominium / apartment complexes, one which is currently under development. As the area continues to grow and expand, information from the mitigation plan will assist in determining areas of concern with respect to the identified hazards. Such information should be considered when permitting takes place to ensure appropriate application of codes and regulations.

Chapter 4.
RISK ASSESSMENT METHODOLOGY

4.1 OVERVIEW

The DMA requires measuring potential losses to critical facilities and property resulting from natural hazards. A hazard is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. Natural hazards can exist with or without the presence of people and land development. However, hazards can be exacerbated by societal behavior and practice, such as building in a floodplain, along a sea cliff, or on an earthquake fault. Natural disasters are inevitable, but the impacts of natural hazards can, at a minimum, be mitigated or, in some instances, prevented entirely.

The goal of the risk assessment is to determine which hazards present the greatest risk and what areas are the most vulnerable to hazards. Whitman County and its planning partners are exposed to many hazards. The risk assessment and vulnerability analysis help identify where mitigation measures could reduce loss of life or damage to property in the planning region. Each hazard-specific risk assessment provides risk-based information to assist Whitman County and its planning partners in determining priorities for implementing mitigation measures.

4.2 METHODOLOGY

The risk assessment for this hazard mitigation plan evaluates the risk of natural hazards prevalent in Whitman County and meets requirements of the DMA (44 CFR, Section 201.6(c)(2)). The risk assessment approach used for this plan entailed using geographic information system (GIS), Hazus hazard-modeling software, and hazard-impact data to develop vulnerability models for people, structures and critical facilities, and evaluating those vulnerabilities in relation to hazard profiles that model where hazards exist. This approach is dependent on the detail and accuracy of the data used. In all instances, this assessment used Best Available Science and data to ensure the highest level of accuracy possible. The output of the data allows emergency management personnel the ability to plan by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- Hazard identification—Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- Vulnerability identification—Determine the impact of natural hazard events on the people, property, environment, economy and lands of the region.
- Cost evaluation—Estimate the cost of potential damage or cost that can be avoided by mitigation.

Utilizing those three phases of assessment, information was developed which identifies the hazards that affect the planning area, the likely location of natural hazard impact, the severity of the impact, previous occurrences, and the probability of future hazard events. That data, once complete, is utilized to complete the Risk Ranking process described in Chapter 14, which applies all of the data capture to the Calculated Priority Risk Index (CPRI). Each planning partner completes this process for their own community, as well as conducting the analysis on a countywide level.

The following elements were utilized in the risk assessment process, and provide the foundation for the standardized risk terminology:

- Hazard: Natural (or human caused) source or cause of harm or damage, demonstrated as actual (deterministic/historical events) or potential (probabilistic) events.

- Risk: The potential for an unwanted outcome resulting from a hazard event, as determined by its likelihood and associated consequences. For this plan, where possible, risk includes potential future losses based on probability, severity and vulnerability, expressed in dollar losses when possible. In some instances, dollar losses are based on actual demonstrated impact, such as through the use of the Hazus model. In other cases, losses are demonstrated through exposure analysis due to the inability to determine the extent to which a structure is impacted.

- Location/Extent: The area of potential or demonstrated impact within the area in which the analysis is being conducted. In some instances, the area of impact is within a geographically defined area, such as a floodplain. In other instances, such as for severe weather, there is no established geographic boundary associated with the hazard, as it can impact the entire area.

- Severity/Magnitude: The extent or magnitude upon which a hazard is ranked, demonstrated in various means, e.g., Richter Scale.

- Vulnerability: The degree of damage, e.g., building damage or the number of people injured.

- Probability of Occurrence and Return Intervals: These terms are used as a synonym for likelihood, or the estimation of the potential of an incident to occur.

4.2.1 Hazard Identification

For this plan, the planning team considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. This plan does not include non-natural (human caused) hazards. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. Based on the review, the planning team confirmed the hazards to be addresses in this plan as follows:

- Drought
- Earthquake
- Flood (including dam failures)
- Landslide
- Severe weather
- Volcano (ash fall)
- Wildfire

Technological hazards (e.g., hazardous material incidents) and human-caused hazards (e.g., terrorist acts) are not addressed in this plan.

Climate Change

Climate change will affect communities in a variety of ways. Impacts could include an increased risk for extreme events such as drought, storms, flooding and forest fires; more heat-related stress; and the spread of existing or new vector-born disease into a community. In many cases, communities are already facing these problems to some degree. Climate change may influence the frequency, intensity, extent and/or magnitude of the problems.

Within the hazard mitigation plan, climate change will be addressed as a secondary impact for each evaluated hazard of concern. Each chapter addressing one of the hazards of concern includes a section with a qualitative discussion on the probable impacts of climate change for that hazard. While many models are currently being developed to assess the potential impacts of climate change, there are currently none available to support hazard mitigation planning. As these models are developed in the future, this risk assessment may be enhanced to better measure these impacts.

4.2.2 Hazard Profiles

The hazard profiles describe the risks associated with identified hazards of concern. Each chapter describes the hazard and the planning area's vulnerabilities. For those municipal planning partners with defined geographic boundaries, this data is identified within the associated tables in the base plan in which the risk at the county level is also identified. The following steps were used to define the risk of each hazard:

- General overview and description of hazard;
- Identification of previous occurrences;
- Geographic areas most affected by the hazard;
- Event frequency estimates;
- Severity estimates;
- Warning time likely to be available for response;
- Risk and vulnerability assessment, which includes identification of impact on people, property, economy and the environment.

4.2.3 Risk Assessment Process

Once the profiles identified above were completed, the following steps were used by each planning partner to define the risk of each hazard:

- Determine exposure to each hazard—Exposure was determined by overlaying hazard maps with an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard.
- Assess the vulnerability of exposed facilities—Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and Hazus (discussed below) were used in this assessment.
- Where specific quantitative assessments could not be completed, vulnerability was measured in general, qualitative term, summarizing the potential impact based on past occurrences,

spatial extent, and subjective damage and casualty potential. Those items were categorized utilizing the criteria established in the CPRI index.

- The final step in the process was to determine the cumulative results of vulnerability based on the risk assessment and Calculated Priority Risk Index (discussed below) scoring, assigning a final qualitative assessment based on the following classifications:
  - Extremely Low—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
  - Low—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
  - Medium—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
  - High—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
  - Extremely High—Very widespread with catastrophic impact.

4.2.4 Hazus and GIS Applications

Earthquake and Flood Modeling Overview

In 1997, FEMA developed the standardized Hazards U.S., or Hazus, model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology, Hazus-MH, with new models for estimating potential losses from hurricanes and floods. The most recent model of Hazus now allows for Tsunami modeling to occurring in certain regions.

Hazus is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation-planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.

- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

The version used for this plan was Hazus MH 4.2, released by FEMA in June 2018.

Levels of Detail for Evaluation

Hazus provides default data for inventory, vulnerability and hazards. This default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- Level 1—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.

- Level 2—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format. In order to calculate losses due to flooding, Hazus uses the following inputs about the built environment: structure location, occupancy type, square footage, first floor height above grade, as well as replacement and content values.

- Level 3—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Building Inventory

No building data was available for use during this update outside of the Hazus default data as the County lacks specific parcel data available in a GIS format. This has been identified as a strategy for future plan updates, and the County does intend to seek grant funding to assist in rectifying this issue. In some instances, the 2013 plan identified building inventory data; however, no methodology was provided to identify how such data was captured (it may have been the result of Hazus default data). In some instances, due to the lack of other available data to illustrate impact, the Planning Team elected to maintain such information in the plan with the understanding that such data is for planning purposes only, and will be updated once better data is available. When utilized, such data is indicated as being 2013 data.

A critical facilities analysis was conducted outside of Hazus for this 2020 update, and was based on general exposure rather than estimated losses for some hazards of concern. Risk to structures is identified based on the structure location and the corresponding exposure to hazard location, where geographically established. Spatial queries were utilized to determine whether parcels or structures were inside or outside of the hazard zone for each hazard identified. A list of critical facilities developed by the County and its planning partners included geospatial data for fire, police, schools, medical facilities, etc.

On completion of the analysis, each planning partner was provided the critical facilities list, on which impact from each hazard is identified for each critical facility. That data was then utilized by each planning partner to determine dollar and other impact (e.g., magnitude and severity within the Calculated Priority Risk Index discussed below). The critical facilities list as a whole is considered privileged in nature from public disclosure; however, each planning partner was left to make the determination as to how they wished to identify specific structures based on their policies in place. In addition, specific critical facility structure impact data is further identified within the various Critical Facilities tables contained in each hazard profile, identified by critical facility type, e.g., power, water, wastewater, etc.

Hazus Application for this Plan

The following methods were used to assess specific hazards for this plan:

- **Flood**—A Hazus (modified) Level 1 analysis was performed. In addition, a depth grid was also developed during the 2013 process, which was again utilized for this 2020 update, with loss outputs updated utilizing the most recent version of Hazus. Analysis was also based on current FEMA regulatory 100- and 500-year flood hazard data based on the 1979 Flood Study. Focus was also placed on a GIS analysis to identify impact to critical infrastructure at risk based on the established list.

- **Earthquake**—A Hazus Level 1 Hazus analysis was performed to assess earthquake risk and exposure. No Shakemaps exist for the area; therefore, earthquake probabilistic data prepared by the U.S. Geological Survey (USGS) for the 100- and 500-year events were used for the analysis of this hazard. A modified version of the National Earthquake Hazard Reduction Program (NEHRP) soils inventory was used. Two probabilistic events were modeled: the 100- and 500-year probabilistic events.

GIS Application for this Plan

Dam, Drought, Hazardous Materials, Landslide, Severe Weather, Volcano, and Wildfire - For these hazards, historical data is not adequate to model future losses as no specific damage functions have been developed. However, GIS is able to map hazard areas and calculate exposure if geographic information is available with respect to the location of the hazard and critical facilities inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment. Locally relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, staff, emergency management personnel, and others. The primary data sources were Whitman County data, augmented with state and federal data sets, including FEMA, USGS, NOAA, WADOE, and WADNR data. Additional data sources for specific hazards are identified within the various profiles. In general analysis was completed as follows:

- **Climate Change** – Existing information was utilized to present future impact of climate change on the planning area. No specific analysis was conducted; however, existing data which illustrates potential impact was incorporated to the greatest extent possible in a qualitative manner.

- **Dam Failure**— No quantitative risk assessment could be performed for dam failure due to the lack of available inundation mapping. Currently, maps exist for only two of the 12 dams within the planning area, and the owners of these dams declined to release this information for security purposes (terrorism). The remaining dams do not have sufficient risk to warrant inundation mapping.

- **Drought** – The risk assessment methodologies used for this plan focus primarily on damage to structures. Does customarily does not impact structures; however, impact to the economy was discussed.

- **Hazardous Materials** – Hazardous materials data was utilized, captured from the Department of Ecology's FY2018 Tier II reporting data, which requires updates by March of each year within the State of Washington Rail lines were also illustrated, as they many times transport chemicals into the area. Hazardous materials sites were incorporated into the critical facilities data.

- **Landslide**—Historic landslide hazard data was used to assess exposure to landslides using Washington DNR Landslide Susceptibility data, in conjunction with Whitman County landslide data. This data depicts landslide susceptibility at a 10 meter resolution across the state of Washington. Landslide damages are illustrated based on the number of critical facilities intersecting the landslide zone and within a 100' buffer.

- **Severe Weather**—Severe weather data was downloaded from various sources, including the Natural Resources Conservation Service and the National Climatic Data Center, as well as PRISM Precipitation, Average Low, and Average High data. Tornado Project data was utilized to identify any events which have occurred in the planning area.

- **Wildfire**—Information on wildfire analysis was captured from various sources, including Washington DNR Wildfire History data, Wildfire Protection data, US Forest Service data, and LAND FIRE data, among other sources. The County also maintains a Comprehensive Wildfire Protection Plan (CWPP). Readers should view the CWPP to obtain additional information.

4.2.5 Calculated Priority Risk Index Scoring Criteria

The method of risk ranking was modified from the 2013 plan edition. For the 2020 update, the Planning Team utilized a Calculated Priority Risk Index (CPRI) score for each hazard of concern, addressing impact both at the county level, and at the Planning Partner level. The same process was followed for both the County and by each Planning Partner. While the base plan defines the process followed, each jurisdictional annex provides only the outputs rather than re-describing the entire process.

Vulnerabilities are described in terms of impact to critical facilities, structures, population, economic values, and functionality of government which can be affected by the hazard event as identified in the below tables.

Hazard impact areas describe the geographic extent a hazard can impact a jurisdiction and are uniquely defined on a hazard-by-hazard basis. Mapping of the hazards, where spatial differences exist, allows for hazard analysis by geographic location. Some hazards can have varying levels of risk based on location. Other hazards cover larger geographic areas and affect the area uniformly. Therefore, a system must be established which addresses all elements (people, property, economy, continuity of government) in order to rate each hazard consistently, and in a manner which addresses the functionality of each Planning Partner involved (e.g., municipality, fire district, public utility district, etc.).

The use of the Calculated Priority Risk Index allows such application, based on established criteria of application to determine the risk factor. For identification purposes, the five criteria on which the CPRI is based are probability, magnitude, geographic extent and location, warning time/speed of onset, and duration of the event (see Figure 4-1) . The criteria are further defined below.

CPRI Category	Degree of Risk			Assigned Weighting Factor
	Impact/ Level ID	Description	Impact Factor	
Probability	Unlikely	• Rare with no documented history of occurrences or events. • Annual probability of less than 1% (~100 years or more).	1	40%
	Possible	• Infrequent occurrences; at least one documented or anecdotal historic event. • Annual probability that is between 1% and 10% (~10 years or more).	2	
	Likely	• Frequent occurrences with at least two or more documented historic events. • Annual probability that is between 10% and 90% (~10 years or less).	3	
	Highly Likely	• Common events with a well-documented history of occurrence. • Annual probability of occurring. (1% chance or 100% Annually).	4	
Magnitude/ Severity	Negligible	• People – Injuries and illnesses are treatable with first aid; minimal hospital impact; no deaths. Negligible impact to quality of life. • Property – Less than 5% of critical facilities and infrastructure impacted and only for a short duration (less than 24-36 hours such as for a snow event); no loss of facilities, with only very minor damage/clean-up. • Economy – Negligible economic impact. • Continuity of government operating at 90% of normal operations with only slight modifications due to diversion of normal work for short-term response activity. Disruption lasts no more than 24-36 hours. • Special Purpose Districts: No Functional Downtime.	1	25%
	Limited	• People – Injuries or illness predominantly minor in nature and do not result in permanent disability; some increased calls for service at hospitals; no deaths; 14% or less of the population impacted. Moderate impact to quality of life. • Property – Slight property damage -greater than 5% and less than 25% of critical and non-critical facilities and infrastructure. • Economy – Impact associated with loss property tax base limited; impact results primarily from lost revenue/tax base from businesses shut down during duration of event and short-term cleanup; increased calls for emergency services result in increased wages. • Continuity of government impacted slightly; 80% of normal operations; most essential services being provided. Disruption lasts >36 hours, but <1 week. • Special Purpose Districts: Functional downtime 179 days or less.	2	
	Critical	• People – Injuries or illness results in some permanent disability or significant injury; hospital calls for service increased significantly; no deaths. 25% to 49% of the population impacted. • Property – Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). • Economy - Moderate impact as a result of critical and non-critical facilities and infrastructure impact, loss of revenue associated with tax base, lost income. • Continuity of government ~50% operational capacity; limited delivery of essential services. Services interrupted for more than 1 week, but <1 month. • Special Purpose Districts: Functional downtime 180-364 days.	3	
	Catastrophic	• People - Injuries or illnesses result in permanent disability and death to a significant amount of the population exposed to a hazard. >50% of the population impacted. • Property – Severe property damage >50% of critical facilities and non-critical facilities and infrastructure impacted. • Economy – Significant impact - loss of buildings /content, inventory, lost revenue, lost income. • Continuity of government significantly impacted; limited services provided (life safety and mandated measures only). Services disrupted for > than 1 month. • Special Purpose Districts: Functional Downtime 365 days or more.	4	
Geographic Extent and Location	Limited	Less than 10% of area impacted.	1	20%
	Moderate	10%-24% of area impacted.	2	
	Significant	25%-49% of area impacted.	3	
	Extensive	50% or more of area impacted.	4	
Warning Time / Speed of Onset	<6 hours	Self-explanatory.	4	10%
	6 to 12 hours	Self-explanatory.	3	
	12 to 24 hours	Self-explanatory.	2	
	> 24 hours	Self-explanatory.	1	
Duration	< 6 hours	Self-explanatory.	1	5%
	< 24 hours	Self-explanatory.	2	
	<1 week	Self-explanatory.	3	
	>1 week	Self-explanatory.	4	

Figure 4-1. Calculated Priority Risk Index (CPRI)

Probability

Probability of a hazard event occurring in the future was assessed based on hazard frequency over a 100-year period (where available). Hazard frequency was based on the number of times the hazard event occurred divided by the period of record. If the hazard lacked a definitive historical record, the probability was assessed qualitatively based on regional history and other contributing factors. Probability of occurrence was assigned a 40% weighting factor, and was broken down as follows:

Rating	Likelihood	Frequency of Occurrence
1	Unlikely	Less than 1% probability in the next 100 years.
2	Possible	Between 1% and 10% probability in the next year, or at least one chance in the next 100 years.
3	Likely	Between 10% and 100% probability in next year, or at least one chance in the next 10 years.
4	Highly Likely	Greater than 1 event per year (frequency greater than 1).

Magnitude

The magnitude of potential hazard events was evaluated for each hazard. Magnitude is a measure of the strength of a hazard event and is usually determined using technical measures specific to the hazard. Magnitude was calculated for each hazard where property damage data was available, and was assigned a 25% weighting factor. Magnitude calculation was determined using the following: *Property Damage / Number of Incidents) / $ of Building Stock Exposure = Magnitude.* In some cases, the Hazus model provided specific people/dollar impact data. For other hazards, a GIS exposure analysis was conducted. Magnitude was broken down as follows:

Rating	Magnitude	Percentage of People and Property Affected
1	Negligible	Less than 5% Very minor impact to people, property, economy, and continuity of government at 90%.
2	Limited	6% to 24% Injuries or illnesses minor in nature, with only slight property damage and minimal loss associated with economic impact; continuity of government only slightly impacted, with 80% functionality.
3	Critical	25% to 49% Injuries result in some permanent disability; 25-49% of population impacted; moderate property damage ; moderate impact to economy, with loss of revenue and facility impact; government at 50% operational capacity with service disruption more than one week, but less than a month.
4	Catastrophic	More than 50% Injuries and illness resulting in permanent disability and death to more than 50% of the population; severe property damage greater than 50%; economy significantly impacted as a result of loss of buildings, content, inventory; government significantly impacted; limited services provided, with disruption anticipated to last beyond one month.

Extent and Location

The measure of the percentage of the people and property within the planning area impacted by the event, and the extent (degree) to which they are impacted. Extent and location were assigned a weighting factor of 20%, and broken down as follows:

Rating	Magnitude	Percentage of People and Property Affected
1	Negligible	Less than 10% Few if any injuries or illness. Minor quality of life lost with little or no property damage. Brief interruption of essential facilities and services for less than four hours.
2	Limited	10% to 24% Minor injuries and illness. Minor, short term property damage that does not threaten structural stability. Shutdown of essential facilities and services for 4 to 24 hours.
3	Critical	25% to 49% Serious injury and illness. Major or long term property damage, that threatens structural stability. Shutdown of essential facilities and services for 24 to 72 hours.
4	Catastrophic	More than 50% Multiple deaths Property destroyed or damaged beyond repair Complete shutdown of essential facilities and services for 3 days or more.

Warning Time/Speed of Onset

The rate at which a hazard occurs, or the time provided in advance of a situation occurring (e.g., notice of a cold front approaching or a potential hurricane, etc.) provides the time necessary to prepare for such an event. Sudden-impact hazards with no advanced warning are of greater concern. Warning Time/Speed of onset was assigned a 10% weighting factor, and broken down as follows:

Rating	Probable amount of warning time
1	More than 24 hours warning time.
2	12-24 hours warning time.
3	5-12 hours warning time.
4	Minimal or no warning time.

Duration

The time span associated with an event was also considered, the concept being the longer an event occurs, the greater the threat or potential for injuries and damages. Duration was assigned a weighting factor of 5%, and was broken down as follows:

Rating	Duration of Event
1	6-24 hours
2	More than 24 hours
3	Less than 1 week
4	More than 1 week

Chapter 12 summarizes all of the analysis conducted by way of completion of the Calculated Priority Risk Index (CPRI) for hazard ranking. It should again be emphasized that each planning partner utilized the outputs from the risk assessment to compute their CPRI for their own respective jurisdiction, following the process identified.

In completion of this scoring process, each planning partner is provided not only the hazard profiles completed during this process, but also a summary report, various loss matrix tables, maps, charts and graphics identifying information at the jurisdiction-level, and also a copy of the critical facilities and infrastructure table established at the onset of the process. The critical facilities spreadsheet is not published within the document due to its confidential nature; however, each planning partner is provided the list for use in identifying specific structures within their planning area which are at risk.

The rating is then incorporated into an Excel Workbook, which calculates the CPRI Score. Each planning partner's completed worksheet is summarized in Chapter 12. An example worksheet is illustrated in Figure 4-2 .

	Probability				Magnitude/Severity				Geographic Extent and Location				Warning Time				Duration				
Hazard	Unlikely / Low (1)	Possible / Medium (2)	Likely / High (3)	Highly Likely / Very High (4)	Negligible (1)	Limited (2)	Critical (3)	Catastrophic (4)	Negligible (1)	Limited (2)	Significant (3)	Extensive (4)	< 6 hours (4)	6 - 12 hours (3)	12 - 24 hours (2)	> 24 hours (1)	< 6 hours (1)	< 24 hours (2)	< 1 week (3)	> 1 week (4)	CPRI Score
Climate Change																					0.00
Drought																					0.00
Earthquake																					0.00
Erosion																					0.00
Flood																					0.00
Landslides																					0.00
Severe Weather																					0.00
Tsunami																					0.00
Volcano																					0.00
Wildfire																					0.00
Other Hazards of Concern																					0.00
																					0.00
																					0.00

Rank	Hazard	CPRI Score	Level
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			

Figure 4-2. Hazard Ranking Worksheet

4.3 PROBABILITY OF OCCURRENCE AND RETURN INTERVALS

Natural hazard events with relatively long return periods, such as a 100-year flood or a 500- or 1,000-year earthquake, are often thought to be very unlikely. In reality, the probability that such events occur over the next 30 or 50 years is relatively high, having significant probabilities of occurring during the lifetime of a building:

- Hazard events with return periods of 100 years have probabilities of occurring in the next 30 or 50 years of about 26 percent and about 40 percent, respectively.
- Hazard events with return periods of 500 years have about a 6 percent and about a 10 percent chance of occurring over the next 30 or 50 years, respectively.
- Hazard events with return periods of 1,000 years have about a 3 percent chance and about a 5 percent chance of occurring over the next 30 or 50 years, respectively.

For life safety considerations, even natural hazard events with return periods of more than 1,000 years are often deemed significant if the consequences of the event happening are very severe (extremely high damage and/or substantial loss of life). For example, the seismic design requirements for new construction are based on the level of ground shaking with a return period of 2,475 years (2 percent probability in 50 years). Providing life safety for this level of ground shaking is deemed necessary for seismic design of new buildings to minimize life safety risk. Of course, a hazard event with a relatively long return period may occur tomorrow, next year, or within a few years. Return periods of 100 years, 500 years, or 1,000 years mean that such events have a 1 percent, a 0.2 percent or a 0.1 percent chance of occurring in any given year.

4.4 COMMUNITY VARIATIONS TO THE RISK ASSESSMENT

Each planning partner within their respective annex describes where or how their risk varies from what is described in the hazard profiles and risk ranking. Variations are documented in the risk assessment section in their annex to the plan, if appropriate. In some instances, declared disaster events may not have impacted a specific jurisdiction or entity. Similarly, there may have been incidents of significance which did not rise to a level of a disaster declaration, but were nonetheless significant to the jurisdiction or entity. As such, those differences are noted where applicable.

4.5 LIMITATIONS

Various data sets were utilized in developing the risk assessment incorporated into this planning effort. In attempting to utilize the various sources, discrepancies may exist. The models and information presented in this document does not replace or supersede any official document or product generated to meet the requirements of any state, federal, or local program, which may be much more detailed and encompassing beyond the scope of this project. This document is intended for planning purposes only. This document and its contents have been prepared and are intended solely for Whitman County and its planning partners' information and use with respect to hazard mitigation planning, incorporating other relevant data into other planning mechanisms as appropriate. While this process utilized best available science and scientific data, the Planning Team, consultant, nor any of the planning partners conducted any scientific analysis within this document, and none should be construed. The process reproduced existing data only in different ways to meet the guidelines and requirements of 44 CFR 201.6. All data layers utilized are identified within the various sections of this document should reviewers wish greater clarification and information.

Loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study;
- Incomplete or outdated inventory, demographic or economic parameter data;
- The unique nature, geographic extent and severity of each hazard;
- Mitigation measures already employed; and
- The amount of advance notice residents have available to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and are for planning purposes only; not life safety measures. The results do not predict precise results and should be used only to understand relative risk. Over the long term, as is

customary with all such planning efforts, Whitman County and its planning partners will continue to collect additional data to assist in better estimating potential losses associated with other hazards as science increases the validity of data.

Some assumptions were made by the planning partnership in an effort to capture as much data as necessary to supplant any significant data gaps. One example of this is the valuation for structures within the assessed data. For structures for which data was not provided, the missing information was determined using averages of similar types of structures, determining square footage and applying a multiplier. This process is identified in the Hazus User's Guide.

Some hazards, such as earthquake, are pre-loaded with scientifically determined scenarios which are used during the modeling process. This does not allow for manipulation of the data as with other hazards, such as flood. In the case of earthquake, greater reliance existed on the use of the Hazus default data, which is known to be less accurate, most often causing higher loss values. Therefore, while loss estimates are provided, they should be viewed with this flaw in mind. A much more in-depth scientific analysis is necessary to rely on this type of data with a high degree of accuracy. Readers should view this document as a baseline or starting point, and information should be further studied and analyzed by scientists and other subject matter experts in specific hazard fields.

Chapter 5.
DAM FAILURE

5.1 GENERAL BACKGROUND

5.1.1 Causes of Dam Failure

Dam failures in the United States typically occur in one of four ways:

- Overtopping of the primary dam structure, which accounts for 34 percent of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30 percent of all dam failures.
- Failure due to piping and seepage accounts for 20 percent of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10 percent of all failures.

The remaining 6 percent of U.S. dam failures are due to miscellaneous causes. Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage. The most likely disaster-related causes of dam failure in Whitman County are earthquakes.

Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

DEFINITIONS

Dam—Any artificial barrier and/or any controlling works, together with appurtenant works, that can or does impound or divert water. (Washington Administrative Code, Title 173, Chapter 175.)

Dam Failure—An uncontrolled release of impounded water due to structural deficiencies in dam.

Emergency Action Plan—A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)

High Hazard Dam—Dams where failure or operational error will probably cause loss of human life. (FEMA 333)

Significant Hazard Dam—Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)

5.1.2 Regulatory Oversight

The potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect the lives and property of the public.

Washington Department of Ecology Dam Safety Program

The Dam Safety Office (DSO) of the Washington Department of Ecology regulates 1,234 dams in the state that impound at least 10 acre-feet of water with 12 listed in Whitman County. The DSO has developed dam safety guidelines to provide dam owners, operators, and design engineers with information on activities, procedures, and requirements involved in the planning, design, construction, operation and maintenance of dams in Washington. The authority to regulate dams in Washington and to provide for public safety is contained in the following laws:

- State Water Code (1917)—RCW 90.03
- Flood Control Act (1935)—RCW 86.16
- Department of Ecology (1970)—RCW 43.21A.

Where water projects involve dams and reservoirs with a storage volume of 10 acre-feet or more, the laws provide for the Department of Ecology to conduct engineering review of the construction plans and specifications, to inspect the dams, and to require remedial action, as necessary, to ensure proper operation, maintenance, and safe performance. The DSO was established within Ecology's Water Resources Program to carry out these responsibilities.

The DSO provides reasonable assurance that impoundment facilities will not pose a threat to lives and property, but dam owners bear primary responsibility for the safety of their structures, through proper design, construction, operation, and maintenance. The DSO regulates dams with the sole purpose of reasonably securing public safety; environmental and natural resource issues are addressed by other state agencies. The DSO neither advocates nor opposes the construction and operation of dams.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety. (U. S. Army Corps of Engineers, 2019)

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license.

Every five years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters), or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors and evaluates seismic research and applies it in investigating and performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on

the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication *Engineering Guidelines for the Evaluation of Hydropower Projects* guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

5.2 FEDERAL ENERGY REGULATORY COMMISSION

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations. (Federal Energy Regulatory Commission 2019)

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations. (Federal Energy Regulatory Commission, 2019)

5.3 HAZARD PROFILE

5.3.1 Previous Occurrences

According to DSO records, 22 notable dam failure events occurred in Washington between 1918 and 2018. None of these occurred within or impacted Whitman County.

5.3.2 Extent and Location

The DSO oversees 12 dams in Whitman County, as listed in Table 5-1. Two are operated by federal agencies, and the remainder are under the jurisdiction of the state. Three of the dams are listed as "significant hazard", which means there are six or less lives at risk downstream of the dam. The remainder of the dams are ranked as low risk, with no lives at risk downstream of the dam.[2] (Note: Little Goose Dam is listed in the Columbia County Dam Inventory list.)

Table 5-1.
Dams in Whitman County

Name	National ID #	Water Course	Owner	Year Built	Dam Type[a]	Crest Length (feet)	Height (feet)	Surface Area (acres)	Drainage area (sq. mi.)	Hazard Class[b]
Lower Granite	WA00349	Snake River	U.S. Army Corps of Engineers	1975	CN, PG, RE	3200	228	8,900	103,200	2D

[2] https://fortress.wa.gov/ecy/publications/documents/94016.pdf

Table 5-1.
Dams in Whitman County

Name	National ID #	Water Course	Owner	Year Built	Dam Type[a]	Crest Length (feet)	Height (feet)	Surface Area (acres)	Drainage area (sq. mi.)	Hazard Class[b]
Little Goose	WA00331	Snake River	U.S. Army Corps of Engineers	1970	CN, PG, RE	2655	226	10,025	103,900	2D
Horn School Rest Area Sewage Lagoon	WA01766	Off-stream	Washington Department of Transportation	1996	RE	122	9	2.6	0.00	2D
Packers	WA00760	Lake Creek	BLM – Spokane District Office	2008	RE	716	8.8			3
Albion Sewage Treatment Lagoons	WA01962	South Fork Palouse River, Off-stream	Albion Public Works Department	1972	RE	2300	8	—	0.01	3
Bennett Pond Dam	WA01557	Pine Creek	John C Bennett	1960	RE	500	8	4.0	0.00	3
Farmington Sewage Lagoon Dike No. 1	WA01430	Pine Cr. Tributary, Off-stream	Town of Farmington	1982	RE	1100	7	9.0	0.01	3
Farmington Sewage Lagoon Dike No. 2	WA01431	Pine Cr. Tributary, Off-stream	Town of Farmington	1982	RE	1400	7	7.0	0.01	3
LaCrosse Sewage Treatment Lagoon	WA01963	Off-stream	Town of LaCrosse	1963	RE	1900	7	6.0	0.01	3
Uniontown Sewage Pond No. 1	WA01448	Union Flat Creek, Off-stream	Town of Uniontown	1982	RE	600	8	9.0	0.01	3
Uniontown Sewage Pond No. 2	WA01449	Union Flat Creek, Off-stream	Town of Uniontown	1982	RE	600	7	11.0	0.01	3
Uniontown Sewage Pond No. 3	WA01450	Union Flat Creek, Off-stream	Town of Uniontown	1982	RE	600	6	30.0	0.03	3

a. RE = Earth Fill; CN = Concrete, PG = Concrete Gravity
b. See Section 5.3.4 for definition of hazard classes

The DSO has prepared dam failure inundation mapping for the Hazard Class 1A and 1B dams. None of the mapping for high hazard dams was made available to the planning team for this effort. Therefore, a complete exposure and vulnerability analysis was not able to be performed.

5.3.3 Frequency

Dam failures are infrequent and usually coincide with events that cause them, such as earthquakes or excessive rainfall. The probability of any type of dam failure is low in today's regulatory environment. There is a "residual risk" associated with dams that remains after safeguards have been implemented. The residual risk is associated with events beyond those that the facility was designed to withstand.

5.3.4 Severity

The DSO classifies dams and reservoirs in a hazard rating system based solely on the potential consequences to downstream life and property that would result from a failure of the dam and sudden release of water. The following codes are used as an index of the potential consequences in the downstream valley if the dam were to fail and release the reservoir water:

- 1A = Greater than 300 lives at risk (High hazard)
- 1B = From 31 to 300 lives at risk (High hazard)
- 1C = From 7 to 30 lives at risk (High hazard)
- 2* = From 1 to 6 lives at risk (Significant hazard)
- 2D = From 1 to 6 lives at risk (Significant hazard)
- 2E** = No lives at risk ** (Significant hazard)
- 3 = No lives at risk (Low hazard).

* Legacy classification, parsing all 2's into 2D's and 2E's

** Significant economic or environmental risk

The Corps of Engineers developed the hazard classification system for dam failures shown in Table 5-2. The Washington and Corps of Engineers hazard rating systems are both based only on the potential consequences of a dam failure; neither system takes into account the probability of such failures.

5.3.5 Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours (U.S. Army Corps of Engineers, 1997).

Whitman County and its planning partners have established protocols for flood warning and response to imminent dam failure in the flood warning portion of adopted emergency operations plans. These protocols are tied to emergency action plans created by the dam owners. Not all dams have emergency action plans; only those rated as high hazard are mandated to do so by state and federal regulations.

5.4 VULNERABILITY ASSESSMENT

5.4.1 Impact on Life, Health, and Safety

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system. The potential for loss of life is also affected by the capacity and number of evacuation routes available to populations living in areas of potential inundation.

5.4.2 Impact on Property

Vulnerable properties are those closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

No exposure analysis was performed for this assessment due to the lack of available inundation mapping. Currently, emergency action plan maps exist for only two of the dams within the planning area. The owners of these dams are not required to release this information for security purposes. The remaining dams do not have sufficient risk to warrant inundation mapping. Readers may obtain additional information concerning inundation by reviewing the flood hazard profile, as inundation may be similar in nature

5.4.3 Impact on Critical Facilities

Critical facilities within the dam inundation area could receive damage from an event should an event occur. This could result in significant down-time of critical facilities and infrastructure. Damage to roads and bridges could isolate populations. The Whitman County port facilities would be vulnerable during an event, which could have significant economic impacts on the planning area.

5.4.4 Impact on Environment

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce foreign elements into local waterways, resulting in destruction of downstream habitat and detrimental effects on many species of animals, especially endangered species such as chinook and sockeye salmon. The extent of the vulnerability of the environment is the same as the exposure of the environment.

5.4.5 Impact on Economy

Urban growth areas and employment growth are planning elements under the Growth Management Act (GMA). At present, the information contained within reviewed reports when compared to the growth of the area presents a consistent ratio to allow for continued economic growth, with little impact from dam inundation. Based on these findings, Whitman County and its planning partners appear to be well equipped to deal with future economic growth and development, taking into consideration the critical areas ordinance as it relates to dam failure flooding. As no inundation maps for the area are available, economic loss as a result of dam failure would be similar to that of a flood.

In general, dam failure, if severe enough, could lead to downstream devastation, including loss of life, personal injuries, property damage, and disaster response. Some of these impacts include repairing or

reconstructing the structure, and losses to a wide range of the facility's beneficiaries. Farms, homes, and businesses may be inundated. Insurers and real estate lenders, such as banks, may incur substantial losses. Governmental bodies may suffer direct losses, as well as relief and recovery obligations. Environmental damage may be severe. Clean-up and recovery efforts may cover extensive periods of time. Utility services may be interrupted, other businesses adversely affected, and jobs lost. (Binder, 2019)

5.4.6 Impact from Climate Change

Potential changes to the hydrographs used to design dams due to the impacts of climate change are a growing concern for the safety of our nation's dams. Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams are already increases in stream flows from earlier releases from dams.

Dams are constructed with safety features known as spillways. Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

5.5 SECONDARY HAZARDS

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat.

Table 5-2.
Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

Table 5-2.
Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: U. S. Department of Homeland Security Federal Emergency Management Agency, 1998; confirmed 2019

5.6 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by comprehensive plans adopted under Washington's GMA. These comprehensive plans, in conjunction with critical-area regulations adopted by municipal planning partners, provide the regulatory and planning capability to address the risks associated with dam failures. Dam failure is currently not addressed as a standalone hazard under these programs, but flooding is. Municipal planning partners have established comprehensive policies regarding sound land use in identified flood hazard areas. Most of the areas vulnerable to severe impacts from dam failure intersect the mapped flood hazard areas. Flood-related policies in the comprehensive plans will help reduce the risk associated with the dam failure hazard for all future development in the planning area.

5.7 SCENARIO

An earthquake in the region could lead to liquefaction of soils around a dam. This could occur without warning during any time of the day. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of a dam that impacts the planning area.

While the probability of dam failure is very low, the probability of flooding associated with changes to dam operational parameters in response to climate change is higher. Dam designs and operations are developed based on hydrographs from the historical record. If these hydrographs experience significant changes over time due to the impacts of climate change, the design and operations may no longer be valid for the changed condition. This could have significant impacts on dams that provide flood control. Specified release rates and impound thresholds may have to be changed. This would result in increased discharges downstream of these facilities, thus increasing the probability and severity of flooding.

5.8 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zones. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Important issues associated with dam failure hazards include the following:

- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure.

However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.

- Mapping for federally regulated dams is already required and available; however, mapping for non-federal-regulated dams that estimates inundation depths is needed to better assess the risk associated with dam failure from these facilities. Future updates to this assessment should attempt to obtain any an inundation mapping that is available within the planning area. This will require coordination between the County and the dam owners.
- Most dam failure mapping required at federal levels requires determination of the probable maximum flood. While the probable maximum flood represents a worst-case scenario, it is generally the event with the lowest probability of occurrence. For non-federal-regulated dams, mapping of dam failure scenarios that are less extreme than the probable maximum flood but have a higher probability of occurrence can be valuable to emergency managers and community officials downstream of these facilities. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Addressing security concerns and the need to inform the public of the risk associated with dam failure is a challenge for public officials.

5.9 RESULTS

Due to the lack of inundation maps from the dam owners, it is difficult to determine the potential impact from a dam failure. While failure of some of the dams would have no, or very limited impact, were Little Goose dam to fail, Whitman County would experience impact as the dam would drain downriver from lower granite. Likewise, agricultural area impacted by inundation would have economic impact on both individuals, as well as the tax base of the county. The Department of Ecology's website currently identifies three dams at a level 2D, meaning six (6) or fewer lives at risk per dam. Review of the flood profile may provide some additional insight. At present, there are a total of 30 critical facilities located within the 100-year floodplain. Not all of those structures would be vulnerable as a result of a dam breach or failure. Based on the lack of specific data on which to identify risk, the Planning Team determined that the dam hazard would not be analyzed separately, but within the flood profile.

Chapter 6.
DROUGHT

6.1 GENERAL BACKGROUND

Drought is a normal phase in the climatic cycle of most geographical regions. According to the National Drought Mitigation Center, drought originates from a deficiency of precipitation over an extended period of time, usually a season or more. This results in a water shortage for some activity, group or environmental sector. Drought is the result of a significant decrease in water supply relative to what is "normal" in a given location. Unlike most disasters, droughts normally occur slowly but last a long time.

DEFINITIONS

Drought—The cumulative impacts of several dry years on water users and agricultural producers. It can include deficiencies in surface and subsurface water supplies and cause impacts to health, well-being, and quality of life.

Hydrological Drought—Deficiencies in surface and subsurface water supplies.

Socioeconomic Drought—Drought impacts on health, well-being, and quality of life.

There are five generally accepted operational definitions of drought: (National Drought Mitigation Center, 2019)

- **Meteorological drought** is an expression of precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought. Definitions are usually region-specific, and based on an understanding of regional climatology. A definition of drought developed in one part of the world may not apply to another, given the wide range of meteorological definitions.
- **Agricultural drought** occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.
- **Hydrological drought** refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes and reservoirs, so hydrological measurements are not the earliest indicators of drought. After precipitation has been reduced or deficient over an extended period of time, this shortage is reflected in declining surface and subsurface water levels. Water supply is controlled not only by precipitation, but also by other factors, including evaporation (which is increased by higher than normal heat and winds), transpiration (the use of water by plants), and human use.
- **Socioeconomic drought** occurs when a physical water shortage starts to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with the supply and demand of an economic good.
- **Ecological drought** is a recent concept defined as a "prolonged and widespread deficit in naturally available water supplies including changes in natural and managed hydrology that create multiple stresses across ecosystems." Ecological drought's impacts are then transferred to human communities via ecosystem services.

Washington has a statutory definition of drought (RCW 43.83B.400), defining an area as being in a drought condition when the water supply for the area is below 75 percent of normal and water uses and users in the area are likely to incur undue hardships because of the water shortage.

6.2 HAZARD PROFILE

Whitman County is not as vulnerable to drought as many other central and eastern Washington counties, although it has had drought for at least 10 to 15 percent of the time over the last 100 years. The main reason for the County's low vulnerability is a minimal reliance on irrigation for crops and water supplies.

6.2.1 Previous Occurrences

Droughts recur every few years in Washington, although FEMA reports no presidentially declared drought situations affecting Whitman County. In the past century, Washington has experienced a number of droughts, including several that lasted for more than a single season – 1928 to 1932, 1992 to 1994, and 1996 to 1997. The droughts of 1977 and 2001, the worst and second worst in state history, provide good examples of how drought can affect the state. More recent droughts in the state occurred in 2005, 2015 (see Figure 6-1 for declared areas), and as of the update of this plan, an on-going drought in 2019.

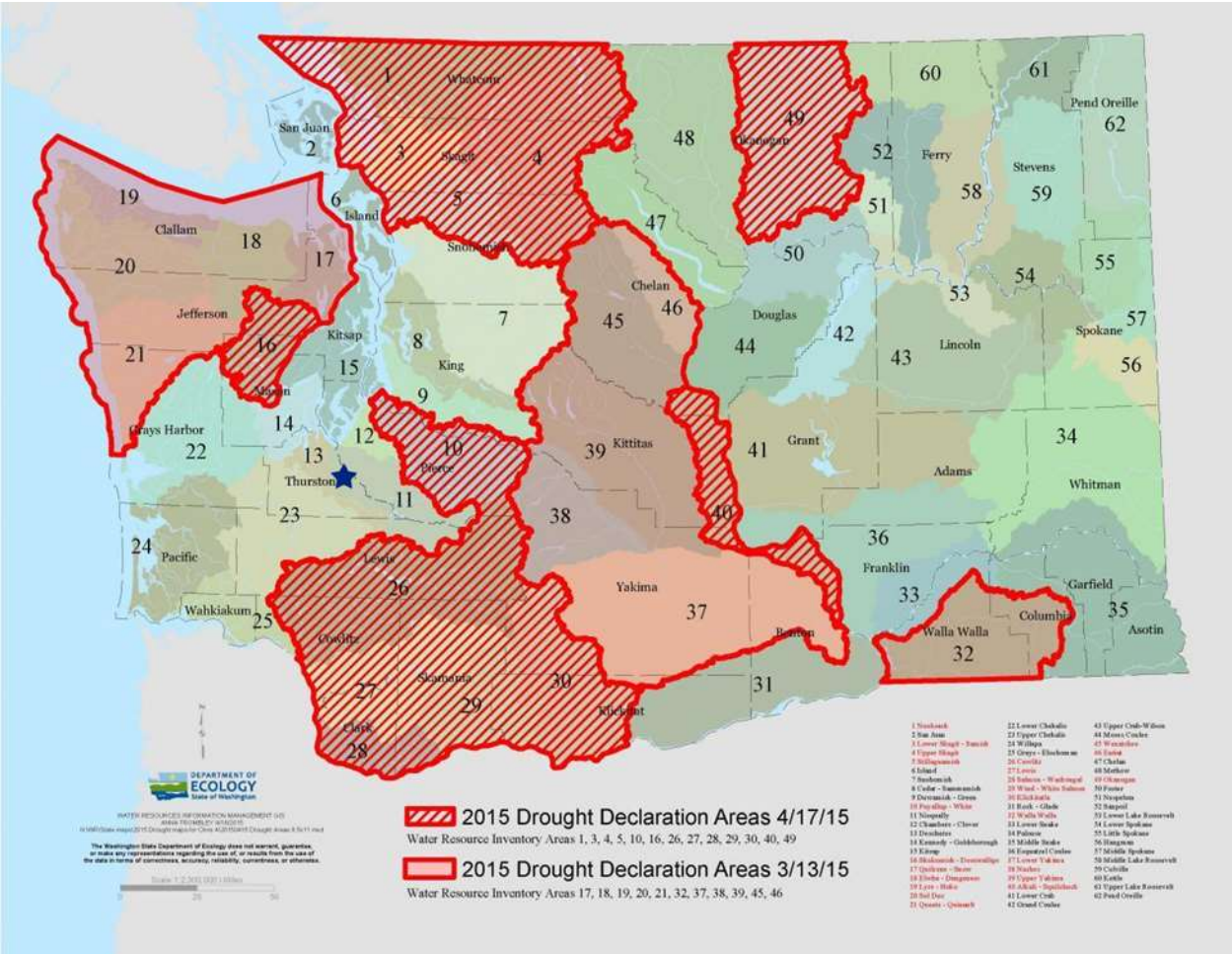


Figure 6-1. Washington State Department of Ecology 2015 Drought Map

As of May 20, 2019, Governor Jay Inslee issued an emergency drought declaration in 24 watersheds statewide (see Figure 6-2). According to the Washington State Department of Ecology, very dry conditions over the last several months and a diminished snowpack impacted streamflow, which was identified to be well below normal conditions across most of the state. Watersheds west of the Cascades crest, which are more rain dependent than rivers on the east side, flowed at much below normal levels. Some rivers set

record daily lows for historic May flows. Statewide, only four (4) percent of rivers were flowing at levels above normal. Stream flows were strong in the southeast corner of the state. Twenty-seven out of 62 watersheds were declared for drought as of May 20, 2019. On August 29, 2019, the USDA identified four Washington counties as natural disaster areas due to the drought situation (King, Pierce, Skagit and Snohomish). Whitman County was not among the counties identified as having a drought emergency. As an agricultural area, droughts do have an impact on the County as a whole. In general, Whitman County historically has not been affected as severely by previous droughts as much of the rest of Eastern Washington (Washington EMD, 2019).

At present, the State's 2018 Hazard Mitigation Plan does identify Whitman County as an area with a high vulnerable population to drought, a medium-high population exposed, and with an overall high drought hazard ranking.

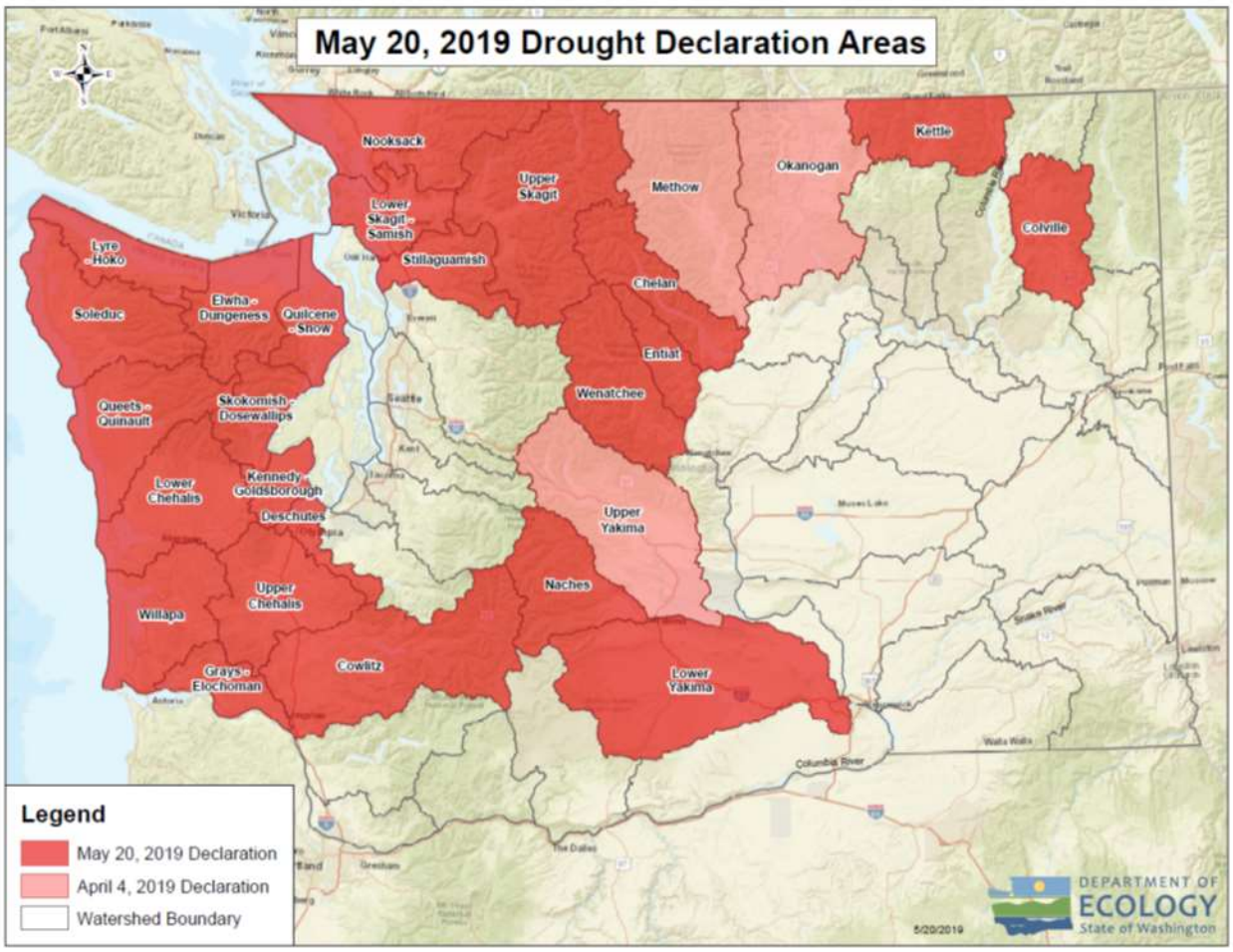


Figure 6-2. May 2019 Drought Declaration Areas

6.2.2 Extent and Location

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity and to map their extent and locations:

- The ***Palmer Z Index*** measures short-term drought on a monthly scale. Figure 6-3 shows this index for May 2019.

- The ***Palmer Crop Moisture Index*** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season (see Figure 6-4). The Soil Moisture Anomaly illustrates deviations from normal soil moisture (See Figure 6-5).
- The ***Palmer (Modified) Drought Index (PDI)*** measures the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months. Weather patterns can change quickly from a long-term drought pattern to a long-term wet pattern, and the PDI can respond fairly rapidly. Figure 6-6 shows this index for May 2019.
- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The ***Palmer Hydrological Drought Index (PHDI)***, another long-term index, was developed to quantify hydrological effects. The PHDI responds more slowly to changing conditions than the PDI. Figure 6-7 shows this index for May 2019.

The following series of maps indicating current conditions as it relates to Drought. These maps change very frequently and are intended to demonstrate information available to viewers. Additional information and current monthly data are available from the NOAA website: http://www.ncdc.noaa.gov/oa/climate/research/prelim/drought/palmer.html

6.2.3 Frequency

The state as a whole experiences severe or extreme drought about 5 percent of the time. According to the *Washington State Enhanced Hazard Mitigation Plan*, all of Eastern Washington, except for the Cascade Mountain foothills, experiences severe or extreme drought 10 to 15 percent of the time—at least once per decade on average. (Washington EMD, 2019). This includes Whitman County. This may be changing, however. For the period of 1985 to 1995, Whitman County experienced the effects of drought 20 to 30 percent of the time, and during the 1977 drought, the County experienced its effect 30 to 40 percent of the time. The 2018 Washington State Enhanced Hazard Mitigation Plan does identify Whitman County as one of the Washington counties most vulnerable to drought (see Figure 6-8).

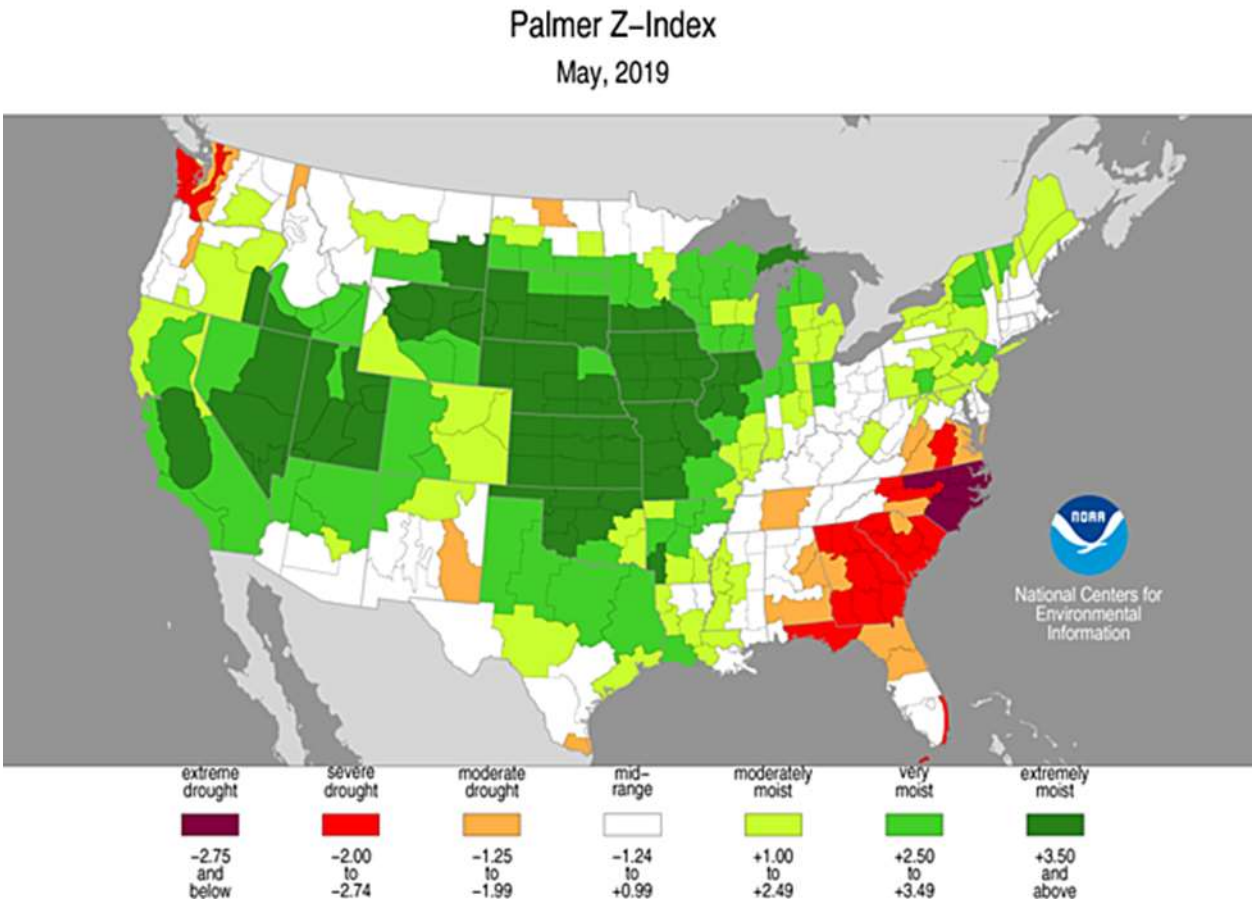


Figure 6-3. Palmer Z Index Short-Term Drought Conditions (May 2019)

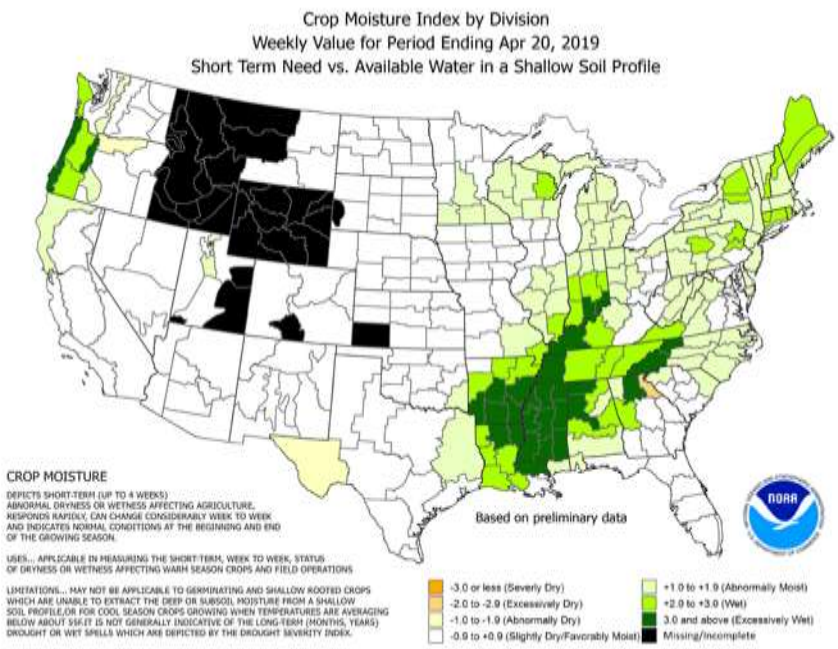


Figure 6-4. Crop Moisture Index April 2019

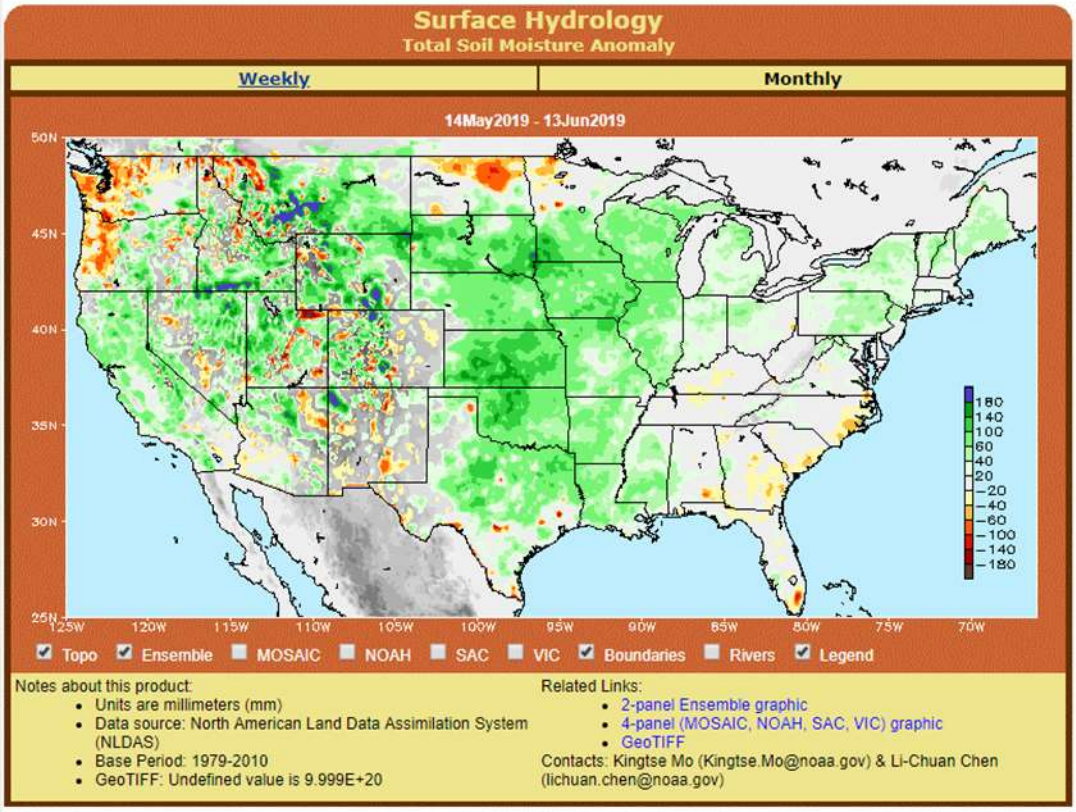


Figure 6-5. Soil Moisture Anomaly (June 2019)

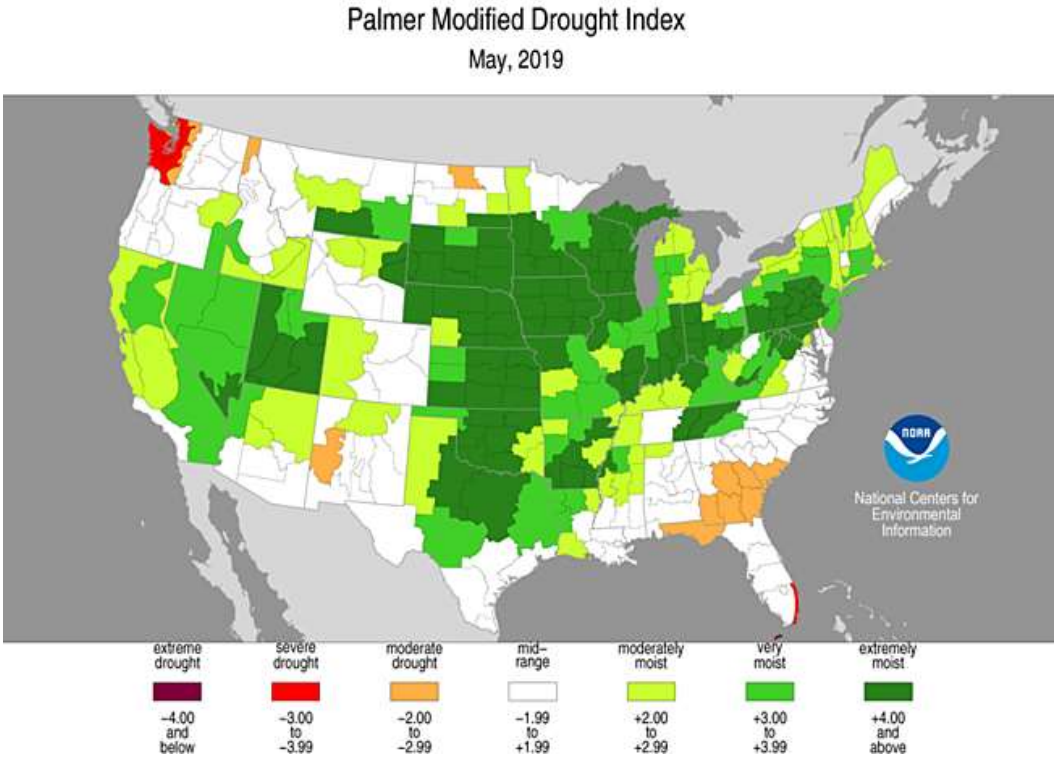


Figure 6-6. Palmer Modified Drought Index (May 2019)

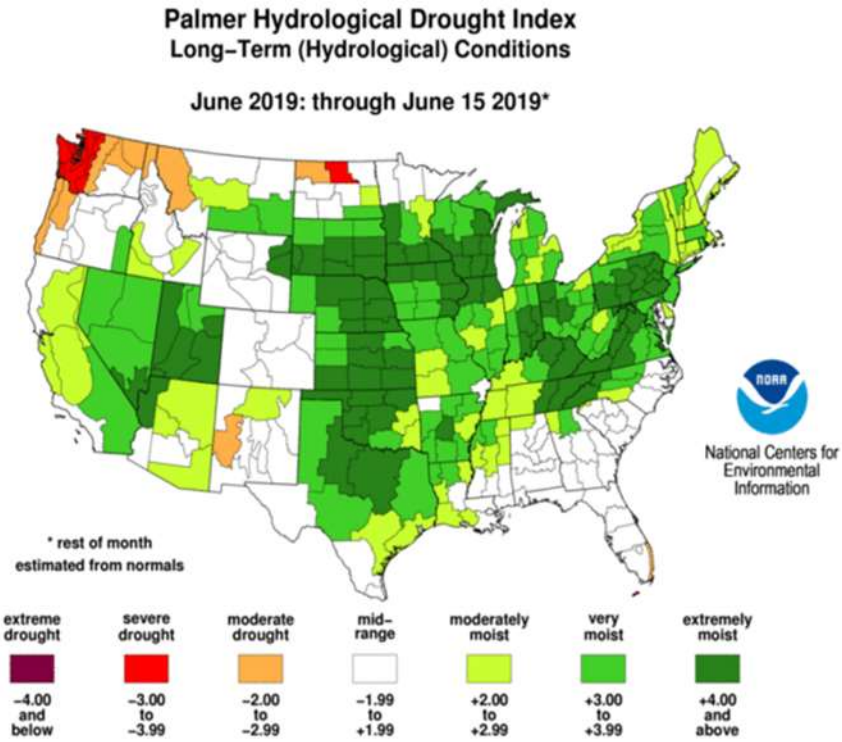


Figure 6-7. Palmer Hydrological Drought Index Long-Term Hydrologic Conditions (May 2019)

Figure 6-8. Washington State 2018 Drought Risk Index

6.2.4 Severity

Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Agricultural—Drought threatens crops that rely on natural precipitation.
- Water supply—Drought threatens supplies of water for irrigated crops and for communities.
- Fire hazard—Drought increases the threat of wildfires from dry conditions in forest and rangelands.

On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between $6 billion and $8 billion annually in the United States and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly. Due to its dry-land farming practices and reliance on ground water, Whitman County does not experience the severity of drought experienced in the central parts of the state that rely heavily on irrigation.

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. A drought directly or indirectly impacts all people in affected areas. Agricultural impacts can result in loss

of work for farm workers and those in related food processing jobs. Other water- or electricity-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them. In Washington, where hydroelectric power plants generate nearly three-quarters of the electricity produced, drought also threatens the supply of electricity. With much of Washington's energy coming from hydroelectric plants, a drought means less inexpensive electricity coming from dams and probably higher electric bills. All people could pay more for water if utilities increase their rates.

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. About 16,000 drinking water systems in Washington get water from the ground; these systems serve about 5.2 million people.

The Palouse Groundwater Basin provides the sole drinking water supply for the residents of Whitman County. Within that basin are two major aquifers, the Wanapum (upper aquifer) and Grande Ronde (lower aquifer), which are confined aquifers. (Palouse Basin Aquifer Committee 2017 Annual Report). A confined aquifer differs from an unconfined aquifer in that there is an impermeable layer of rock or soil present that prevents water from readily entering from the surface above. While we pump water out of our confined aquifers, water is not reentering the aquifers at the rate that we are pumping water out. The aquifer levels have been declining since the beginning of usage.

The County currently has a low population and does not expect much growth relative to other areas of the State, so there is not expected to be a significant increase in domestic demand for water that could rapidly diminish the supply of water in the aquifers. However, groundwater levels in the two major aquifers are slowly declining from present water usage (see Figure 6-9 – no updated graphic available as of the 2020 update).

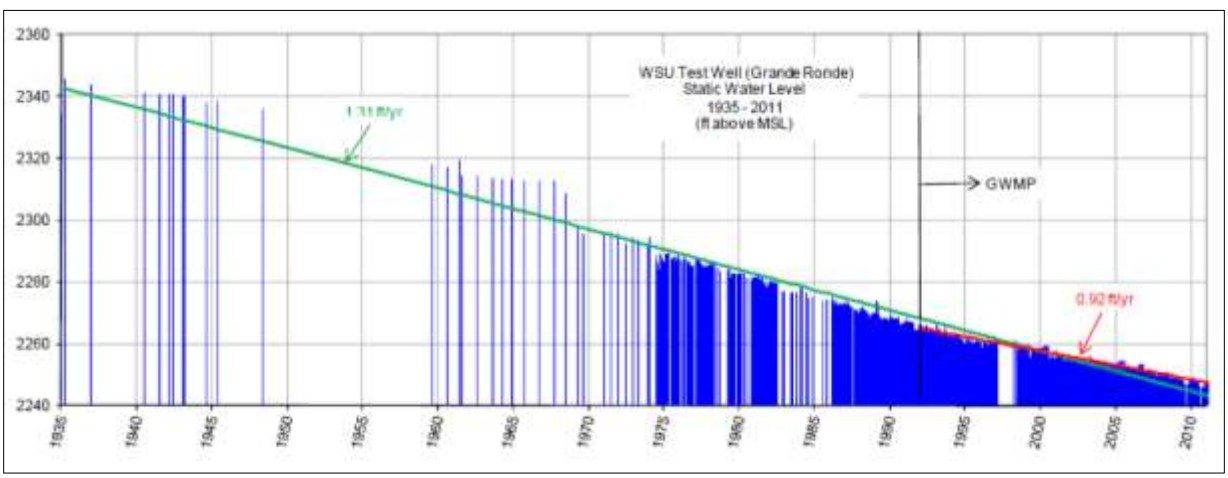


Figure 6-9. Declining Water Levels in Grande Ronde Aquifer, 1935 – 2010

Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

6.2.5 Warning Time

Droughts are climatic patterns that occur over long periods of time. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions.

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

6.3 VULNERABILITY ASSESSMENT

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand.

According to the 2018 Washington State Enhanced Hazard Mitigation Plan, Whitman County is among the 75 percent of total land area of the state estimated to be at medium or higher exposure from droughts. When applying the State's severity risk index, Whitman County gained a "High" rating based on the State's Drought Risk Index (WA EMD).[3]

The State's plan indicates that all census tracts in the County are ranked medium or higher for drought exposure. At current indicators (June 2019), Whitman County is not among those counties declared in the May 2019 drought situation; however, based on the low levels of precipitation, when reviewing the high wildfire danger impacting in particular the eastern portion of Washington State over the course of the last several years, it is clear that drought situations in the short-term significantly increase the long-range fire prediction models, indicating drought as a clear and significant hazard of concern.

6.3.1 Impact on Life, Health and Safety

All people, property and environments in the Whitman County planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions.

The planning partnership has the ability to minimize any impacts on residents and water consumers in the county should several consecutive dry years occur. No significant life or health impacts are anticipated as a result of drought within the planning area.

[3] Washington State Enhanced Hazard Mitigation Plan (2018) https://mil.wa.gov/enhanced-hazard-mitigation-plan

6.3.2 Impact on Property

No structures will be directly affected by drought conditions, though some structures may become vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

6.3.3 Impact on Critical Facilities

Critical facilities as defined for this plan will continue to be operational during a drought. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant.

6.3.4 Impact on Environment

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

6.3.5 Impact on the Economy

Economic impact will be largely associated with industries that use water or depend on water for their business. Agricultural industries will be impacted if water usage is restricted for irrigation. With the high agricultural aspect of the County's economy, a drought situation which restricts irrigation would be catastrophic on the County.

6.3.6 Impacts from Climate Change

Research conducted by the Climate Impacts Group at the University of Washington indicates that the temperature of Eastern Washington is increasing. As temperatures increase there will be less water stored as ice and snow. This reduction may not result in a net change in annual precipitation, but it will result in lower late spring and summer river flows. Accordingly, there will be increased competition between power, sport fishing and environmentalists, and farmers dependent on irritation.

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights

- Groundwater overdraft
- Aging urban water infrastructure.

As illustrated in Figure 6-10, since 1980, the United States has suffered 250 billion-dollar disaster events with Severe Storm numbering 109, or 43.6% of the billion-dollar disaster events. 42 Tropical Cyclone events (16.8%), 31 Flooding events (12.4%), 26 Drought events (10.4%), 17 Winter Storm events (6.8%), 16 Wildfire events (6.4%) and 9 Freeze events (3.6%) round out the list. There have been 13,220 deaths as a result of these 250 disaster events coupled with $1,707.8 CPI-Adjusted losses (billions of dollars). (NOAA National Centers for Environmental Information (NCEI), 2019).

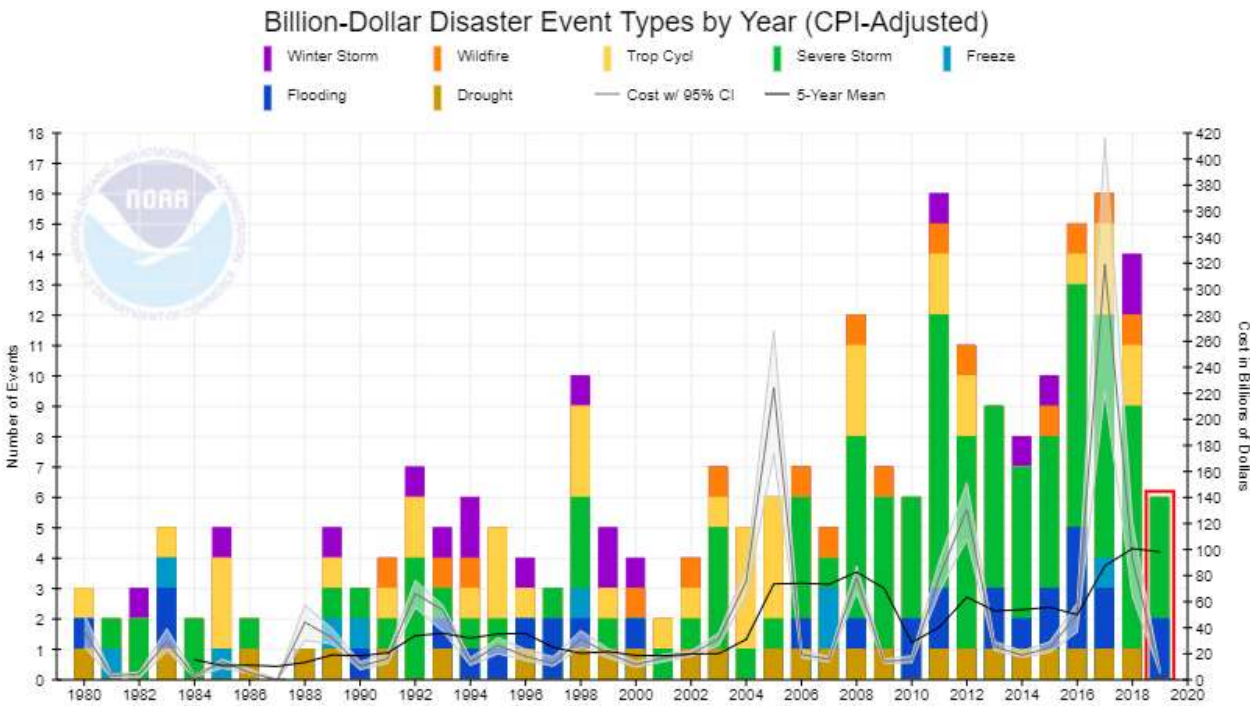


Figure 6-10. Billion-Dollar Disaster Event Types by Year (CPI-Adjusted) 1980 - 2019

The best advice to water resource managers regarding climate change is to start addressing current stresses on water supplies and build flexibility and robustness into any system. Flexibility helps to ensure a quick response to changing conditions, and robustness helps people prepare for and survive the worst conditions. With this approach to planning, water system managers will be better able to adapt to the impacts of climate change.

There is no 'one-size fits all' approach for communities to anticipate, plan, and adapt to the changing climate. Projected climate impacts are not expected to be the same in every region of the county. Local awareness of climate change vulnerabilities differs. Available resources to assess and adapt, financial and technical, vary. A variety of processes and approaches are available to help communities understand their climate change vulnerabilities and take action. (United Sates Environmental Agency, 2019)

6.4 SECONDARY HAZARDS

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends.

6.5 FUTURE TRENDS IN DEVELOPMENT

The U.S. Geological Survey's water use figures for Washington State show that public supply—domestic, commercial, industrial, and thermoelectric generation—uses about one gallon of every eight. Growing counties will find their rate of water use grow as their population grows. Whitman County's average annual growth rate is below the state average. This rate of growth is not anticipated to significantly increase during the performance period of this plan update.

Each municipal planning partner in this effort has an established comprehensive plan that includes policies directing land use and dealing with issues of water supply and the protection of water resources. These plans provide the capability at the local municipal level to protect future development from the impacts of drought. All planning partners reviewed their general plans under the capability assessments performed for this effort. Deficiencies identified by these reviews can be identified as mitigation actions to increase the capability to deal with future trends in development.

6.6 SCENARIO

An extreme multiyear drought more intense than the 1977 drought could impact the region with little warning. Combinations of low precipitation and unusually high temperatures could occur over several consecutive years. Intensified by such conditions, extreme wildfires could break out throughout Whitman County, increasing the need for water. Surrounding communities, also in drought conditions, could increase their demand for water supplies relied upon by the planning partnership, causing social and political conflicts. If such conditions persisted for several years, the economy of Whitman County could experience setbacks, especially in water dependent industries.

6.7 ISSUES

The planning team has identified the following drought-related issues:

- Identification and development of alternative water supplies
- Use of groundwater recharge techniques to stabilize the groundwater supply
- The probability of increased drought frequencies and durations due to climate change
- The promotion of active water conservation even during non-drought periods.

6.8 RESULTS

Washington State's 2018 Hazard Mitigation Plan indicates that all census tracts in the County are ranked medium or higher for drought exposure. As indicated, at current indicators (June 2019), Whitman County is not among those counties declared in the May 2019 drought situation; however, based on the low levels of precipitation, and when taking into account the impact of a drought situation on the high wildfire danger impacting the eastern portion of the state over the course of the last several years, it is clear that drought is a significant hazard of concern as the impact to the agricultural community (both crops and livestock) would also be of significance. Based on those findings, the Planning Team determined the Drought Hazard to be of high concern, with a CPRI score of 2.95.

Chapter 7.
EARTHQUAKE

7.1 GENERAL BACKGROUND

7.1.1 How Earthquakes Happen

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults.

DEFINITIONS

Earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Focal Depth—The depth from the earth's surface to the hypocenter.

Hypocenter—The region underground where an earthquake's energy originates

Liquefaction— Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

It is generally agreed that three source zones exist for Pacific Northwest quakes: a shallow (crustal) zone; the Cascadia Subduction Zone; and a deep, intraplate "Benioff" zone. These are shown in Figure 7-1. More than 90 percent of Pacific Northwest earthquakes occur along the boundary between the Juan de Fuca plate and the North American plate.

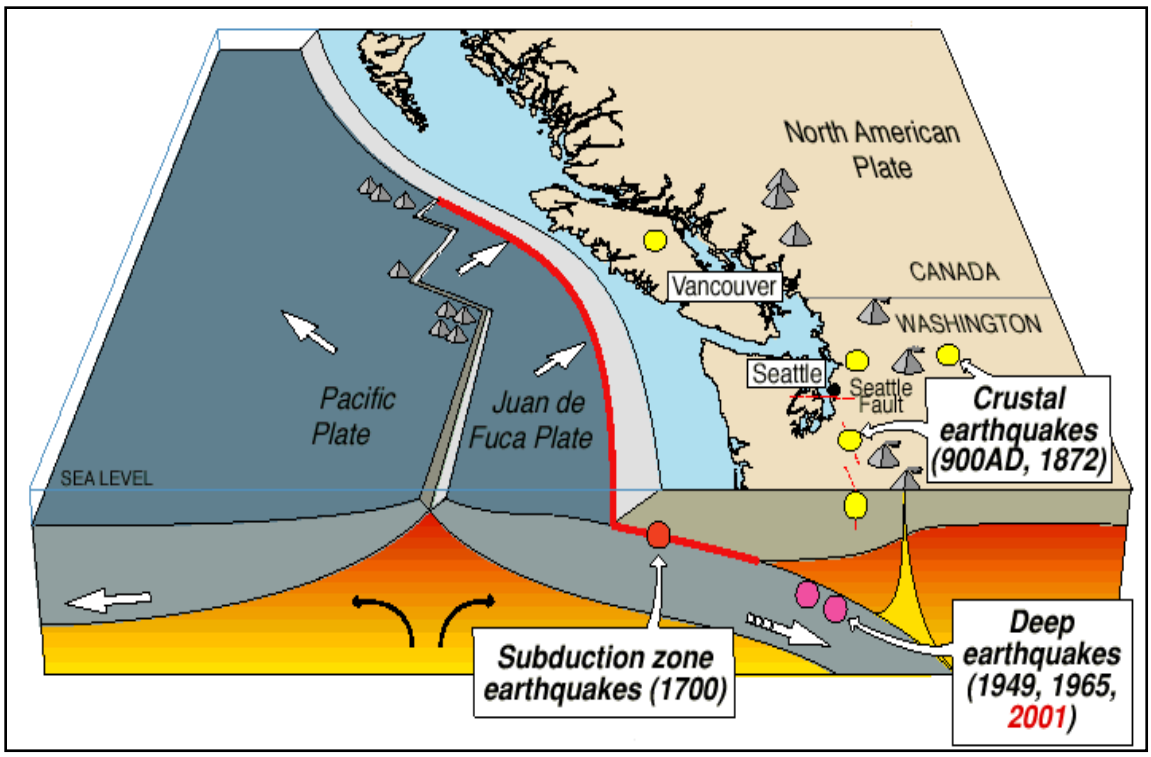


Figure 7-1. Earthquake Types in the Pacific Northwest

7.1.2 Earthquake Classifications

Earthquakes are classified according to the amount of energy released as measured by magnitude or intensity scales. Currently the most commonly used scales are the moment magnitude (Mw) scale, and the modified Mercalli intensity scale. Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes. Table 7-1 presents a classification of earthquakes according to their magnitude. Table 7-2 compares the moment magnitude scale to the modified Mercalli intensity scale.

Table 7-1.
Earthquake Magnitude Classes

Magnitude Class	Magnitude Range (M = magnitude)
Great	M > 8
Major	7 <= M < 7.9
Strong	6 <= M < 6.9
Moderate	5 <= M < 5.9
Light	4 <= M < 4.9
Minor	3 <= M < 3.9
Micro	M < 3

Table 7-2.
Earthquake Magnitude and Intensity

Magnitude (Mw)	Intensity (Modified Mercalli)	Description
1.0—3.0	I	I. Not felt except by a very few under especially favorable conditions
3.0—3.9	II—III	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 is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
4.0—4.9	IV—V	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 a heavy truck striking building. Standing cars rocked noticeably.
5.0—5.9	VI—VII	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 in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
6.0—6.9	VII—IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary 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 frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII and higher	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.

7.1.3 Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing the annual probabilities over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage “short period structures” (e.g. single-family

dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 7-3 lists damage potential by PGA factors compared to the Mercalli scale.

Table 7-3.
Mercalli Scale and Peak Ground Acceleration Comparison

Mercalli Scale	Potential Damage	Estimated PGA
I	None	0.017
II-III	None	0.017
IV	None	0.014-0.039
V	Very Light	0.039-0.092
VI	None to Slight; USGS-Light	0.02-0.05
	Unreinforced Masonry-Stair Step Cracks; Damage to Chimneys; Threshold of Damage	0.04-0.18
VII	Slight-Moderate; USGS-Moderate	0.05-0.10
	Unreinforced Masonry-Significant; Cracking of parapets	0.08-0.16
	Masonry may fail; Threshold of Structural Damage	0.10-0.34
VIII	Moderate-Extensive; USGS: Moderate-Heavy	0.10-0.20
	Unreinforced Masonry-Extensive Cracking; fall of parapets and gable ends	0.16-0.65
IX	Extensive-Complete; USGS-Heavy	0.20-0.50
	Structural collapse of some un-reinforced masonry buildings; walls out of plane. Damage to seismically designed structures	0.32-1.24
X	Complete ground failures; USGS- Very Heavy (X+); Structural collapse of most un-reinforced masonry buildings; notable damage to seismically designed structures; ground failure	0.50-1.00

7.1.4 Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the quake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 7-4 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

Table 7-4.
NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	

7.2 HAZARD PROFILE

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

7.2.1 Previous Occurrences

The U.S. Geological Survey's National Earthquake Information Center records of thousands of earthquakes magnitude 2.5+ or larger occurring in the State of Washington area between 2005 and 2018.[4] During the time period 2010-2015, there have been ~60 M3+ earthquakes occurring in Washington State.[5]

Washington's two largest crustal earthquakes since European settlement occurred in Eastern Washington: the 1872 quake near Lake Chelan and the 1936 earthquake near Walla Walla. Of these two, only the Walla Walla earthquake caused any damage in Whitman County. Residents of Spokane County felt a swarm of earthquakes in 2001; the largest earthquake in the swarm had a magnitude of 4.0. Significant earthquakes near Whitman County are described in the following sections.

[4] https://www.usgs.gov/natural-hazards/earthquake-hazards/science/information-region-washington?qt-science_center_objects=0#qt-science_center_objects

[5] USGS Lists. Accessed 5 Nov 2019. Available at: https://www.usgs.gov/natural-hazards/earthquake-hazards/lists-maps-and-statistics

Lake Chelan, December 14, 1872

The magnitude 6.8 (estimated) Lake Chelan earthquake occurred about 9:40 p.m. and was felt from British Columbia to Oregon and from the Pacific Ocean to Montana. It occurred in a wilderness area that had only a few inhabitants. Reported effects included the following:

- Extensive landslides occurred on shorelines of the Columbia River. One slide, at Ribbon Cliff between Entiat and Winesap, blocked the Columbia River for several hours. Other slides occurred throughout the Cascade Mountains.
- Ground fissures occurred at the east end of Lake Chelan in the area of the Indian camp area; in the Chelan Landing-Chelan Falls area; on a mountain about 12 miles west of the Indian camp area; on the east side of the Columbia River (where three springs formed); and near the top of a ridge on the east side of the Columbia River.

Source: USGS NEIC, 2019

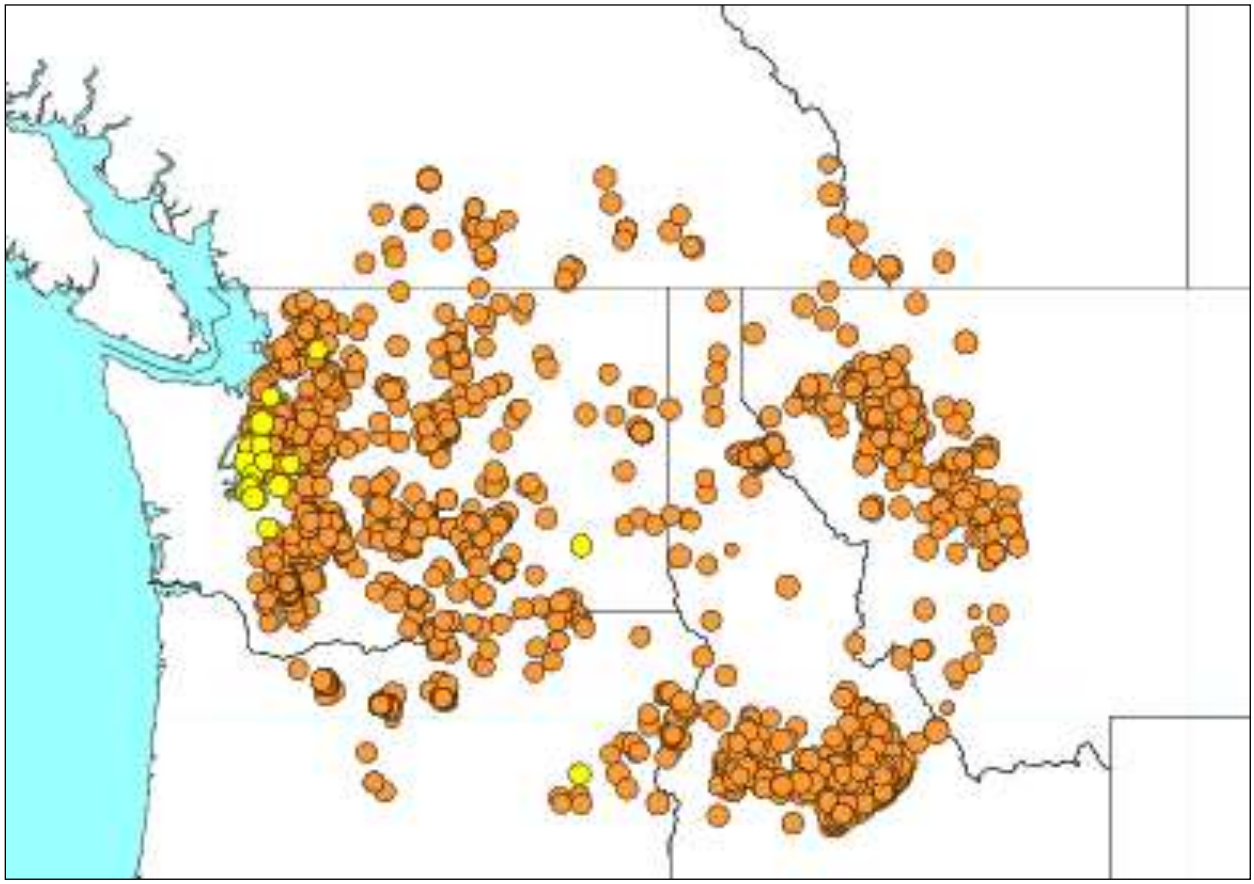


Figure 7-2. Earthquakes within 250 miles of Whitman County Center, 1973 – 2011
(Most recent graphic available for update from source)

- Water spouted as much as 27 feet in the air from a fissure at Chelan Falls. The geyser activity continued for several days, and, after diminishing, left permanent springs.
- In the area of the epicenter, the quake damaged one log building near the mouth of the Wenatchee River. Ground shaking threw people to the floor, waves were observed in the ground, and loud detonations were heard. The logs on another cabin caved in about 2 miles above the Ribbon Cliff slide area.

- Damaging ground shaking of intensity VI extended to the west throughout the Puget Sound basin and to the southeast beyond the Hanford Site. Individuals in Idaho, Montana, Oregon and Canada felt the earthquake. Aftershocks occurred in the area for two years.

Walla Walla Earthquake, July 15, 1936

This magnitude-6.1 earthquake occurred at 11:05 a.m. about 5 miles south-southeast of Walla Walla. It was widely felt through Oregon, Washington and northern Idaho, with the greatest shaking in northeast Oregon. Property damage was estimated at $100,000 (about $1.8 million in 2019 dollars).

The earthquake moved small objects, rattled windows, and cracked plaster in Colfax, Hooper, Page, Pomeroy, Prescott, Touchet, Wallula and Wheeler; most of the impact and damage was near Walla Walla.

The earthquake knocked down a few chimneys and many loose chimney bricks; damaged a brick home used by the warden at the State Penitentiary that was condemned and declared unsafe; and damaged the local railroad station. Several homes moved an inch or less on their foundations. Five miles southwest of Walla Walla, the quake restored the flow of a weakened 600-foot deep artesian well to close to original strength; the flow had not diminished after several months. Walla Walla residents reported about 15 or 20 aftershocks.

Hebgen Lake (Montana), August 18, 1959

The Hebgen Lake earthquake in Montana was felt in parts of eastern Washington. The magnitude-7.5 event generated Intensity X shaking, killed 28 people as a result of a landslide, formed “Quake Lake,” and did $11 million ($96.8 million in 2019 dollars) in damage to roads and timber. Many campers in the Yellowstone area were trapped for days and a fishing lodge dropped into a lake. There were six aftershocks of magnitude 5.5 or greater within one day. The initial earthquake was felt in an area of over 450,000 square miles.

Borah Peak (Idaho), October 28, 1983

The Borah Peak earthquake was the largest recorded in Idaho, both in magnitude and in the amount of property damage. At a magnitude of 7.3, it was also the largest earthquake to hit the continental United States since the Hebgen Lake quake. The epicenter was in the Barton Flats area, 10 miles northwest of Mackay and 30 miles southeast of Challis. The maximum observed Intensity was IX (based on surface faulting), and the earthquake was felt in an area over 330,000 square miles. Four aftershocks of magnitude 5.5 or greater were recorded within 1 year.

Spokane Earthquake Swarm, 2001

Spokane in 2001 had the most noticed earthquake swarm in the Northwest in recent decades. Dozens of earthquakes occurred over nearly a year. Scientists at the Pacific Northwest Seismograph Network in Seattle said the epicenter of the events was 1 mile north of Gonzaga University and 2.9 miles underground. The largest of the quakes was only a Magnitude 4 event, so little damage done. No major property damage or casualties were caused by the events. However, because the fault whose movement caused the swarm was very shallow, even earthquakes of Magnitude 2 and less were felt. In June and November, there were days with numerous felt events.

7.2.2 Extent and Location

In Eastern Washington, geologists have uncovered evidence of a number of surface faults; however, they have not yet determined how active the faults are, nor determined the extent of the risk they pose to the public. One fault, Toppenish Ridge, appears to have been the source of two earthquakes with magnitudes

of 6.5 to 7.3 in the past 10,000 years. The most recent earthquakes to occur in the planning region are the 2001 Spokane earthquake swarms, which were very shallow earthquakes, with most events within a few miles of the surface.

The events occurred near a suspected fault informally called the Latah Fault; however, the relation between the fault and the swarm is uncertain. Geologists have mapped the Spokane area, but none confirmed the presence of major faults that might be capable of producing earthquakes. State geologists continue to investigate the geology and earthquake risk in Spokane.

Identifying the extent and location of an earthquake is not as simple as it is for other hazards such as flood, landslide or wildfire. The impact of an earthquake is largely a function of the following components:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically).

Mapping that shows the impacts of these components was used to assess the risk of earthquakes within the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. The mapping used in this assessment is described below.

Shake Maps

A shake map is a representation of ground shaking produced by an earthquake. The information it presents is different from the earthquake magnitude and epicenter that are released after an earthquake because shake maps focus on the ground shaking resulting from the earthquake, rather than the parameters describing the earthquake source. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the extent and variation of ground shaking in a region immediately following significant earthquakes.

Ground motion and intensity maps are derived from peak ground motion amplitudes recorded on seismic sensors (accelerometers), with interpolation based on estimated amplitudes where data are lacking, and site amplification corrections. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. A probabilistic seismic hazard map shows the hazard from earthquakes that geologists and seismologists agree could occur. The maps are expressed in terms of probability of exceeding a certain ground motion, such as the 10-percent probability of exceedance in 50 years. This level of ground shaking has been used for designing buildings in high seismic areas.

Figure 7-3 and Figure 7-4 illustrate the estimated ground motion for the 100-year and 500-year probabilistic earthquakes in Whitman County.

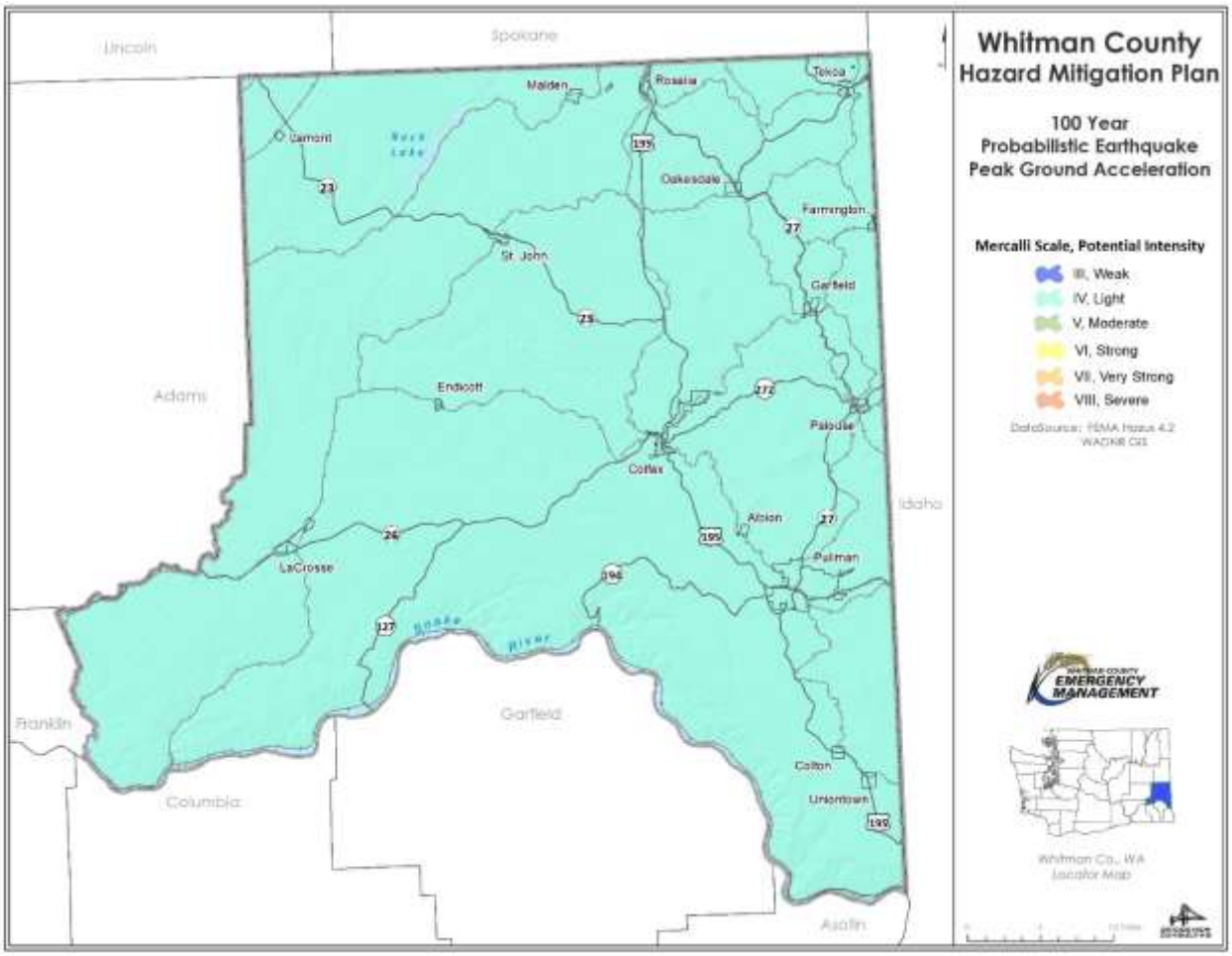


Figure 7-3. 100-year Probabilistic Earthquake

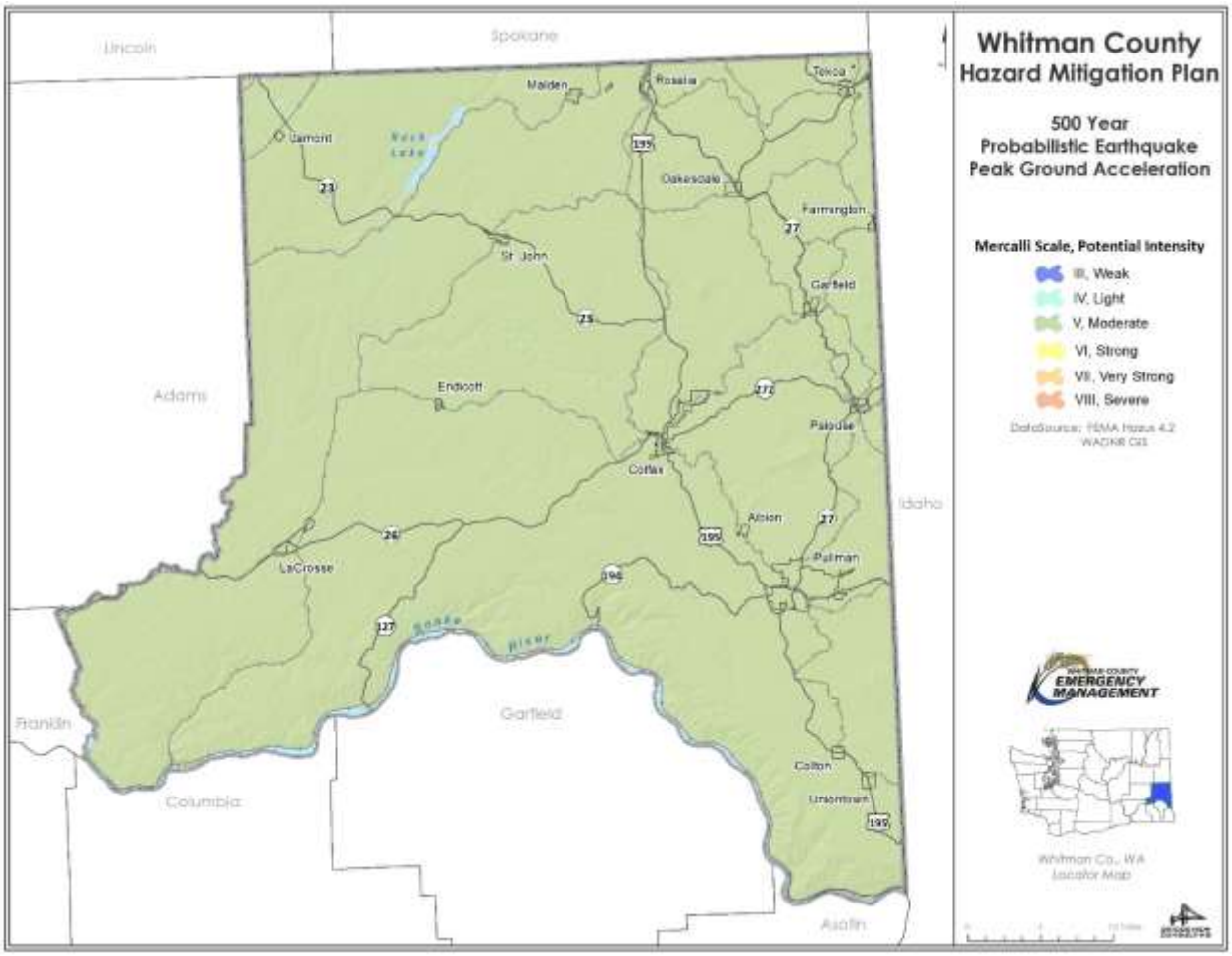


Figure 7-4. 500-year Probabilistic Earthquake

NEHRP Soil Maps

NEHRP soil types define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F. Figure 7-5 shows NEHRP soil classifications in the county.

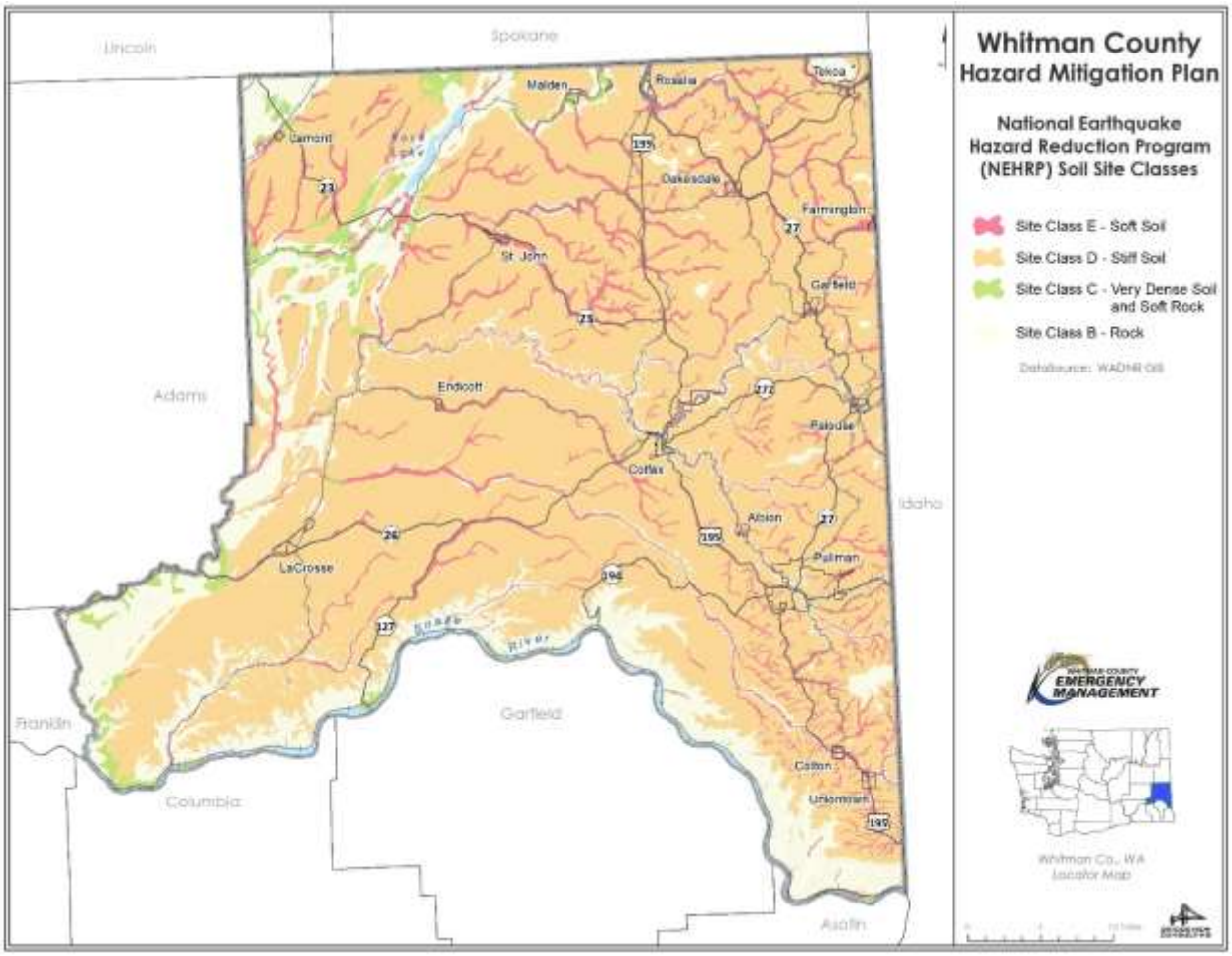


Figure 7-5. NEHRP Soil Classifications

Liquefaction Maps

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. In general, areas with NEHRP Soils D, E and F are also susceptible to liquefaction. If there is a dry soil crust, excess water will sometimes come to the surface through cracks in the confining layer, bringing liquefied sand with it, creating sand boils. Figure 7-6 shows the liquefaction susceptibility in Whitman County.

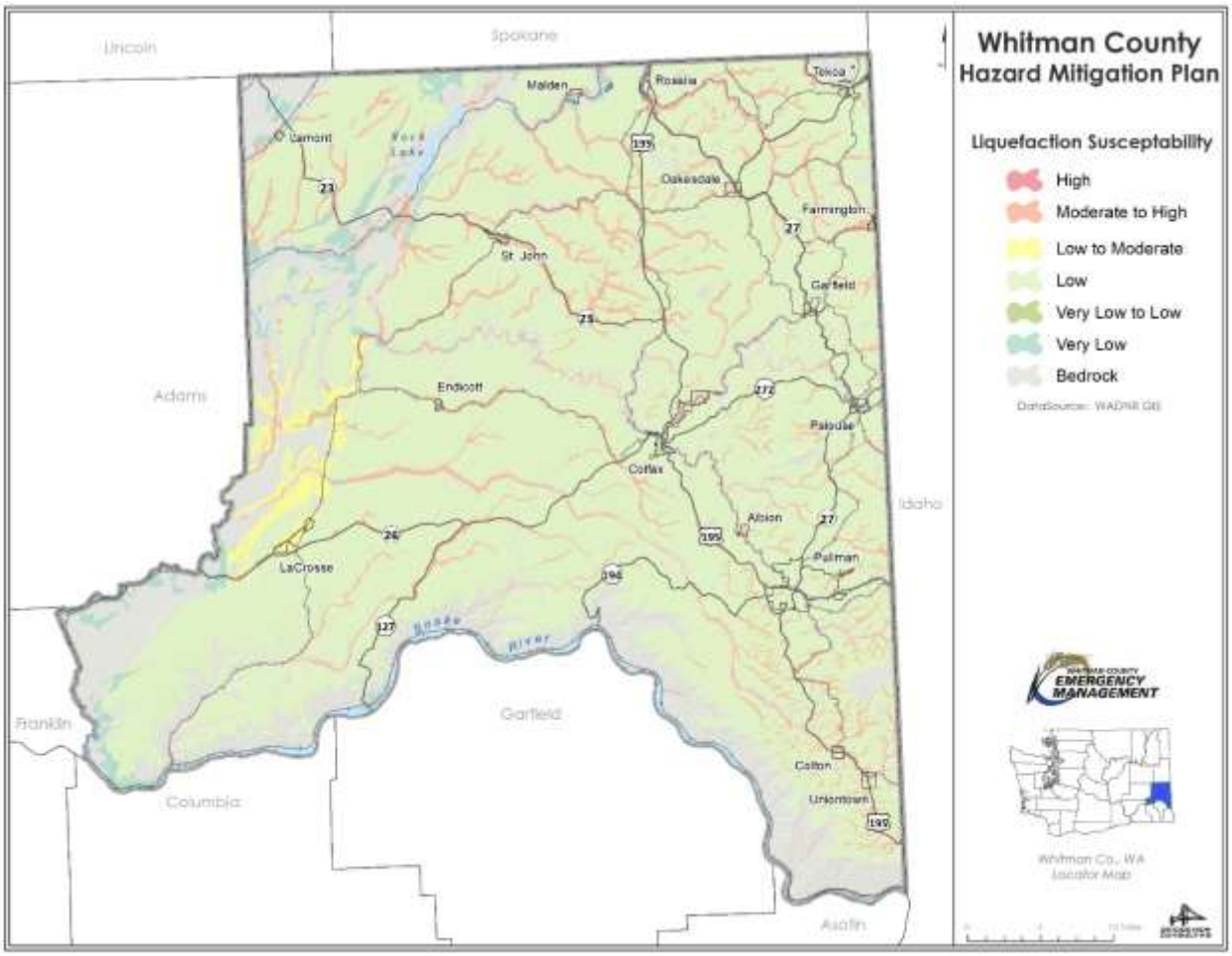


Figure 7-6. Liquefaction Susceptibility

7.2.3 Frequency

The USGS estimated that a Cascadia Subduction Zone earthquake has a 10 to 15 percent probability of occurrence in 50 years, and a crustal zone earthquake has a recurrence interval of about 500 to 600 years. In general, it is difficult to estimate the probability of occurrence of crustal earthquake events. The best estimate for a major crustal earthquake to occur is once every 1000 years. A Benioff zone earthquake has an 85 percent probability of occurrence in 50 years, making it the most likely of the three types.

7.2.4 Severity

The severity of an earthquake can be expressed in terms of intensity or magnitude. Intensity represents the observed effects of ground shaking on people, buildings and natural features. The USGS has created ground motion maps based on current information about several fault zones. These maps show the PGA that has a certain probability (2 percent or 10 percent) of being exceeded in a 50-year period. The PGA is measured in numbers of g's (the acceleration associated with gravity). Figure 7-7 shows the PGAs with a 2-percent exceedance chance in 50 years in Washington. The Eastern Washington area, including Whitman County, is in a low-risk area, with a 2 percent probability in a 50-year period of ground shaking from a seismic event exceeding 0.15 g.

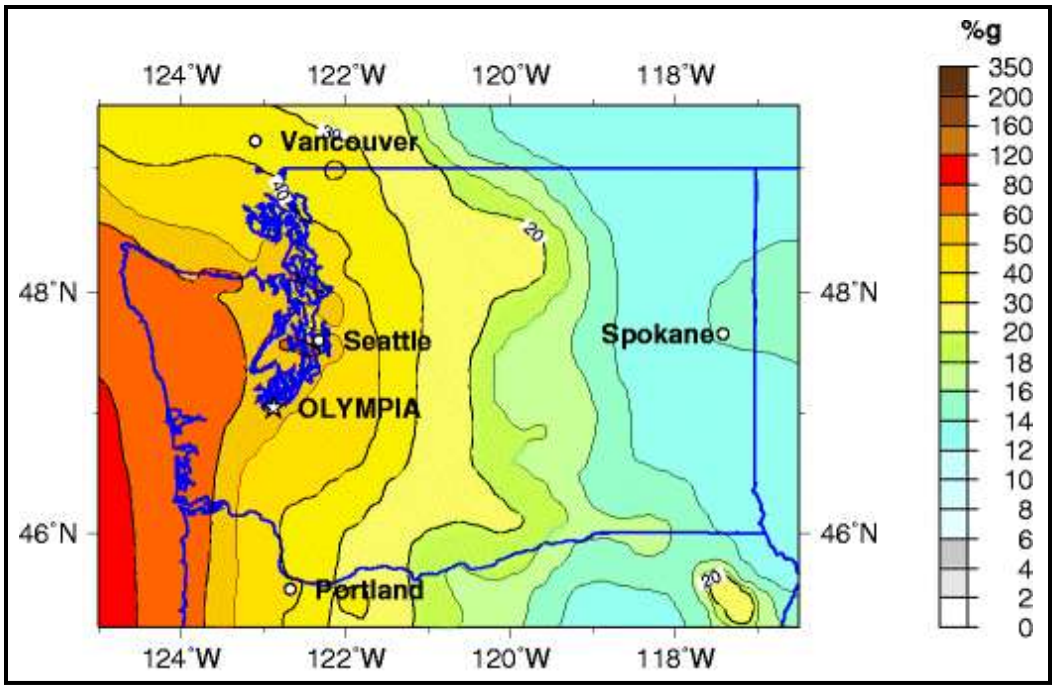


Figure 7-7. PGA with 2-Percent Probability of Exceedance in 50 Years, Northwest Region

Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is determined by the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally determined value for each earthquake event.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

- How hard did the ground shake?
- How did the ground move? (Horizontally or vertically)
- How stable was the soil?
- What is the fragility of the built environment in the area of impact?

Past events have indicated that an earthquake in the Whitman County area would cause little or no damage. Most crustal earthquakes are in 5.0 to 5.5 magnitude range, and do not have a history of occurrence in the County proper. Nonetheless severity can increase in areas that have softer soils, such as the unconsolidated sediments found in the Palouse River Valley.

7.2.5 Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. The U.S. Geological Survey (USGS) along with a coalition of State and university partners is developing and testing the ShakeAlert System for the West Coast of the United States. Before general public alerting can begin long-term, operational funding must be secured and the speed and reach of mass alerting technologies must be tested and improved. The seconds to tens of seconds of advance warning can allow people and systems to take actions to protect life and property from destructive shaking. In the fall of 2018, the West Coast ShakeAlert® Earthquake Early Warning System became sufficiently functional and

tested to begin Phase 1 of alerting in California, Oregon, and Washington. Several commercial and institutional users are alerting personnel and taking automated actions; an important step in a strategy of phased rollout leading to full public operation. (ShakeAlert, 2019)

7.3 VULNERABILITY ASSESSMENT

Earthquake vulnerability data was generated using a Level 2 HAZUS-MH analysis. Once the location and size of a hypothetical earthquake are identified, HAZUS-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up.

7.3.1 Impact on Life, Health, and Safety

The entire population of Whitman County is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil types their homes are constructed on, their proximity to fault location, etc. Whether directly impacted or indirectly impact, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

Three population groups are particularly vulnerable to earthquake hazards:

- **Linguistically Isolated Populations**——Problems arise when there is an urgent need to inform non-English speaking residents of an earthquake event. They are vulnerable because of difficulties in understanding hazard-related information from predominantly English-speaking media and government agencies.
- **Population Below Poverty Level**—This population group may lack the financial resources to improve their homes to prevent or mitigate earthquake damage. Poorer residents are also less likely to have insurance to compensate for losses in earthquakes.
- **Population Over 65 Years Old or Under 5 Years Old** —These population group are vulnerable because they are more likely to need special medical attention or assistance, which may not be available due to isolation caused by earthquakes. Elderly residents also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations.

Impacts on persons and households in the planning area were estimated for the 100-year and 500-year earthquakes scenario events through the Hazus analysis. Table 7-5 summarizes the results.

Table 7-5.
Estimated Earthquake Impact on Person and Households

	Number of Displaced Households	Number of Persons Requiring Short-Term Shelter
100-Year Earthquake	12	11
500-Year Earthquake	12	11

7.3.2 Impact on Property

According to Hazus 2019 estimates, there are 14,305 structures in Whitman County, with a total assessed value of $4.79 billion. 78 percent of the structures are wood frame construction. Figure 7-8 illustrates the building construction type impacted by a 100-year probabilistic earthquake event. Since all structures in the planning area are susceptible to earthquake impacts to varying degrees, this total represents the county-wide property exposure to seismic events. Most of the buildings (89 percent) are residential.

Building Age

Structures that are in compliance with the Uniform Building Code (UBC) of 1970 or later are generally less vulnerable to seismic damage because 1970 was when the UBC started including seismic construction standards based on regional location. This stipulated that all structures be constructed to at least seismic risk Zone 2 standards. The State of Washington adopted the UBC as its state building code in 1972, so it is assumed that buildings in the planning area built after 1972 were built in conformance with UBC seismic standards and have less vulnerability. Issues such as code enforcement and code compliance could impact this assumption. Construction material is also important when determining the potential risk to a structure. However, for planning purposes, establishing this line of demarcation can be an effective tool for estimating vulnerability. In 1994, seismic risk Zone 3 standards of the UBC went into effect in Washington, requiring all new construction to be capable of withstanding the effects of 0.3 times the force of gravity. More recent housing stock is in compliance with Zone 3 standards. In July 2019 the state again upgraded the building code to follow International Building Code Standards.

Based on Census data, the median date of construction for the planning area is 1966. Based on that data, it is estimated that approximately 55 percent of the building stock in the planning area was constructed prior to 1970. Due to the lack of parcel-based information in GIS format for the planning area, a more detailed analysis of the building stock was not possible. As better data and technology become available, this degree of analysis is recommended to determine seismic vulnerability in the planning area.

Soft-Story Buildings

A soft-story building is a multi-story building with one or more floors that are “soft” due to structural design. If a building has a floor that is 70-percent less stiff than the floor above it, it is considered a soft-story building. In earthquakes, soft stories cannot cope with the lateral forces caused by swaying of the building. Since soft stories are typically associated with retail spaces and parking garages, they are often on the lower stories of a building. When they collapse, they can take the whole building down with them, causing serious structural damage that may render the structure unusable. Soft-story collapse is one of the leading causes of earthquake damage to private residences. Exposure associated with soft story construction in the planning area is not currently known. This type of data will need to be generated to support future risk assessments of the earthquake hazard.

The Hazus analysis also estimated the amount of earthquake-caused debris in the planning area for the 100-year and 500-year earthquakes and the two scenario events, as summarized in Table 7-6.

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	11125.93	78.20	16.72	26.44	1.12	8.13	0.00	0.00	0.00	0.00
Steel	384.87	2.71	2.92	4.62	0.81	5.84	0.06	9.41	0.00	0.00
Concrete	340.60	2.39	2.79	4.41	0.45	3.23	0.02	3.59	0.00	0.00
Precast	256.08	1.80	3.21	5.08	1.47	10.64	0.19	27.77	0.00	0.00
RM	575.39	4.04	4.72	7.47	1.71	12.36	0.15	22.69	0.00	0.00
URM	127.30	0.89	3.38	5.34	1.12	8.14	0.13	18.86	0.01	100.00
MH	1417.08	9.96	29.50	46.65	7.14	51.66	0.12	17.67	0.00	0.00
Total	**14,227**		**63**		**14**		**1**		**0**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Figure 7-8. Hazus Results - Expected Building Damage by Building (Construction) Type

Table 7-6. Estimated Earthquake-Caused Debris	
Debris to Be Removed (tons)	
100-Year Earthquake	500-Year Earthquake
5	8.88

7.3.3 Impact on Critical Facilities and Infrastructure

All critical facilities in Whitman County are exposed to the earthquake hazard. Table 3-3 and Table 3-4 in Chapter 3 list the number of each type of facility by jurisdiction. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding hazardous materials are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

Level of Damage

Hazus classifies the vulnerability of critical facilities to earthquake damage in five categories: no damage, slight damage, moderate damage, extensive damage, or complete damage. The model was used to assign a vulnerability category to each critical facility in the planning area except hazmat facilities and "other infrastructure" facilities, for which there are no established damage functions. The analysis was performed for the 100-year event which has the highest probability of occurrence and the largest potential impact on the planning area. Table 7-7 summarizes the results.

Time to Return to Functionality

Hazus estimates the time to restore critical facilities to fully functional use. Results are presented as probability of being functional at specified time increments: 1, 3, 7, 14, 30 and 90 days after the event. For example, Hazus may estimate that a facility has 5 percent chance of being fully functional at Day 3, and a

95-percent chance of being fully functional at Day 90. The analysis of critical facilities in the planning area was performed for the 100-year event. Table 7-8 summarizes the results.

Table 7-7.
Critical Facility Vulnerability to 100-Year Earthquake Event

Category[a]	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Medical and Health	7	0	0	0	**0**
Government Functions	2	2	0	0	**0**
Protective Functions	29	0	0	0	**0**
Schools	29	0	0	0	**0**
Other Critical Functions	14	6	0	0	**0**
Bridges	400	0	0	0	**0**
Water supply	31	0	0	0	**0**
Wastewater	12	0	0	0	**0**
Communications	13	0	0	0	**0**
Total	**537**	**8**	**0**	**0**	**0**

Table 7-8.
Functionality of Critical Facilities for 100-Year Event

Planning Unit	# of Critical Facilities	Probability of Being Fully Functional (%)					
		at Day 1	at Day 3	at Day 7	at Day 14	at Day 30	at Day 90
Medical and Health	7	99.29	99.30	99.86	99.86	99.90	99.90
Government Functions	4	99.25	99.25	99.85	99.9	99.9	99.9
Protective Functions	29	99.14	99.14	99.85	99.86	99.90	99.90
Schools	29	99.28	99.28	99.87	99.90	99.90	99.90
Other Critical functions	14	99.88	99.90	99.90	99.90	99.90	99.90
Bridges	400	99.99	100.00	100.00	100.00	100.00	100.00
Water supply	31	99.62	99.90	99.90	99.90	99.90	99.90
Wastewater	12	98.44	99.73	99.90	99.90	99.90	99.90
Communications	13	99.9	99.9	99.9	99.9	99.9	99.9
Total/Average	**537**	**99.42**	**99.60**	**99.89**	**99.90**	**99.91**	**99.91**

7.3.4 Impact on Environment

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. It is also possible for streams to be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

7.3.5 Impacts on Economy

Economic losses due to earthquake damage include damage to buildings, including the cost of structural and non-structural damage, damage to contents, and loss of inventory, loss of wages and loss of income. Loss of tax base both from revenue and lack of improved land values will increase the economic loss to the County and its planning partners. In addition, loss of goods and services may hamper recovery efforts, and even preclude residents from rebuilding within the area. Hazus results illustrate that 0.97 (millions of dollars) of building-related losses are possible as the result of the 100-year probabilistic event, with 32 percent of estimated losses relating to business interruption of the region. The largest loss was sustained by the residential occupancies, which made up over 51 percent of the total losses.

7.3.6 Impacts from Climate Change

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

7.4 SECONDARY HAZARDS

Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

7.5 FUTURE TRENDS IN DEVELOPMENT

The land use elements of the comprehensive plans adopted by the municipal planning partners provide a long-range guide to the physical development of the planning area and its urban growth area. As the planning area begins to experience growth, Whitman County and its planning partners will need to manage growth in a way that accounts for impacts from potential earthquakes. With tools such as the Washington State Building Code and local critical-area ordinances that define seismic hazard areas, the planning partners are prepared to deal with future growth.

Once the technological capability of the planning partnership is enhanced with tools such as GIS, this assessment should be revisited to provide a better gauge of vulnerability, looking at parameters such as zoned land use and age of structures.

7.6 SCENARIO

Any seismic activity of Magnitude 6.0 or greater on faults within the planning area would have significant impacts. The seismic event likely to have the largest impact is a Magnitude 5.5 or greater event on the Latah Creek Fault. Potential warning systems could give 40 seconds' notice that a major earthquake is about to occur; this would not provide adequate time for preparation. Earthquakes of this magnitude or higher would lead to significant structural failure of property on unstable soils. With the abundance of floodplain within the planning area, liquefaction impacts in these areas could be widespread.

There are numerous crustal faults throughout the Columbia Plateau and in areas north and south. These have not been mapped sufficiently for scientists to make any conclusions about the effect they can have on earthquakes, but it is possible that a fault near Whitman County could rupture, causing a shallow crustal earthquake in the County. Damage would most likely occur to older structures in the downtown areas of some communities located on softer (NEHRP D and E) soils. Injuries may occur from debris, such as parapets and chimneys that could topple or be shaken loose and fall on those walking or driving below. An earthquake may also cause minor landslides along unstable slopes. This would be even more likely if the earthquake occurred during the rainy or snowy winter and early spring months.

7.7 ISSUES

More research needs to be conducted to determine the exposure and vulnerability of Whitman County and the Columbia Plateau region in general to earthquakes. The County and its communities should inventory and assess older structures and seek ways to retrofit those that are determined most likely to be damaged during an earthquake. Until additional data on the impacts of events typical for this region are developed, non-structural retrofitting techniques should be considered and promoted by the partnership. Important issues associated with an earthquake include but are not limited to the following:

- A more robust assessor data set would significantly enhance the partnership's ability to assess seismic risk.
- More scenario-based shake map data is need for the region.
- More information is needed on the exposure and performance of soft-story construction within the planning area.
- According to the 2010 U.S. census, more than 43 percent of the planning area's building stock was built prior to 1970, when seismic provisions became uniformly applied through building code applications.
- Critical facility owner should be encouraged to create or enhance Continuity of Operations Plans using the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Earthquakes could trigger other natural hazard events such as dam failures and landslides, which could severely impact the county.

7.8 RESULTS

Based on review and analysis of the data, the Planning Team determined that the probability for impact from an Earthquake throughout the area is limited. While earthquakes have occurred, they have been minor in nature. The losses related to earthquake scenarios are largely due to the proximity to the faults, as well as the soils type. Based on the 100-year event, the PGA is identified as being light in nature, while the 500-year event illustrates moderate ground shaking. Historic earthquake events in the County are limited in

nature with respect to previous impact. The County does have a large portion of its structure built to lower building codes due to their age; with the majority of the general building stock being wood structures. Newer buildings are constructed to higher standards. Based on the potential impact, the Planning Team determined the CPRI score to be 2.45, with overall vulnerability determined to be of medium level.

Chapter 8.
FLOOD

8.1 GENERAL BACKGROUND

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by a flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.

Floodway—The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

8.1.1 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is a statistical tool used to define the probability that a certain river discharge (flow) level will be equaled or exceeded within a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

8.1.2 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in quantity and diversity of plant and animal species. A floodplain can contain 100 or even 1000 times as many species as a river. Wetting of the floodplain soil

releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly; however, the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

8.1.3 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

8.1.4 Federal Flood Programs

National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters and business owners in participating communities. For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their floodplain management program.

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

Whitman County entered the NFIP on May 1, 1980. Structures permitted or built in the County before then are called "pre-FIRM" structures, and structures built afterwards are called "post-FIRM." The insurance rate is different for the two types of structures. The current FIRM effective date for Whitman County is May 1, 1980.

Of Whitman County's 16 incorporated municipalities, 14 participate in the NFIP, as shown in Table 8-1. According to the Washington Department of Ecology, all are in good standing with the provisions of the

NFIP as of this plan update. Program compliance is monitored by the Department of Ecology through Community Assistance Visits. Maintaining compliance under the NFIP is an important component of flood risk reduction. All planning partners that participate in the NFIP have identified initiatives to maintain their compliance and good standing and are committed to doing so through enforcement of programs that at a minimum, meet the NFIP participation requirements. All NFIP participating planning partners thoroughly understand that NFIP compliance is a prerequisite to most FEMA funding initiatives.

Table 8-1.
NFIP Status of Whitman County and Incorporated Municipalities

City	CID	Date of Entry into the NFIP	Current FIRM Effective Date
Albion	530206	08/01/1978	08/01/1978
Colfax	530207	08/01/1978	08/01/1978
Colton	530244	07/02/1979	07/02/1979
Endicott	530208	07/17/1978	07/17/1978
Farmington	530295	07/03/1985	07/03/1985 (M)
Garfield	530209	08/01/1978	08/01/1978
Malden	530250	05/01/2010	05/01/2010 (L)
Oakesdale	530210	09/29/1978	09/29/1978
Palouse	530211	07/17/1978	07/17/1978
Pullman	530212	07/02/1979	05/19/1981
Rosalia	530213	07/17/1978	07/17/1978
St. John	530214	5/26/1981	5/26/1981 (M)
Tekoa	530215	08/01/1979	08/01/1979
Uniontown	530216	08/01/1978	08/01/1978
Whitman County	530205	05/01/1980	05/01/1980

(M) = No elevations determined; All Zone A, C and X.
(L) = Original FIRM by letter; All Zone A, C and X

The Community Rating System

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.
- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) CRS activities can help to save lives and reduce property damage. Communities

participating in the CRS represent a significant portion of the nation's flood risk; over 66 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS represent a broad mixture of flood risks, including both coastal and riverine flood risks. None of the NFIP participating communities in Whitman County are currently participating in the CRS program.

8.2 HAZARD PROFILE

The principal cause of flooding in Whitman County is heavy rainfall brought in with warm Chinook winds, usually in combination with snowmelt over a frozen impermeable ground during the winter or early spring. The sudden increase in runoff overwhelms rivers and creeks, which typically overtop. The South Fork Palouse River, for instance, has an average annual flow of about 40 cubic feet per second (cfs), but can experience peak flows of 3,000 to 5,000 cfs. Floods can also be intensified by ice jams against low clearance railroad and road bridges. Floods in Whitman County are typically of short duration, usually less than one day, and flood stages rise and fall rapidly.

Erosion and transported sediment are major secondary hazards of flooding. The intense runoff can strip away topsoil and deposit it elsewhere, usually where it is impeded, such as at bridge abutments. Sediment deposits have been a major effect of flooding in Pullman. The erosion can deposit sediment in river and creek beds, decreasing their capacity to transport water.

Most watercourses in Whitman County are intermittent drainages that flow only in winter and spring. Few of these drainages have naturally armored channels, and if they are not fully vegetated, they become major sources of eroded sediment. These drainages and the sediment they transport are particularly problematic to downstream developments if vegetation has been removed from the upstream watershed and floodplains. Brush fires, tilling and the grazing of large animals can remove vegetation from these critical areas. Such transported sediment has contributed to the flood hazard in most local communities. Of particular concern are Pullman and Colfax, located on the South Fork Palouse; Palouse located on the North Fork of the Palouse River; Colton and Uniontown located on Union Flat Creek; Endicott, located on Rebel Flat Creek; and Rosalia, located on Pine Creek. In the specific watersheds transporting sediment into these communities, extraordinary measures should be taken to manage agricultural and grazing practices. Every effort should be taken to maintain a vegetative cover, especially along the floodplains of these intermittent streams, and to manage the riparian zone to reduce velocity.

8.2.1 Previous Occurrences

Since settlement began in the 1870s, Whitman County and its small farming communities have experienced frequent flooding. Efforts have been made over the last half-century to mitigate flooding, but these efforts have often proven to be environmentally detrimental over the long term (river channelization in Colfax) or expensive to maintain (dredging and maintenance in Pullman). Table 8-2 summarizes presidential declared disasters related to flooding in Whitman County.

Table 8-2.
Whitman County Flood Events

Date	Declaration #	Type of event	Estimated Damage[a]
March 1963	146	Flooding	$62,500
December 1964	185	Washington Heavy Rains & Flooding	$150,000
January, 1972	322	Severe Storms, Flooding	$75,321
January 1974	414	Severe Storms, Snowmelt, Flooding	—
July 1975	—	Thunderstorm/Flash flooding	$50,000
December 1977	545	Severe Storms, Mudslides, and Flooding	—
May 1980	—	Thunderstorms, flooding	$50,000
July 1987	—	Flash Flood	$25,000
March 1989	822	Heavy Rains, Flooding, Mudslides	$153,000
May 1990	—	Flash flooding	$12,500
January 1991	—	Flash flood	$50,000
February 1996	1100	Severe Storms/Flooding	—
January 1997	1159	Severe Storms/Flooding	—
June 1998	—	Flash Flood	$500,000
January 1999	—	Flooding	$300,000
February 2000	—	Urban, small streams flooding	$50,000
May 2004	—	Flooding	$100,000
January 2007	—	Flooding	$25,000
January 2009	—	Flooding	$10,000
April 2019	--	Flooding (Pullman)	~$250,000

a. Data obtained from Spatial Hazard Events and Losses Database for the United States (SHELDUS), NOAA Weather Data, Planning Partner input

Little data is available on floods occurring prior to 1964. Extensive flooding in the Oakesdale area as a result of the overflow of McCoy Creek and its tributaries occurred in 1948 and again in 1963. Periodic overflow of Hangman and Little Hangman Creeks occurred near Tekoa in 1948 as a result of excessive precipitation and ice jams at bridges. Serious flooding occurred in the Garfield area along Silver Creek in 1948. Major flooding as a result of overflow of the South Fork of the Palouse River occurred in 1910, 1933 and 1948. Based on estimates from gauging stations in the City of Pullman, the 1910 flood event was considered to be the 125-year event prior to 1964. Some additional significant past flood events in Whitman County occurred as follows:

- **January 1972 Flood Event**—This was a "rain-on-snow" event typical for the region. Significant flooding in Whitman County was in the southeastern portion of the County along the Palouse River. Albion and Pullman experienced significant flooding along the South Fork of the Palouse River. This event was estimated to be a 30-year flood event.
- **January 1974 Flood Event**— The major factor for this one-day flood event was the formation of ice jams. A heavy rainfall during a period of significant snow accumulation created frozen, impenetrable soils. The principal ice jam formed at the Union Pacific Railroad trestle west of the Town of Garfield. This caused significant flooding along Silver Creek. Flooding was also

experienced along the Palouse River and along Little Hangman Creek at Tekoa. The 1974 flood event is considered to be the flood of record for this region.

- **February 1996 Flood Event**—Severe rainstorms and a warming trend caused many rivers in Washington to flood between November 1995 and February 1996, resulting in two presidential disaster declarations for the state. The event in February 1996 included severe flooding and mud flows in Whitman County. Flooding was experienced along the South Fork of the Palouse River.
- **December 1996 Flood Event**—Eastern Washington experienced generally cold and snowy weather before the last week of December 1996, when warmer temperatures and moist air moved into the region. Many areas experienced 1 to 2 inches of rainfall over two to three days, which melted snow and led to flooding. This condition was made worse by frozen ground, preventing precipitation from infiltrating the ground. Major flooding occurred along Pine Creek and the South Fork of the Palouse River. The flooding along the South Fork Palouse River was estimated to be a 10-year recurrence interval.

  The 1996 floods resulted in countywide damage, with unincorporated areas experiencing as much flooding as some of the towns. The County received $892,000 in Public Assistance for the 1996 flood.
- **January 2007 Flood Event**—A prolonged period of moderate to heavy rain and snow melt led to flooding in the County, with basement flooding in Colfax. Precipitation of 1 to 2 inches was common. McCoy and Spring Creeks in and near Oakesdale rose rapidly out of their banks, with water reaching the foundations of nine homes, flooding basements and crawl spaces. Flooding of Pine Creek shut down both lanes of State Route 27 south of Tekoa. In Colfax, Clay Street was flooded as runoff filled storm drains with mud. Several other streets were flooded as well. The run-off also entered into the basements of some homes. The North Fork of the Palouse River reached 14 feet, resulting in flooding of Lion's Club Park.

8.2.2 Extent and Location

The November 1979 Flood Insurance Study is the primary source of data used in this risk assessment to map the extent and location of the flood hazard, as shown in Figure 8-1. FEMA mapping generates flood insurance rate maps only for water courses that drain a half square mile or larger. To estimate the potential extent and locations of flood hazard areas not mapped by FEMA, Hazus was used to generate approximate floodplains on unmapped water courses. Figure 8-2 illustrates the floodplains mapped using this approach. The analysis presented below is based on the Hazus-generated depth grid scenario illustrated in Figure 8-2.

Flooding does not occur on the Snake River due to its location in a deep, steep gorge and two major flood control structures: the Little Goose Dam, and the Lower Granite Dam. The rivers and streams that have caused the greatest flood damage are the South Fork Palouse, the North Fork Palouse, Paradise Creek and Pine Creek. Union Flat Creek may also experience flooding. Although these streams can overtop anywhere, they typically cause damaging flooding in the communities that have development and infrastructure in the floodplains. The most severe flooding, in terms of economic cost and damage, occur in Pullman, the largest city in the County. Most of the floodplain in this city is developed, and includes the downtown business district. There are also numerous structures, such as buildings and bridges, that constrict the flow of water during storms, and can aggravate flooding. Palouse, with much of its downtown in a formerly marshy floodplain, has also experienced severe flooding and is the second most vulnerable community to flooding in the County.

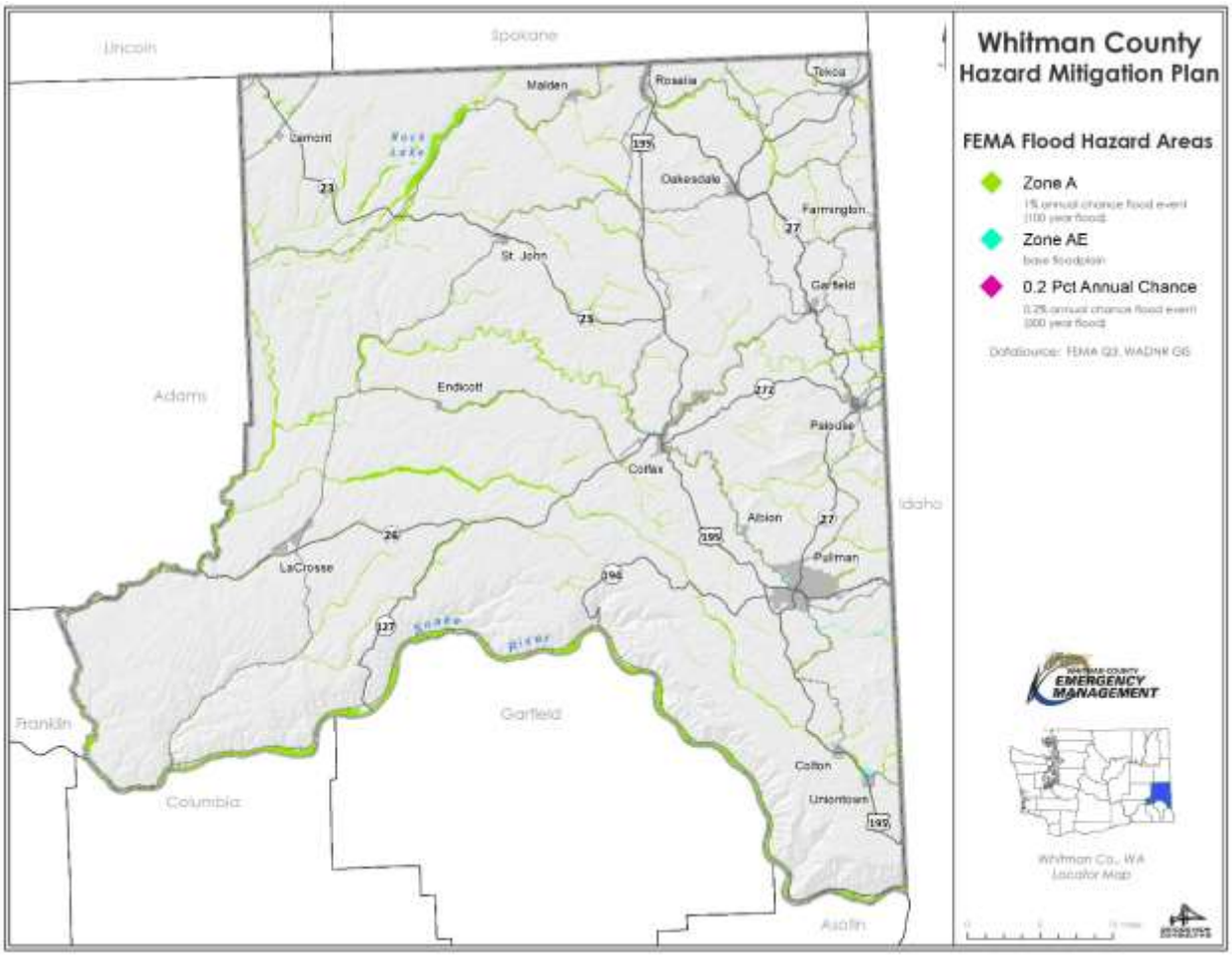


Figure 8-1. FEMA Flood Hazard Areas

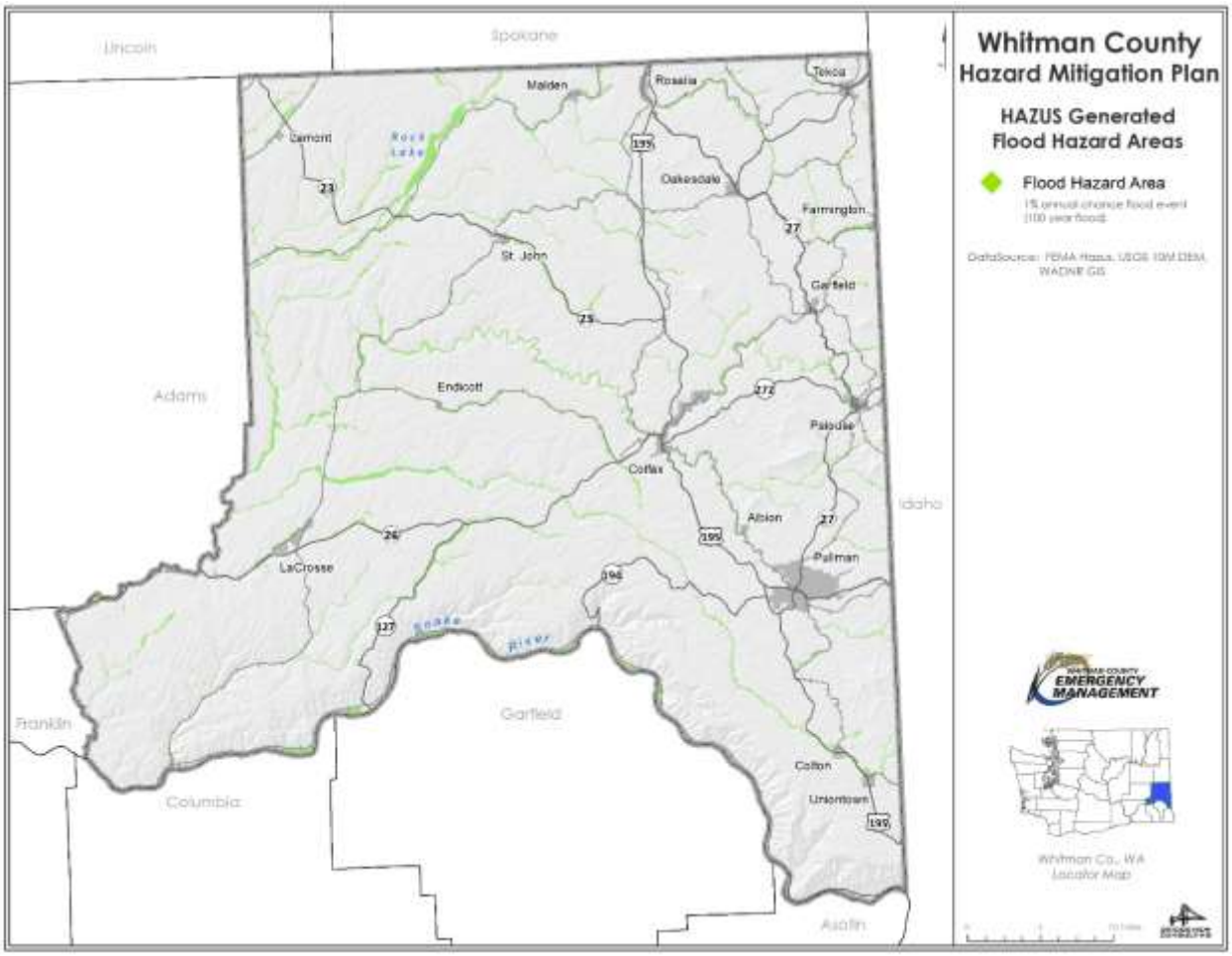


Figure 8-2. Hazus Generated Flood Hazard Areas

8.2.3 Frequency

The Washington State Hazard Mitigation Plan (2018) lists Whitman County among the counties with the most frequent flooding in eastern Washington. Major flooding in Whitman County can be expected on average every six to seven years. Figure 8-3 shows the frequency of flooding in Washington by county (2010 WA HMP).

Source: Washington EMD, 2010 (Most recent available – update requested 7/2019, but not available as of this publication.)

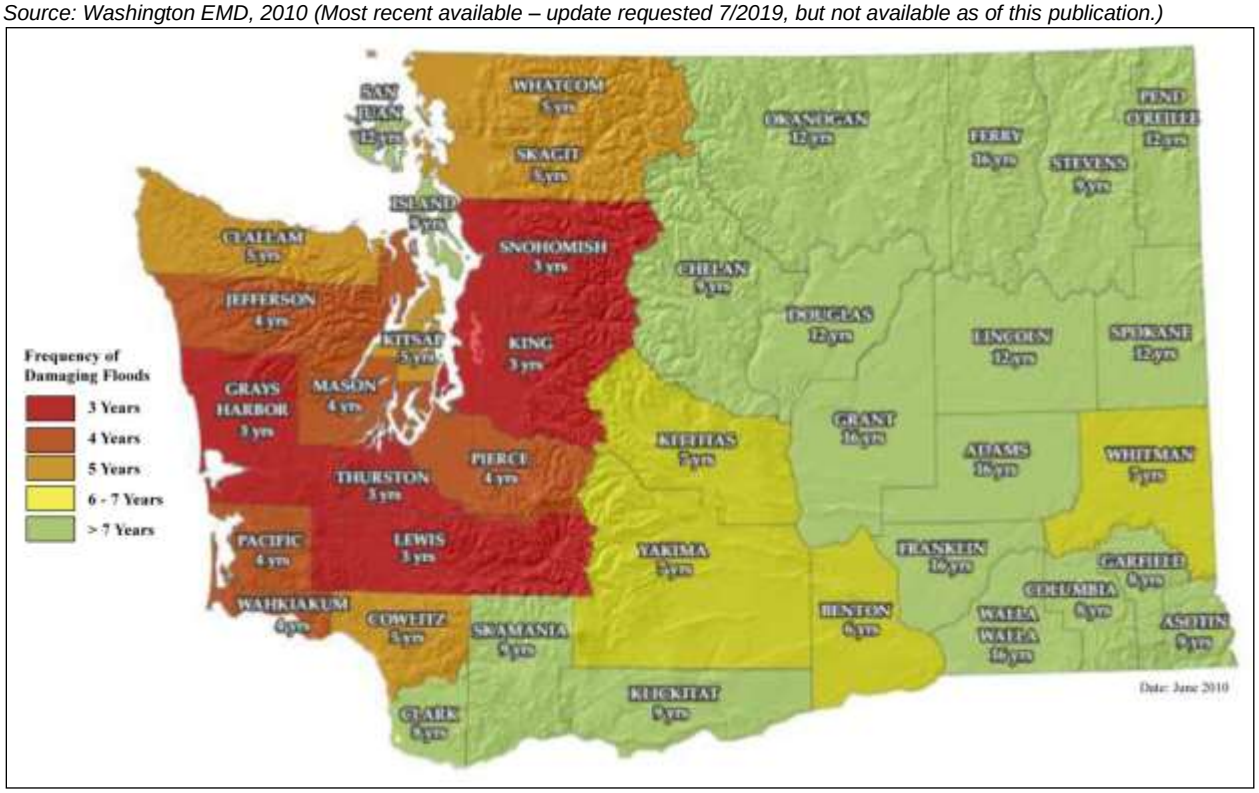


Figure 8-3. Frequency of Major Flooding in Washington by County

8.2.4 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges; Table 8-3 lists peak flows used by FEMA to map the floodplains of Whitman County. These discharges are based on historical data and have been identified for different recurrence intervals.

Table 8-3.
Summary of Peak Discharges Within Whitman County

Source/Location	Drainage Area (square miles)	Discharge (cubic feet/second) 10-Year	50-Year	100-Year	500-Year
S. Fork Palouse River					
At S.E. Pullman Corporate limits	84	2,120	3,970	5,030	7,800
Upstream of Paradise Creek	84	2,122	3,967	5,028	7,800
Above Missouri Flat Creek	--	2,710	5,310	6,860	11,900
Downstream of Missouri Flat Creek	164	4,138	7,740	9,813	16,000
At West Pullman Corporate limits	164	4,140	7,740	9,810	16,000
At U.P. Railroad Bridge	182	4,640	8,720	11,070	17,000
Palouse River					
Above the north City limits of Palouse	360	7,300	11,410	13,430	18,000
Downstream of Colfax	796	15,400	24,700	29,200	41,000
Union Flat Creek					
Above the S. Fork Union Flat Creek	96	1,730	2,860	3,400	4,900
Below Uniontown	109	1,940	3,180	3,790	5,400
Downstream of Colton Corporate limits	125	2,180	3,570	4,250	6,100
South Fork Union Flat Creek					
At Mouth	12	260	450	550	830
Rebel Flat Creek					
At Endicott	57	1,020	1,730	2,070	3,000
Silver Creek					
At Garfield	30.8	1,230	2,410	3,130	5,000
McCoy Creek					
Above Spring Creek	8.44	204	353	431	650
Above East corporate limits of Oakesdale	17.19	381	650	789	1,150
Spring Creek					
At confluence with McCoy Creek	7.34	180	313	383	570
Pine Creek					
Downstream limit of flooding affecting Rosalia	194	4,980	9,940	12,940	21,500
Hangman Creek					
Below confluence with Little Hangman Creek	200	3,950	6,540	7,870	11,000
Above confluence with Little Hangman Creek	130	2,820	4,630	5,570	7,800
Little Hangman Creek					
At confluence with Hangman Creek	60	1,260	2,230	2,750	4,100
Missouri Flat Creek					
At S. Fork Palouse River	27.1	810	1,270	1,500	2,130
Airport Rd. Creek					
At State HWY 270	--	230	510	680	1,260
Wawawai Creek					
At U.S. Highway 195	--	60	140	200	410
Dry Fork Creek					
At S. Fork Palouse River	7.5	260	640	890	1,750
Paradise Creek					
At S. Fork Palouse River	34.5	1,060	2,000	2,560	4,000

8.2.5 Warning Time

Flooding in Whitman County tends to occur as flash flooding, when warm Chinook winds drop rain on frozen snow cover and cause massive wash-off, quickly filling small creeks and rivers beyond capacity. Potentially severe storms can be predicted days in advance, but actual flooding may be predicted only hours in advance. In most cases, there is ample warning of pending flood threats in Whitman County. Previous flood damage in the region was usually caused by lack of time for preparedness or response.

Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. The National Weather Service uses a two-tiered warning system for flash flooding:

- A Flash Flood Watch covers a large area (a thousand square miles or greater, usually several counties) for up to 12 hours. A Flash Flood Watch is issued when conditions are favorable to produce flash flooding within the next 12 hours.
- A Flash Flood Warning generally covers a very small area (a few square miles to several hundred square miles) for up to 6 hours.

Whitman County Emergency Management has established flood warning protocols outlining the response to flooding in the planning area. County emergency managers use these scenarios to help dictate response to flooding.

8.3 VULNERABILITY ASSESSMENT

Some land uses are more vulnerable to flooding, such as single-family homes, while others are less vulnerable, such as agricultural land or parks. Most of unincorporated Whitman County is zoned Agricultural District. Most land use in this zone is farming or ranching, but rural residences and certain other conditional uses may be allowed. All of these uses are subject to flood hazard review.

The other zones are Heavy Commercial, Airport Commercial, Light Industrial, Heavy Industrial, Highway-Waterway Commercial, Pullman-Moscow Corridor—North, Pullman-Moscow Corridor—South, Cluster Residential, and Rural Community Residential, Center and Commercial Districts. The latter three zones are limited to a dozen very small designated unincorporated communities that were platted long ago. About 14 developments were recognized as Heavy Commercial, Light Industrial, or Heavy Industrial zones when the code was adopted in 1979. Since then, a few zones may have been added each year. Generally, when land is rezoned, flood hazard sites are not included. Some speculative large area zones have been approved where they do include some flood hazard, but County codes will ensure that future development in those areas will comply with flood hazard regulations.

Within Whitman County, adherence to flood hazard regulations tends to locate development away from the floodplain. This is because in many cases, the land parcel sizes are larger than typical urban lots, and there is room for the owner to move. In cases where lot size or other reasons prevent location out of flood hazard areas, it is possible for a development to be given a floodplain development permit for fill, construction, or both, as long as engineering satisfactory to the County Engineer is provided. Rather than pay the engineering costs, most people find it possible to find a higher elevation. The code requires that all building permits, except internal remodeling and roofs, be reviewed for compliance with County land use codes including flood hazard. In addition, developments that must undergo State Environmental Policy Act review may be required by policy to provide stormwater runoff control for a 25-year storm event. In the Pullman-Moscow Corridor zones, that requirement is set by code for a 50-year storm event. Land uses based on zoning differ in the incorporated areas that have their own land use regulations.

A detailed analysis of existing land use within identified floodplains on a parcel-by-parcel basis was not performed under this risk assessment due to the lack of GIS-based information at a parcel level. Based on

a qualitative review of County and city policy, it can be assumed that floodplain land use in the planning area is predominately agricultural, with residential and light commercial uses possible in the incorporated areas. Agricultural, low-density uses typically have a lesser degree of exposure to flood risk and should continue to be promoted within the identified floodplains of the planning area.

Methodology

As a result of the lack of parcel level data, for the 2020 update, an updated flood analysis was run using Hazus version 4.2, utilizing the 2013 100-year flood depth grid previously developed as no new flood data was available. The model used census data at the block level, which has a level of accuracy acceptable for planning purposes as the lack of digital parcel-based information in a GIS format provided no other reasonable option. The Planning Team determined that until such time as digital parcel data is available, the 2013 depth grid, coupled with Hazus default data, remained best available data, and was utilized in these loss estimations. Instances where the 2013 outputs from the original Hazus runs were used are referenced as such.

An additional exposure analysis was completed outside of Hazus for the 2020 Update identified critical facilities layer, as not all relevant building data was available to incorporate structures into the Hazus program. All other relevant data within the profile as appropriate was updated. The County intends to enhance this profile once it has been able to capture digital parcel data, which it hopes to complete within the next few years.

8.3.1 Impact to Life, Health, and Safety

Population counts of those living in the floodplain were generated by analyzing census blocks that intersect with the 100-year floodplain scenario. Census blocks do not follow the boundaries of the floodplain. Therefore, the methodology used to generate these estimates counted census block groups whose centers are in the floodplain or where the majority of the population most likely lives in or near the floodplain. Based on the 2019 scenario, Hazus estimated that approximately 175 buildings will be moderately damaged, with 37 buildings completely destroyed. The 2019 Hazus outputs further estimated that a 100-year flood could displace up to 740 households, or 2,221 people, with 81 of those people needing short-term shelter.

8.3.2 Impact on Property

Hazus calculates losses to structures from flooding by looking at depth of flooding and type of structure. Using historical flood insurance claim data, Hazus estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. For this analysis, Hazus default data was utilized, as no building structure layer was available. FEMA's flood study was utilized to establish floodplain acres. Table 8-4 summarize the total area and total number of structures in the floodplain by municipality. The 2013 Hazus model determined that there are 2,660 structures within the 100-year floodplain. About 68 percent of these structures are in unincorporated areas. The majority of the structures are residential, with the remainder being commercial, industrial or agricultural type occupancies.

Table 8-5 summarizes the estimated value of potentially exposed buildings in the planning area. This methodology estimated $1.37 million worth of building-and-contents exposure (2013 figures) to the 100-year flood, representing ~3.0 percent of the total assessed value of the planning area.

Table 8-4.
Area and Structures Within the 100-Year Floodplain

	Area in Floodplain (Acres)	Number of Structures in Floodplain							
		Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	**Total**
Albion	54	78	0	0	0	0	0	0	**78**
Colfax	300	25	1	0	0	0	0	0	**26**
Colton	83	27	0	0	0	0	0	0	**27**
Endicott	33	36	0	0	0	0	0	0	**36**
Farmington	17	18	0	0	0	0	0	0	**18**
Garfield	70	70	2	1	0	0	0	0	**73**
LaCrosse	0	0	0	0	0	0	0	0	**0**
Lamont	0	0	0	0	0	0	0	0	**0**
Malden	6	6	0	0	0	0	0	0	**6**
Oakesdale	113	77	1	1	0	0	2	0	**81**
Palouse	99	63	3	1	0	0	0	0	**67**
Pullman	364	247	67	5	1	1	0	0	**321**
Rosalia	71	26	1	0	0	0	0	0	**27**
St. John	26	21	0	1	0	0	0	0	**22**
Tekoa	98	28	0	0	0	0	0	0	**28**
Uniontown	123	27	0	1	0	0	0	0	**28**
Unincorporated	49,736	1,665	95	27	31	1	1	2	**1,822**
Total	**51,193**	**2,414**	**170**	**37**	**32**	**2**	**3**	**2**	**2,660**

Table 8-5.
Potential Flood Loss for the 100-Year Flood Event

	Estimated Flood Loss			% of Total Assessed Value
	Structural	Contents	**Total**	
Albion	$1,144,000	$953,000	$2,097,000	3.4%
Colfax	$31,767,000	$42,349,000	$74,116,000	17.8%
Colton	$270,000	$311,000	$581,000	1.4%
Endicott	$311,000	$158,000	$469,000	1.6%
Farmington	$160,000	$96,000	$256,000	1.7%
Garfield	$765,000	$571,000	$1,336,000	1.7%
LaCrosse	$0	$0	$0	0.0%
Lamont	$68,000	$155,000	$223,000	2.6%
Malden	$109,000	$159,000	$268,000	1.3%
Oakesdale	$494,000	$582,000	$1,076,000	2.1%
Palouse	$2,346,000	$2,086,000	$4,432,000	5.0%
Pullman	$12,919,000	$25,983,000	$38,902,000	1.4%
Rosalia	$228,000	$136,000	$364,000	0.7%
St. John	$1,285,000	$1,996,000	$3,281,000	5.0%
Tekoa	$1,131,000	$1,409,000	$2,540,000	3.1%
Uniontown	$233,000	$301,000	$534,000	1.4%
Unincorporated	$3,197,000	$3,588,000	$6,785,000	0.8%
Total	**$56,427,000**	**$80,833,000**	**$137,260,000**	**2.9%**

National Flood Insurance Program

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built before a FIRM is adopted are more vulnerable to flooding because they do not meet code or are located in hazardous areas. The first FIRMs in Whitman County were available in 1978. Table 8-6 lists flood insurance statistics for Whitman County. Fifteen communities in the planning area participate in the NFIP.

Table 8-6.
Flood Insurance Statistics for Whitman County

Jurisdiction	Date of Entry Initial FIRM Effective Date	# of Flood Insurance Policies as of 9/30/18	Insurance In Force	Total Annual Premium	Claims, 11/1978 to 9/30/18	Value of Claims paid, 11/1978 to 9/30/18
Albion	8/1/1978	6	$770,500	$6,281	4	$38,034
Colfax	8/1/1978	5	$1,155,000	$1,698	0	$0

Table 8-6.
Flood Insurance Statistics for Whitman County

Jurisdiction	Date of Entry Initial FIRM Effective Date	# of Flood Insurance Policies as of 9/30/18	Insurance In Force	Total Annual Premium	Claims, 11/1978 to 9/30/18	Value of Claims paid, 11/1978 to 9/30/18
Colton	7/2/1979	0	0	0	0	$0
Endicott	7/17/1978	4	$289,800	$5,144	1	$1,433
Farmington	7/3/1985	1	$27,200	417	0	0
Garfield	8/1/1978	5	$574,800	$4,199	2	24,665
LaCrosse	NP	—	—	—	—	—
Lamont	NP	—	—	—	—	—
Malden	5/01/2010	0	0	0	0	$0
Oakesdale	9/29/1978	5	$1,092,500	$2,726	0	$0
Palouse	7/17/1978	13	$2,312,300	$18,315	8	$262,594
Pullman	7/2/1979	43	$9,552,900	$73,625	30	$137,628
Rosalia	7/17/1978	5	$622,800	$7,446	3	$9,183
St. John	5/26/1981	0	0	0	0	$0
Tekoa	8/1/1979	0	0	0	0	$0
Uniontown	8/1/1978	1	$103.200	$2,088	0	$0
Unincorporated	5/1/1980	19	$3,168,900	$15,534	6	$1,957
Total		**107**	**$19,669,900**	**$137,473**	**54**	**$411,3624**

Changes in Flood Insurance Coverage - 2013 to 2020:

At the time of the 2013 update (2012 NFIP data), there were 99 existing flood insurance policies in place, with 42 claims valued at $410,399, with total coverage in force of $14,563,820. The number of policies in force, as well as the amount of coverage in force has increased, as have the claims filed since the last plan update, rising to 54 claims. As of the 2020 update, total value of claims increased to $475,494, with the addition of eight (8) new policies, to equate to total coverage in force of $19,669,900.

Some of the more significant changes which occurred follow:

- Albion reduced policies from 11 in 2013, to 6 in 2018, reducing coverage in place from $1,259,600 down to $770,500;
- Colfax lost two policies, with coverage dropping from $1,645,000 down to $1,155,000;
- Colton no longer has any policies in force, having 2 during the 2013 update;
- Garfield reduced the number of policies from 8 to 5, with total coverage falling from $883,400 to $574,800;
- Oakesdale maintained the same number of policies; however, the total coverage rose from $525,500 to $ 1,092,500, with premiums falling from $3,775 to $2,726;
- Palouse doubled the number of claims from 4 to 8 since the last plan was completed, yet they reduced the number of flood insurance policies in place by three, from 16 down to 13. Total

coverage increased from $1,964,200 to $2,312,300, with premium totals increasing from $16,402 to $ 18,315;

- Pullman increased claims filed by one, to 30 from 29, while also reducing the number of insurance policies in place, from 49 in 2012, to only 43 in 2018 (most recent data available as of update);
- Whitman County reduced the number of policies from 23 town to 19, increasing coverage amounts from $2,536,800 to $3,168,900, with premiums increasing from $11,548 to $15,534.
- Of the 107 total policies, 84 fall within the identified A-Zone.

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property.

Repetitive loss properties make up only 1 to 2 percent of flood insurance policies in force nationally, yet they account for 40 percent of the nation's flood insurance claim payments. In 1998, FEMA reported that the NFIP's 75,000 repetitive loss structures have already cost $2.8 billion in flood insurance payments and that numerous other flood-prone structures remain in the floodplain at high risk. The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. A recent report on repetitive losses by the National Wildlife Federation found that 20 percent of these properties are outside any mapped 100-year floodplain. The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by the policies.

FEMA-sponsored programs, such as the CRS, require participating communities to identify repetitive loss areas. A repetitive loss area is the portion of a floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss.

During the 2013 update, FEMA's list of repetitive loss properties identified four such properties in the Whitman County planning area existing through December 31, 2011. All were within the City of Pullman, and none were mitigated. The four properties included two commercial properties (one being the City pool building) and two were identified as residential. All were within the City's special flood hazard area. The dates of loss coincided with riverine flood events from the flood sources reflected on FEMA's FIRM for Pullman. Therefore, it can be concluded that the overall cause of repetitive flooding were consistent with the flood events that remain the basis for the city's FIRM.

Since the completion of the 2013 plan, there have been no additional repetitive or severe repetitive loss properties reported as of public of this 2020 update.[6]

[6] Email communication with Michael Levkowitz, WA State EMD 9/17/19.

8.3.3 Impact on Critical Facilities and Infrastructure

Impact to critical facilities was reviewed outside of the Hazus platform, based on exposure analysis for the 2020 critical facilities list. Table 8-7 summarizes the critical facilities in the 100-year floodplain of Whitman County.

Tier II Facilities

Tier II facilities are those that can harm the surrounding environment if damaged by a flood due to the release of hazardous materials. During a flood event, containers holding these materials could rupture and leak into the surrounding area, having a disastrous effect on the environment as well as residents. For this update, the 2018 Washington State Department of Ecology reports were utilized to identify hazardous materials facilities in the County.

Table 8-7.
Critical Facilities in the 100-Year Floodplain

Jurisdiction	Medical and Health Services	Government Function	Protective	Hazardous Materials	Schools	Other	**Total**
Albion	0	0	0	0	0	0	**0**
Colfax	0	0	2	1	0	0	**3**
Colton	0	0	0	1	0	0	**1**
Endicott	0	0	0	1	0	0	**1**
Farmington	0	0	0	0	0	0	**0**
Garfield	1	2	1	2	0	0	**6**
LaCrosse	0	0	0	0	0	0	**0**
Lamont	0	0	0	0	0	0	**0**
Malden	0	0	0	0	0	0	**0**
Oakesdale	0	0	0	0	0	0	**0**
Palouse	0	1	1	0	0	0	**2**
Pullman	0	0	0	2	2	0	**4**
Rosalia	0	0	0	0	0	0	**0**
St. John	0	0	1	0	0	0	**1**
Tekoa	0	0	0	0	0	0	**0**
Uniontown	0	0	0	1	0	0	**1**
Unincorporated	0	0	2	9	0	0	**11**
Total	**1**	**3**	**7**	**17**	**2**	**0**	**30**

Utilities/Infrastructure

Roads or railroads that are blocked or damaged can prevent access throughout the County and can isolate residents and emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris from floods also can cause isolation. Water and sewer systems can be flooded or backed up, causing further health problems. Underground utilities can also be

damaged during flood events. Thus, it is critical to identify which infrastructure is exposed to flooding to determine what is vulnerable and who may be at risk if that infrastructure is damaged. Due to the lack of GIS information, a detailed analysis was not performed to identify potentially vulnerable utilities. There are two large gas pipelines that cross Whitman County; one from Williams Gas Pipeline and the other is from TransCanada GTN System. They total 195.2 miles. (Washington Utilities and Transportation Commission 2019) The exposure of these pipelines to flooding is not known at this time.

Railroads

Palouse River & Coulee City Railroad is comprised of three branch lines: the Hooper line, running from Hooper Junction to Colfax, Washington; the Pleasant Valley line, running from Winona Junction to Thornton, Washington; and the South Subdivision line, running from Wallula to Walla Walla, Washington, Walla Walla to Dayton, Washington, and Walla Walla to Weston, Oregon. Portions of this railroad cross identified floodplains. Nonetheless the railroad tracks tend to be well protected from flooding because the railroad routes are built as levees or as embankments 10 to 15 feet above the surrounding area. In some instances, railroads can worsen flooding because they can prevent drainage of flooded areas.

Roads

Several roads in Whitman County have been affected by past flood events, both inside and outside the 100-year floodplain. Many of these roads, such as portions of U.S. 195 and SR 26 are built above the flood level, and many others function as levees to prevent flooding. Nonetheless, in certain events these roads may be blocked or damaged by flooding, preventing access to many areas. The majority of Public Assistance funds requested by Whitman County for the 1996 flood events (DR-1100 and DR-1159) was for repair to damaged roads that were flooded or undercut due to severe erosion.

Bridges

Flooding events can significantly impact road bridges. These are important because they often provide the only ingress and egress to some neighborhoods or rural areas. An analysis showed that there are approximately 100 bridges that are in or cross over the floodplain. The Hazus model includes default inventories of roads and bridges. The basis of these inventories would be facilities with a federal interest due to funding or jurisdiction. A large percentage of bridges with potential vulnerability to flooding are County-owned and maintained and fall outside the scope of the default inventory. A GIS-based inventory of County-owned facilities was not available for this analysis; therefore, estimated vulnerability is based solely on default parameters.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding events. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can also be backed up, causing wastes to spill into homes, neighborhoods, rivers and streams.

8.3.4 Impact on Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

The listing of salmon and trout species as threatened or endangered under the Endangered Species Act has had a significant impact on rural counties such as Whitman County in that they must now take into account the impact of their programs on habitat. This can affect the implementation of flood mitigation alternatives such as stream channel maintenance, stream channel modification or watershed management.

Due to the rural, agricultural nature of the planning area, much of the identified floodplain in Whitman County is in or approximates its natural state. This allows for these floodplains to provide beneficial functions such as floodwater storage, water quality and enhancement of habitat. Whitman County and its planning partners have adopted critical areas regulations that strive to preserve and enhance these areas through regulated land use.

8.3.5 Impact on Economy

Impact on the economy related to a flood event in Whitman County would include loss of property and associated tax revenue, as well as potential loss of businesses. Depending on the duration between onset of the event and recovery, businesses within the area may not be able to sustain the economic loss of their business being disrupted for an extended period of time. Historical data has demonstrated that those businesses impacted by a disaster are less likely to reopen after an event. Flooding also has impacts on agricultural areas. Agricultural land in the County are subject to flooding. Likewise, inundation frequently affects croplands, something on which the County relies as a source of income. Landmass is also vulnerable to floods due to erosion when river and stream banks fail and overflow. Hazus outputs illustrate that total building-related losses were estimated to be $162 million dollars, with 49 percent of the estimated losses related to business interruption in the region, including loss of income, relocation costs, lost rental income, and lost wages.

8.3.6 Impact from Climate Change

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood event s (e.g. 10 -year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With

potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation and regulation of flood protection facilities such as dams, floodways, bypass channels and levees, as well as the design of local sewers and storm drains.

8.4 SECONDARY HAZARDS

The most problematic secondary hazard for flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or storm sewers.

8.5 FUTURE TRENDS IN DEVELOPMENT

The Whitman County planning area has experienced a relatively slow rate of growth in recent years. Extrapolating from these historical trends, anticipated development trends for the planning area are considered low to moderate, consisting primarily of residential development with the exception of the Pullman vicinity (see Volume 2 for jurisdiction-specific growth trends). Higher rates of growth tend to increase demand for new development. With this fact in mind, it would be assumed that development/redevelopment trends within Whitman County are not such that there is major concern toward development within identified flood hazard areas.

Whitman County is not subject to the full planning requirements of the state Growth Management Act. The County and its cities have adopted critical areas and resources lands regulations pursuant to the Growth Management Act requirements for jurisdictions not mandated to fully plan. Maintaining the agricultural heritage of Whitman County is a high priority for its land use programs and managers. However, with the changed tax structure of Washington State severely affecting the budgets of small cities, towns and rural counties, municipalities are often forced into positions to revise their land use policies in order to optimize financial resources. It has been Whitman County's policy in the past to not allow for an increase in exposure within its floodplains. Flood loss history and the current land use trends support these policies. The information in this plan provides Whitman County and its Planning Partners a tool to ensure that there is no increase in exposure within the floodplains of the planning area.

8.6 SCENARIO

The worst flooding in Whitman County would occur during winter or early spring when heavy rainfall is accompanied by warm Chinook winds. This heavy rainfall in conjunction with the warm air causes snowmelt and rapid runoff on frozen ground. The top layers of the loess soil have the potential to erode away during this rapid runoff. The extent of erosion will depend on the extent of ground cover and agricultural management regimes in practice at the time of the event. The more ground cover and accompanying measures reducing velocity, the less erosion and less transported sediment.

The sudden increase in runoff overwhelms rivers and creeks, which typically overtop, flooding areas where the rivers are blocked or channel capacity is otherwise reduced, such as in towns that have numerous bridges. The runoff also carries debris, ice and sediment, which can be deposited where the rivers overflow and contribute to scour. Minor flooding can occur along numerous roadways, leaving sediment and minor landslides that are costly and time-consuming to clean up. Not all rivers flood at the same time as others,

or during the same events, so it is difficult to predict where flooding may actually occur during any given predicted storm event. All of these impacts could be significantly exacerbated due to the impacts of climate change.

8.7 ISSUES

The streams and rivers of Whitman County are generally low-flow rivers. However, during severe weather events in conjunction with accumulated snow on the ground, rivers that have average discharges of 40 cfs can swell to 15,000 cfs. Except in the most severe events, or when exacerbated by human-built structures such as bridge abutments, the rivers typically have handled the added flow without overtopping. However, stream capacities are diminishing due to sedimentation. Rivers that previously overtopped during 50-year events may now overtop during 10- or 30-year events. Much of this erosion can be attributed to cultivation of the rich, dry and highly erodible soil for wheat and other grain farming; although erosion of the soil is a natural occurrence, intense cultivation over the last 130 years has sped up the process. In addition to maintenance and dredging of problem rivers, it is recommended that watersheds whose streams drain into flood-prone communities be designated as target watersheds where farming practices should be implemented to reduce erosion and lessen the flood vulnerability of the most at-risk communities.

Accurate hazard identification allows hazard mitigation planners to accurately reflect the benefits of a proposed initiative, which can be crucial when prioritizing an action plan. The risk assessment in this plan is based on the FIRMs produced for the planning area by FEMA, the average age of which is over 30 years. At the time of this 2020 planning process, this was the best available information to identify the extent and location of flooding in Whitman County. Even with the low rate of growth in the planning area, stream channel conditions and hydrology changes have occurred within this region to draw into question the accuracy of these maps. Although new mapping would not significantly alter the mitigation recommendations of this plan, it would provide a much more accurate assessment of risk and may be able to provide a better gauge of where these initiatives should be implemented to maximize the net benefits. Future enhancements and revisions to this plan should focus on using or obtaining the best available science and technology to accurately identify the flood hazards within Whitman County.

The planning team has identified the following flood-related issues relevant to the planning area:

- The accuracy of the existing flood hazard mapping produced by FEMA in reflecting the true flood risk within the planning area is questionable. Flood maps need to be updated using the best available data, science and technology.
- Information on the assets exposed to flooding in a digital format would significantly enhance the flood hazard risk assessment for this plan.
- The risk associated with the flood hazard overlaps the risk associated with other hazards such as earthquake and landslide. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- There is no consistency of land-use practices within the planning area or the scope of regulatory floodplain management beyond the minimum requirements of the NFIP.
- Potential climate change could alter flood conditions in Whitman County.
- More information is needed on flood risk to support the concept of risk-based analysis of capital projects.
- There needs to be a sustained effort to gather historical damage data, such as high-water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.

- Ongoing flood hazard mitigation will require funding from multiple sources.
- There needs to be a coordinated hazard mitigation effort between jurisdictions affected by flood hazards in the county.
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.
- The promotion of flood insurance as a means of protecting private property owners from the economic impacts of frequent flood events should continue.
- Existing floodplain-compatible uses such as agricultural and open space need to be maintained. There is constant pressure to convert these existing uses to more intense uses within the planning area during times of moderate to high growth.
- The economy affects a jurisdiction's ability to manage its floodplains. Budget cuts and personnel losses can strain resources needed to support floodplain management.
- A buildable-lands analysis that looks at vacant lands and their designated land use would be a valuable tool in helping decision-makers make wise decisions about future development. This could be made possible by digitizing the land use zoning designations for the entire planning area in a parcel level database

8.8 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from flood throughout the area is highly likely. The area experiences some level of flood annually, albeit not necessarily to the level of a disaster declaration, and in many instances, creates more of a nuisance flooding than a significant hazard in most areas of the County. While structural damage may vary due to flood depths and existing floodplain management regulations, the actual area within the floodplain is limited in nature, with fewer structures exposed; however, there is a fairly high rate of property ownership that does not have flood insurance. Based on the potential impact, the Planning Team determined the CPRI score to be 2.55, with overall vulnerability determined to be a medium level.

Chapter 9.
LANDSLIDE

9.1 GENERAL BACKGROUND

A landslide is a mass of rock, earth or debris moving down a slope. Landslides may be minor or very large, and can move at slow to very high speeds. They can be initiated by storms, earthquakes, fires, volcanic eruptions or human modification of the land.

Mudslides (or mudflows or debris flows) are rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud or "slurry." A debris flow or mudflow can move rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars and anything else in its path. Although these slides behave as fluids, they pack many times the hydraulic force of water due to the mass of material included in them. Locally, they can be some of the most destructive events in nature.

DEFINITIONS

Landslide—The sliding movement of masses of loosened rock and soil down a hillside or slope. Such failures occur when the strength of the soils forming the slope is exceeded by the pressure, such as weight or saturation, acting upon them.

Mass Movement—A collective term for landslides, debris flows, falls and sinkholes.

Mudslide (or Mudflow or Debris Flow)—A river of rock, earth, organic matter and other materials saturated with water.

All mass movements are caused by a combination of geological and climate conditions, as well as the encroaching influence of urbanization. Vulnerable natural conditions are affected by human residential, agricultural, commercial and industrial development and the infrastructure that supports it.

9.2 HAZARD PROFILE

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 40 percent (based on Washington State Dept. of Natural Resource guidelines)
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable
- The presence or potential for snow avalanches
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Flows and slides are commonly categorized by the form of initial ground failure. Common types of slides are shown in Figure 9-1 through Figure 9-4. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

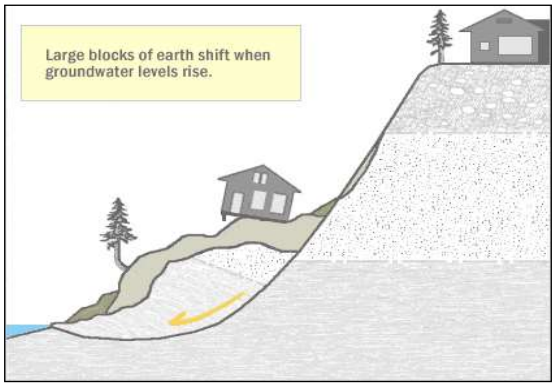


Figure 9-1. Deep Seated Slide

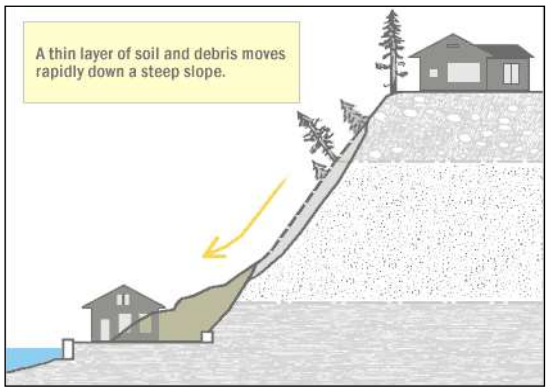


Figure 9-2. Shallow Colluvial Slide

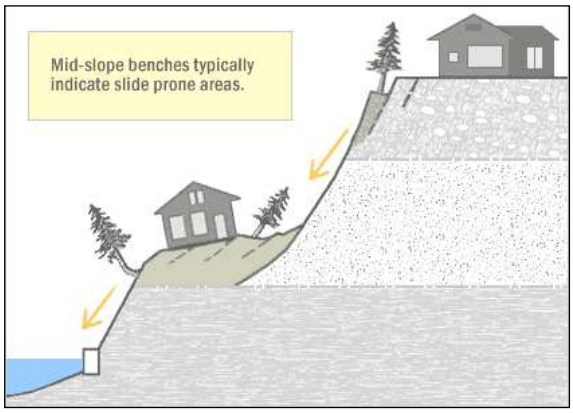


Figure 9-3. Bench Slide

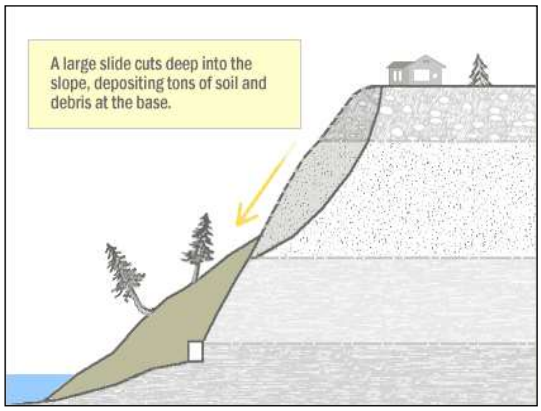


Figure 9-4. Large Slide

Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

9.2.1 Previous Occurrences

There is little recorded information regarding landslides in Whitman County. The Spatial Hazard Events and Losses Database for the United States (SHELDUS) has a record of one landslide event in Whitman County since 1960—on January 26, 1965. This event coincided with a presidential disaster declaration for severe storms and flooding. There are no records in the county of fatalities attributed to mass movement. However, deaths as a result of slides and slope collapses have occurred across the west coast.

9.2.2 Extent and Location

The best available predictor of where movement of slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding.

Identifying unstable slopes to aid in mitigating landslide hazards is an integral part of land management and regulation in Washington through the Landslide Hazard Zonation Project prepared by the Forest Practices Division of the Washington Department of Natural Resources. Permanent rules adopted by the Washington Forest Practices Board in 2001 address landslide hazards from specific landforms across the state (WAC 222-16-050 (1)(d)). This methodology was developed to provide standardized methods for landslide inventories and for producing hazard maps to identify unstable slopes in support of forest practices rules. It also provides a framework for monitoring the success of new forest practices related to unstable slopes. As of this 2020 update, there are no Landslide Hazard Zonation maps for the Whitman County planning area. Future landslide risk assessments should use this data once it becomes available. Washington State Department of Natural Resources (WA DNR) does maintain a list of previous landslide hazards occurring in the State. While the information is dated in nature, it remains the best available information. Those areas identified by WA DNR are identified in Figure 9-5.

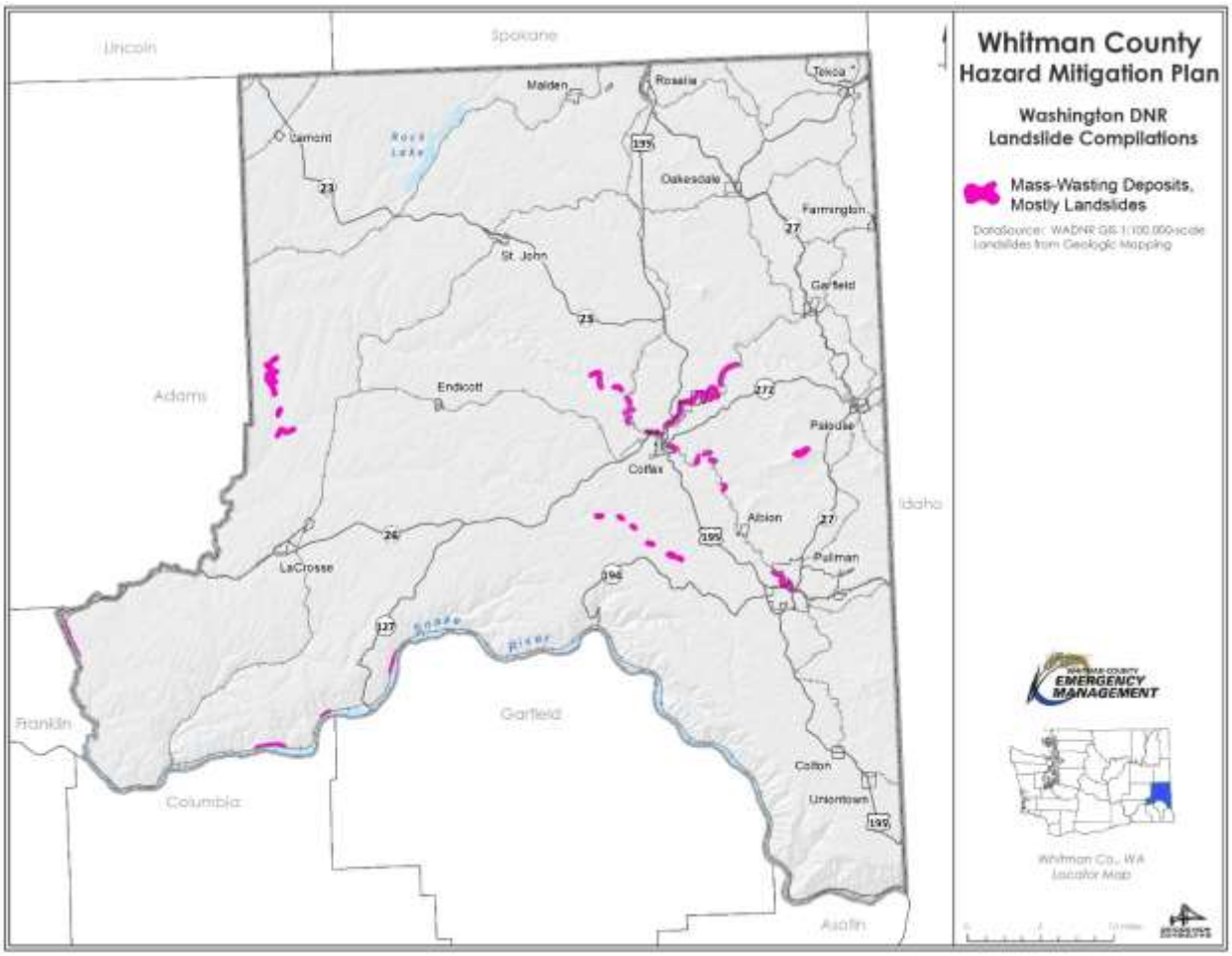


Figure 9-5. DNR Historic Landslides

9.2.3 Frequency

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires, so landslide frequency is related to the frequency of these other hazards. In Whitman County, landslides typically occur during and after major storms when agricultural lands have been tilled and are free of vegetative cover. Therefore, the potential for landslides coincides with the potential for sequential severe storms that saturate steep, vulnerable soils as well as with agricultural production. According to SHELDUS records, the planning area has been impacted by severe storms at least once every other year since 1960. Until better data is generated specifically for landslide hazards, this severe storm frequency is appropriate for the purpose of ranking risk associated with the landslide hazard.

In general, landslides are most likely during periods of higher than average rainfall. The ground must be saturated prior to the onset of a major storm for significant landsliding to occur. Water is involved in nearly all cases; and human influence has been identified in more than 80 percent of reported slides.

9.2.4 Severity

Landslide disasters occur on a regular basis. A landslide can destroy homes, chew apart a highway, or trigger more catastrophic events such as flooding if it happens in the wrong place at the wrong time. Human settlements around the world are built near landslide-prone cliffs and mountains, which can result in tragic

consequences. Geologic history has a number of examples of landslides that were large enough to move entire mountains. In the modern era, landslide disasters such as the Monte Toc landslide in Italy, the 1991 Pubjabi landslide in India, and the Khait landslide in Russia have claimed thousands of casualties and caused considerable damage. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion.

9.2.5 Warning Time

Mass movements can occur suddenly or slowly. The velocity of movement may range from inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred. Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped roadbeds
- Rapid increase in creek water levels, possibly accompanied by increased soil content
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

9.3 VULNERABILITY ASSESSMENT

9.3.1 Impact on Life, Health and Safety

Due to the nature of census block group data, it is difficult to determine populations vulnerable to mass movements. In general, all persons exposed to higher risk landslide areas are considered to be vulnerable. Increasing population and the fact that many homes are built on view property atop or below bluffs and on steep slopes subject to mass movement, increases the number of lives endangered by this hazard.

9.3.2 Impact on Property

A building exposure analysis could not be performed for this assessment due to the lack of available digital parcel data for the planning area. Currently, there is no nationally accepted damage functions established for the landslide hazard. However, to gauge the potential landslide risk exposure solely based on areas with

land slide potential, an area analysis was performed for each municipality in the planning area. Table 9-1 illustrates the percentage of the total area of each municipality with slopes 40 percent or greater. Figure 9-6 illustrates those areas.

Table 9-1.
Landslide Area Exposure

		Slopes 40% or Greater	
	Total Area (acres)	Estimated Area Exposed (acres)	Percent of Total Area
Albion	251	1	0.54%
Colfax	2,396	342	14.29%
Colton	395	0	0.00%
Endicott	183	0	0.13%
Farmington	236	0	0.00%
Garfield	577	0	0.06%
LaCrosse	934	0	0.00%
Lamont	186	1	0.54%
Malden	477	3	0.54%
Oakesdale	665	0	0.00%
Palouse	666	10	1.45%
Pullman	7,015	15	0.21%
Rosalia	385	1	0.37%
St. John	421	0	0.03%
Tekoa	800	2	0.29%
Uniontown	590	0	0.00%
Unincorporated	1,377,235	58,355	4.24%
Total	**1,393,411**	**58,732**	**4.21%**

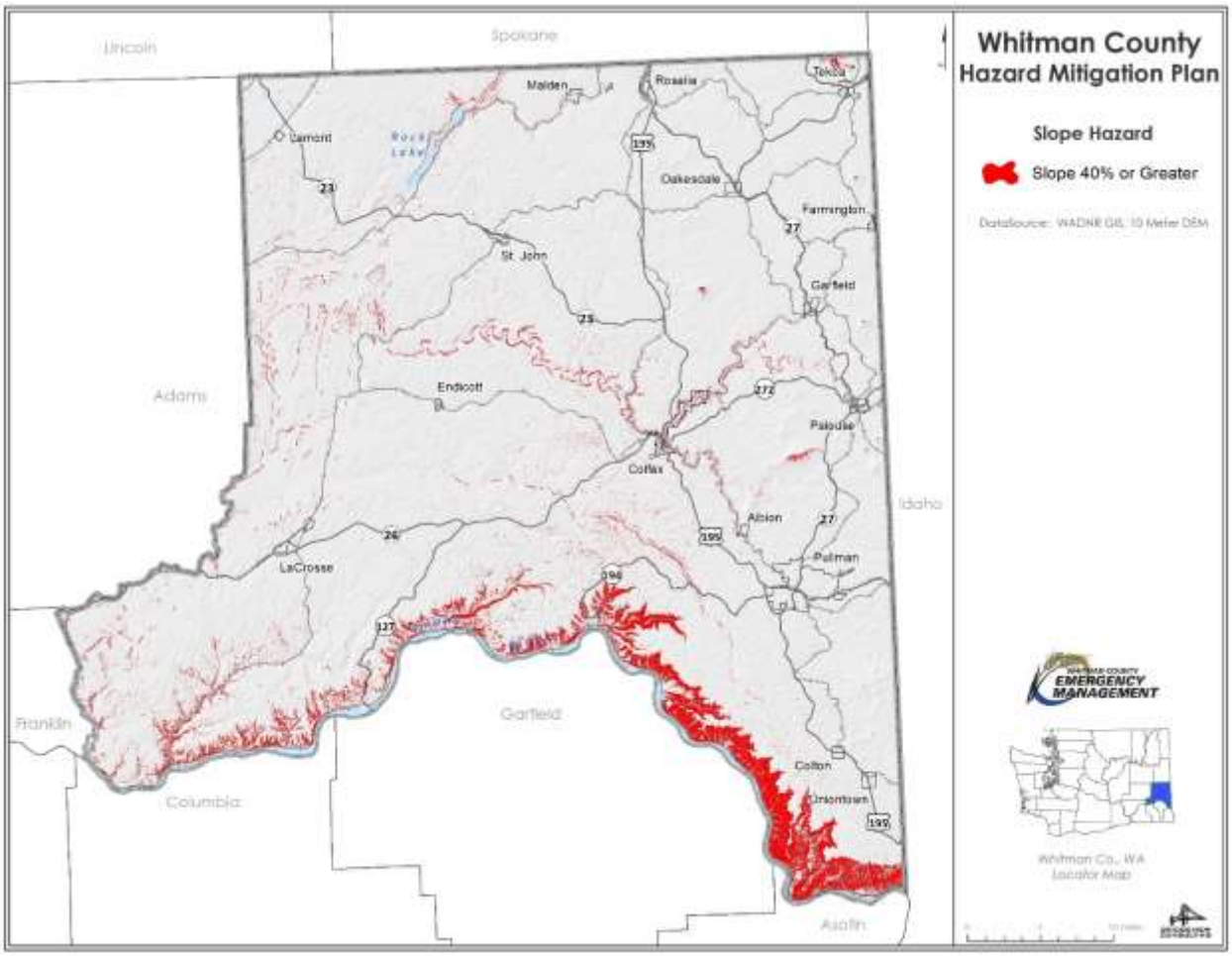


Figure 9-6. Potential Landslide Hazard Areas

9.3.3 Impact on Critical Facilities and Infrastructure

There are 21 critical facilities exposed to the landslide hazard to some degree. No loss estimation of these facilities was performed due to the lack of established damage functions for the landslide hazard. A more in-depth analysis of the mitigation measures taken by these facilities to prevent damage from mass movements should be done to determine if they could withstand impacts of a mass movement. Table 9-2 summarizes the critical facilities exposed to the landslide hazard. Figure 9-7 illustrates critical facilities in proximity to landslide hazard areas.

TABLE 9-2.
CRITICAL FACILITIES EXPOSED TO LANDSLIDE HAZARDS

	Number of Exposed Critical Facilities in Risk Area
Medical and Health Services	0
Government Function	0
Protective Function	1
Schools	0
Hazmat	0

TABLE 9-2.
CRITICAL FACILITIES EXPOSED TO LANDSLIDE HAZARDS

	Number of Exposed Critical Facilities in Risk Area
Other Critical Function	1
Bridges	15
Water	3
Wastewater	0
Power	0
Communications	1
Total	**21**

Several types of infrastructure have the potential to be exposed to mass movements, including transportation, water and sewer and power infrastructure. Susceptible areas of the county include roads and transportation infrastructure. At this time, all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available. Those include:

- **Roads**—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges**—Landslides can significantly impact road bridges. Mass movements can knock out abutments or significantly weaken the soil supporting them, making them hazardous for use.
- **Power Lines**—Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil under a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.

9.3.4 Impact on Environment

Environmental problems as a result of mass movements can be numerous. Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Wildlife habitat on hillsides can be lost for prolonged periods due to landslides.

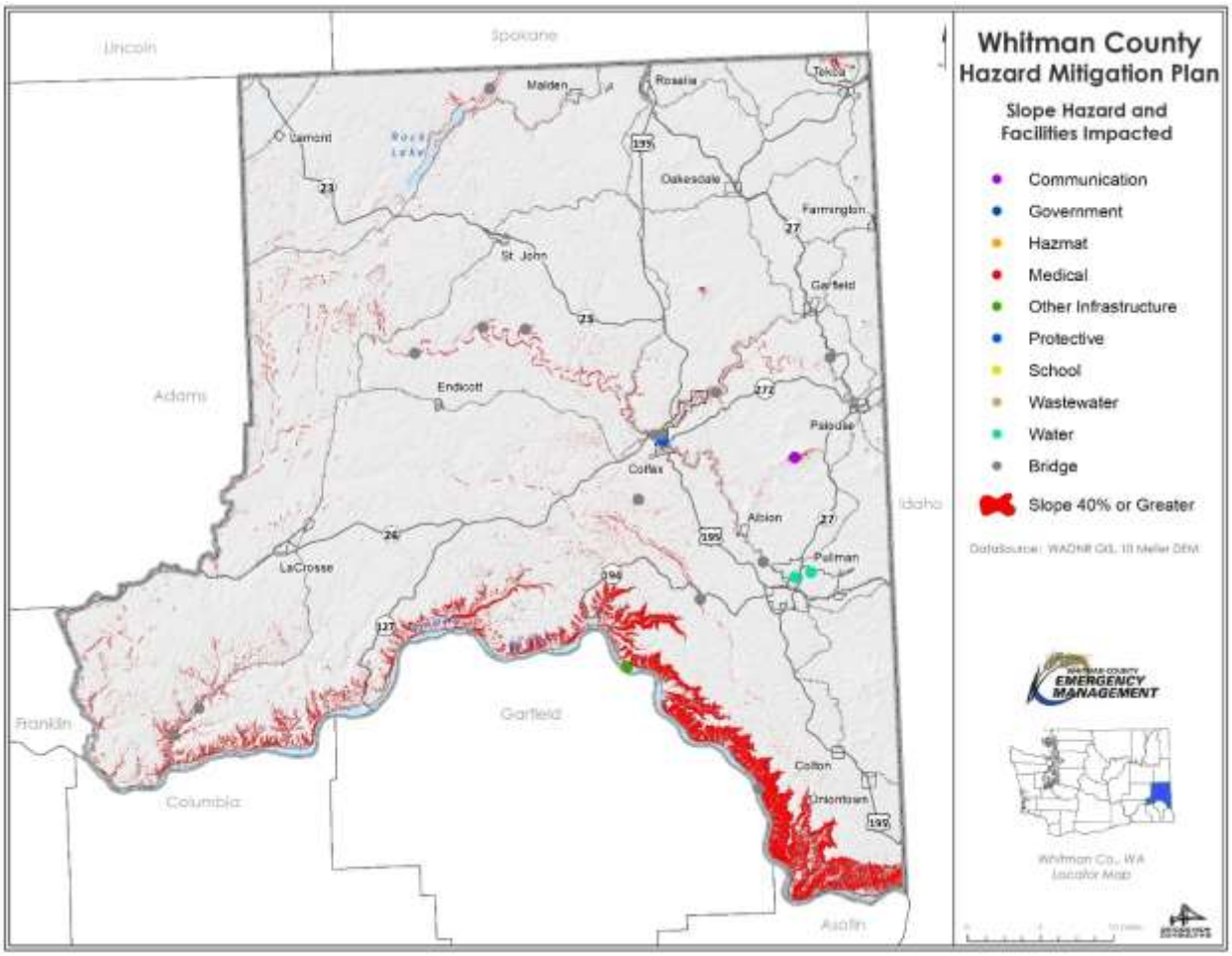


Figure 9-7. Landslide Hazard Areas in Proximity to Critical Facilities

9.3.5 Impact on Economy

A landslide or erosion event could have significant impact on both the private sector and governmental agencies. Economic losses include damage costs as well as lost revenue and taxes. Damaged bridges, roadways, marinas, boat docks, municipal airports all can have a significant impact on the economy. Damages in this capacity could have a significant economic impact on not only Whitman County, but also other areas of the state.

The impact on commodity flow from a significant landslide shutting down major access routes would not only limit the resources available for citizens' use, but also would cause economic impact on businesses in the area. Debris could impact cargo staging areas and lands needed for business operations. With primary transportation routes in the hazard areas impacted, the use of primary roadways reduces travel time, and in some cases, restricts ingress and egress. In some cases, travel time increases to much greater distances. Impacts would also significantly reduce the tourism industry within the County, impacting local communities and their economy.

Loss of access to businesses, including agricultural areas, may result in decreased tax revenues to the municipalities, school districts, and the County overall. While these impacts will be temporary, more severe and chronic landslide event may result in loss of private property, causing permanent decreases in property tax revenue.

9.3.6 Impact from Climate Change

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

9.4 SECONDARY HAZARDS

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They also can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

9.5 FUTURE TRENDS IN DEVELOPMENT

Landslide hazard areas are included in "geologically hazardous areas," one category of critical areas regulated under the state GMA for Whitman County. They are defined as follows:

> "Landslide hazard areas" means areas potentially subject to mass earth movement based on a combination of geologic, topographic, and hydrologic factors. These include the following:
>
> – Areas of historical landslides as evidenced by landslide deposits, avalanche tracks, and areas susceptible to basal undercutting by streams, rivers or waves
>
> – Areas with slopes steeper than 40 percent that intersect geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock, and which contain springs or groundwater seeps
>
> – Areas located in a canyon or an active alluvial fan, susceptible to inundation by debris flows or catastrophic flooding.

Whitman County and its planning partners are well-equipped to deal with future growth and development within the planning area. The landslide hazard portions of the planning area are regulated by County Code (Title 9) as well as by the International Building Code. Development will occur in landslide hazards within the planning area, but it will be regulated such that the degree of risk will be reduced through building standards and performance measures.

9.6 SCENARIO

Major landslides in Whitman County occur as a result of soil conditions that have been affected by severe storms, groundwater or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain and caused flooding. Landslides are most likely during late winter when the water table is high and soils are exposed due to farming practices. After heavy rains from November to December, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it causes weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the weakening of the slope. Gravity, poor drainage, a rising groundwater table and poor soil exacerbate hazardous conditions.

Mass movements are becoming more of a concern as development moves outside of city centers and into areas less developed in terms of infrastructure. Most mass movements would be isolated events affecting specific areas. It is probable that private and public property, including infrastructure, will be affected. Mass movements could affect bridges that pass over landslide prone ravines and knock out rail service through the county. Road obstructions caused by mass movements would create isolation problems for residents and businesses in sparsely developed areas. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power and communication access to residents.

Continued heavy rains and flooding will complicate the problem further. As emergency response resources are applied to flooding problems, it is possible they will be unavailable to assist with landslides.

9.7 ISSUES

Important issues associated with landslides in Whitman County include the following:

- There are many unknowns about the potential impact of this hazard due to the lack of available information.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- The impact of climate change on landslides is uncertain. If climate change impacts atmospheric conditions, then exposure to landslide risks is likely to increase.
- Landslides may cause negative environmental consequences, including water quality degradation.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

9.8 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from a landslide throughout the area is likely. The area experiences some level of landslide activity annually, although in many instances, there is no structural impact. Thankfully, no injuries have been reported to have occurred as a result of a landslide event. Customarily, landslide events occur in conjunction with other weather events, such as flooding or other severe weather. As emergency response resources may be applied to the primary issue causing the landslide, it is possible that first responders may be taxed, with response times impacted. Likewise, impact from a landslide to roadways could also increase response times due to related issues with ingress and egress to areas. Based on the potential impact, the Planning Team determined the CPRI score to be 1.9, with overall vulnerability determined to be a medium level.

Chapter 10.
SEVERE WEATHER

10.1 GENERAL BACKGROUND

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. It includes thunderstorms, downbursts, tornadoes, waterspouts, snowstorms, ice storms, and dust storms.

Severe weather can be categorized into two groups: those that form over wide geographic areas are classified as general severe weather; those with a more limited geographic area are classified as localized severe weather. Severe weather, technically, is different from extreme weather, which refers to unusual weather events are at the extremes of the historical distribution for a given area.

Five types of severe weather events typically impact Whitman County: thunderstorms, damaging winds, hailstorms, heavy snowfall associated with winter storms and flash flooding. Flooding issues associated with severe weather are discussed in Chapter 8. The other four types of severe weather common to Whitman County are described in the following sections.

10.1.1 Thunderstorms

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado.

Three factors cause thunderstorms to form: moisture, rising unstable air (air that keeps rising when disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the

DEFINITIONS

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to six tons of ice, creating a threat to power and telephone lines and transportation routes.

Severe Local Storm—"Microscale" atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Thunderstorm—A storm featuring heavy rains, strong winds, thunder and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Tornado—Funnel clouds that generate winds up to 500 miles per hour. They can affect an area up to three-quarters of a mile wide, with a path of varying length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale, ranging from F0 to F5.

Windstorm—A storm featuring violent winds. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

Winter Storm—A storm having significant snowfall, ice, and/or freezing rain; the quantity of precipitation varies by elevation.

charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder. Thunderstorms have three stages (see Figure 10-1):

- The ***developing stage*** of a thunderstorm is marked by a cumulus cloud that is being pushed upward by a rising column of air (updraft). The cumulus cloud soon looks like a tower (called towering cumulus) as the updraft continues to develop. There is little to no rain during this stage but occasional lightning. The developing stage lasts about 10 minutes.
- The thunderstorm enters the ***mature stage*** when the updraft continues to feed the storm, but precipitation begins to fall out of the storm, and a downdraft begins (a column of air pushing downward). When the downdraft and rain-cooled air spread out along the ground, they form a gust front, or a line of gusty winds. The mature stage is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The storm occasionally has a black or dark green appearance.
- Eventually, a large amount of precipitation is produced and the updraft is overcome by the downdraft beginning the ***dissipating stage***. At the ground, the gust front moves out a long distance from the storm and cuts off the warm moist air that was feeding the thunderstorm. Rainfall decreases in intensity, but lightning remains a danger.

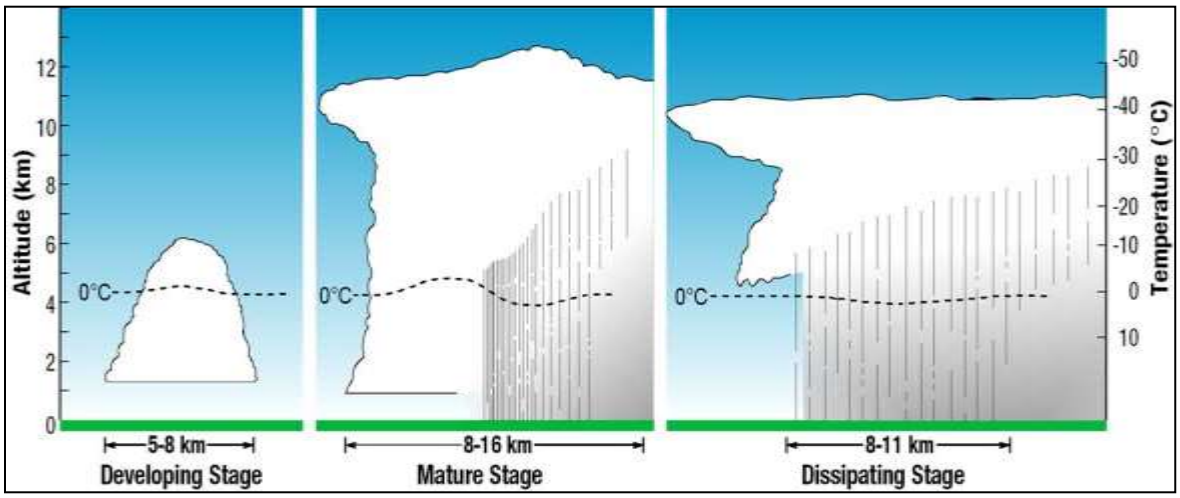


Figure 10-1. The Thunderstorm Life Cycle

There are four types of thunderstorms:

- **Single-Cell Thunderstorms—**Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.
- **Multi-Cell Cluster Storm—**A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.
- **Multi-Cell Squall Line—**A multi-cell line storm, or squall line, consists of a long line of storms with a continuous well-developed gust front at the leading edge. The line of storms can

be solid, or there can be gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.

- **Super-Cell Storm—**A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles an hour or more, and strong to violent tornadoes.

10.1.2 Damaging Winds

Damaging winds are classified as those exceeding 60 mph. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-line winds—**Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.
- **Downdrafts—**A small-scale column of air that rapidly sinks toward the ground.
- **Downbursts—**A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- **Microbursts—**A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- **Gust front—**A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- **Derecho—**A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word “derecho” is of Spanish origin and means “straight ahead.” Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.

- **Bow Echo**—A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

Figure 10-2 illustrates the potential wind power distribution countywide.

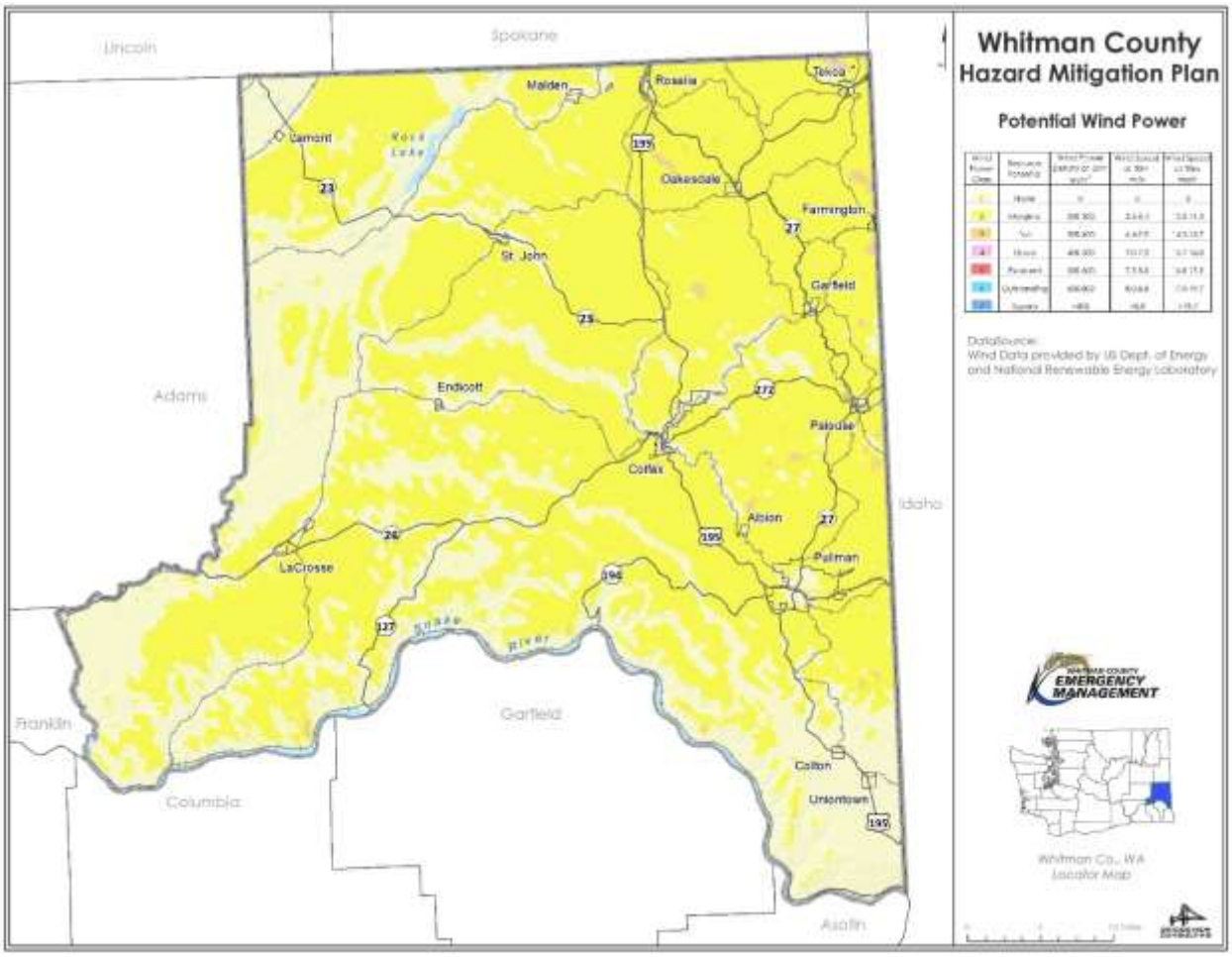


Figure 10-2. Potential Wind Power Countywide

10.1.3 Hailstorms

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Recent studies suggest that super-cooled water may accumulate on frozen particles near the back side of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

Hailstones grow two ways: by wet growth or dry growth. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super cold. When the tiny piece of ice collides with a super-cooled drop, the water does not freeze on the ice immediately. Instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice. Dry growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are "frozen" in place, leaving cloudy ice.

Hailstones can have layers like an onion if they travel up and down in an updraft, or they can have few or no layers if they are "balanced" in an updraft. One can tell how many times a hailstone traveled to the top of the storm by counting its layers. Hailstones can begin to melt and then re-freeze together, forming large and very irregularly shaped hail.

10.1.4 Winter Storms/Heavy Snow

The National Weather Service defines a winter storm as having significant snowfall, ice and/or freezing rain; the quantity of precipitation varies by elevation. Heavy snowfall is 4 inches or more in a 12-hour period, or 6 inches or more in a 24-hour period in non-mountainous areas; and 12 inches or more in a 12-hour period or 18 inches or more in a 24-hour period in mountainous areas. There are three key ingredients to a severe winter storm:

- **Cold Air**—Below-freezing temperatures in the clouds and near the ground are necessary to make snow and/or ice.
- **Moisture**—Moisture is required in order to form clouds and precipitation. Air blowing across a body of water, such as a large lake or the ocean, is an excellent source of moisture.
- **Lift**—Lift is required in order to raise the moist air to form the clouds and cause precipitation. An example of lift is warm air colliding with cold air and being forced to rise over the cold dome. The boundary between the warm and cold air masses is called a front. Another example of lift is air flowing up a mountain side.

The Pacific Ocean provides a virtually unlimited source of moisture for storms. If the air is cold enough, snow falls over Washington and Oregon and sometimes in California. Cold air from the north has to filter through mountain canyons into the basins and valleys to the south. If the cold air is deep enough, it can spill over the mountain ridge. As the air funnels through canyons and over ridges, wind speeds can reach 100 mph, damaging roofs and taking down power and telephone lines. Combining these winds with snow results in a blizzard.

Heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost of snow removal, repairing damage, and loss of business can have large economic impacts on cities and towns.

Areas most vulnerable to winter storms are those affected by convergence of dry, cold air from the interior of the North American continent, and warm, moist air off the Pacific Ocean. Typically, significant winter storms occur during the transition between cold and warm periods.

10.2 HAZARD PROFILE

10.2.1 Previous Occurrences

Table 10-1 summarizes severe weather events in Whitman County since 2006, as recorded by the National Oceanic and Atmospheric Administration (NOAA) and FEMA Disaster History Data. One disaster declaration for a severe storm has occurred since completion of the 2013 plan (DR4249).

10.2.2 Extent and Location

Severe weather events have the potential to happen anywhere in the planning area. Communities in low-lying areas next to streams or lakes are more susceptible to flooding. Wind events are most damaging to

areas that are heavily wooded. Figure 10-3 illustrates the average monthly temperatures within the County. Figure 10-4 and Figure 10-5 illustrate the distribution of temperature countywide.

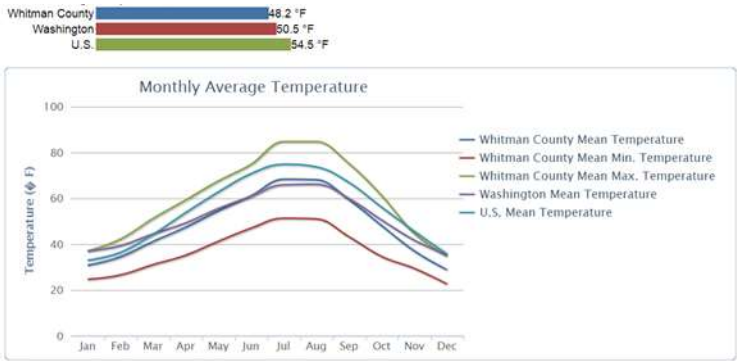


Figure 10-3. Whitman County Monthly Temperature Averages

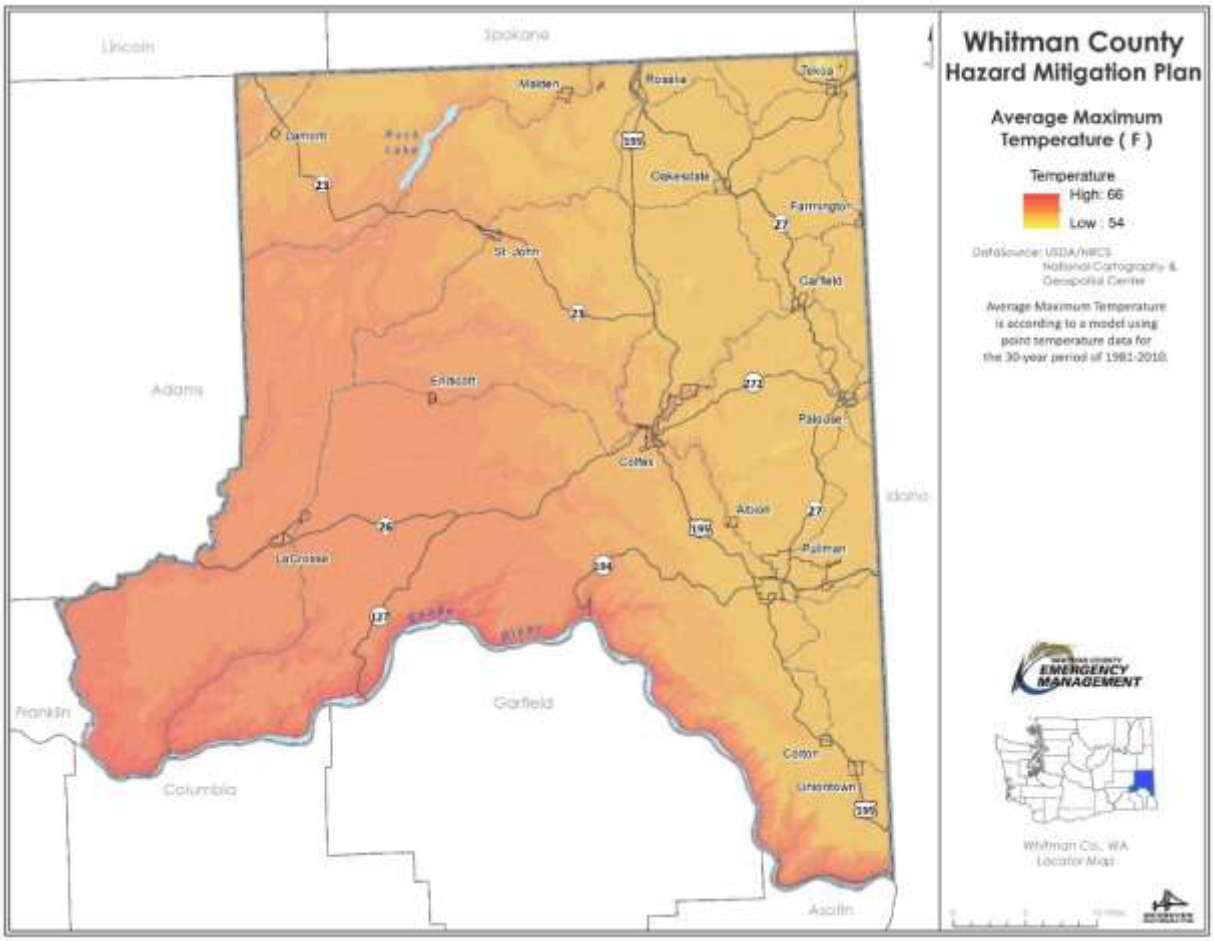


Figure 10-4. Whitman County Average Maximum Temperature Distribution

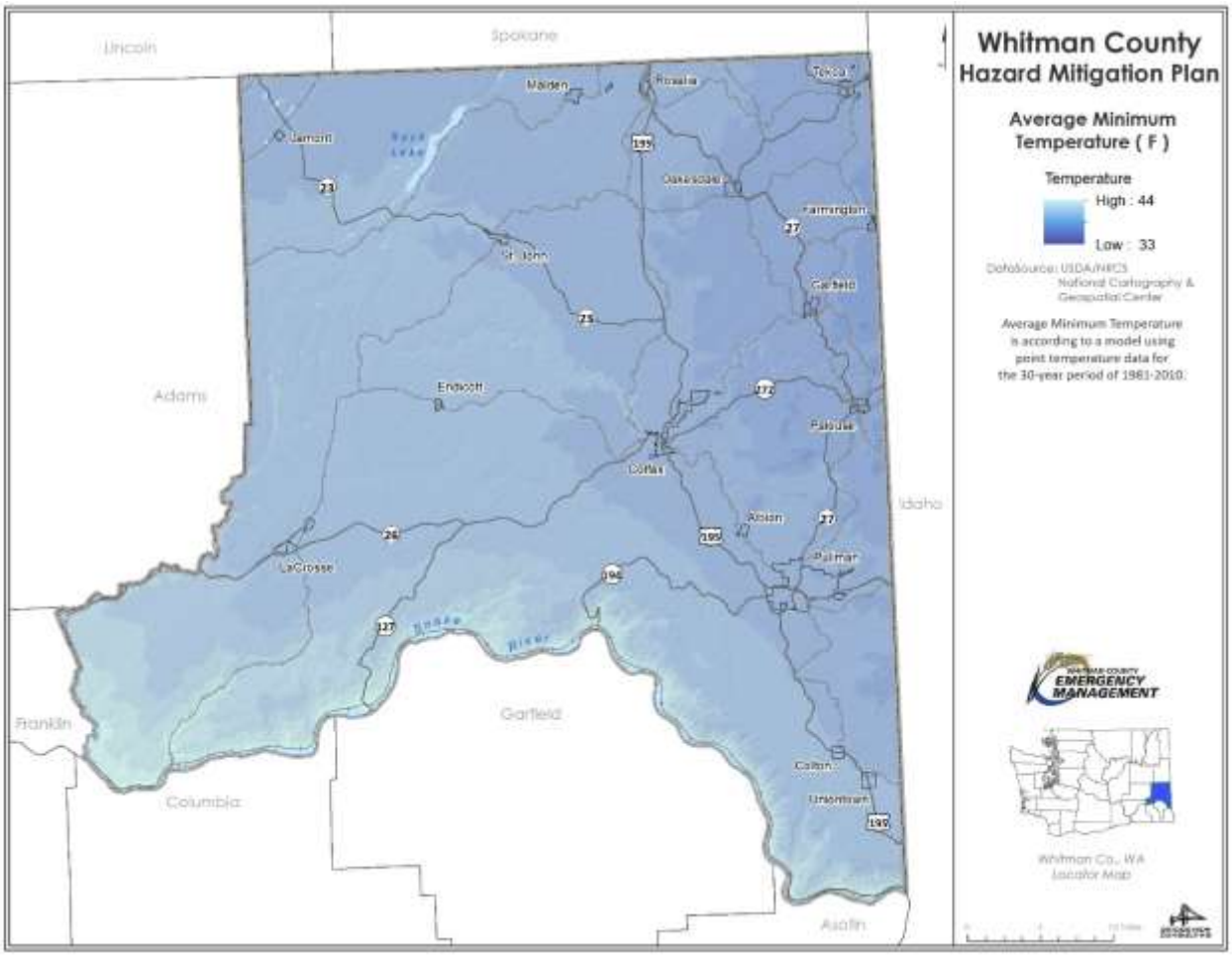


Figure 10-5. Whitman County Average Minimum Temperature Distribution

10.2.3 Frequency

The severe weather events for Whitman County are often related to high winds associated with winter storms and thunderstorms. The planning area can expect to experience exposure to some type of severe weather event at least annually. Severe weather in Whitman County tends to be infrequent. The County will experience about one hail event each year, but damage is usually non-significant. Tornadoes are infrequent, with three events documented since 1950, which equates to an average of one tornado occurring approximately every 20 years.

The 2018 Washington State Hazard Mitigation Plan states that there is a high likelihood of numerous severe weather events annually. However, many of these are likely to be small weather anomalies that may not develop into a large event. The frequency, duration and intensity of extreme heat is expected to increase in Washington State as a whole, as has been demonstrated over the last number of years when we have reached record-setting temperatures. This will in turn increase other weather extremes including severe/high winds, hail, lightning, tornados and winter storms (Washington EMD, 2018).

10.2.4 Severity

The most common problems associated with severe storms are immobility and loss of utilities. Fatalities are uncommon, but can occur. Roads may become impassable due to flooding, downed trees, ice or snow,

or a landslide. Power lines may be downed due to high winds or ice accumulation, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury.

Windstorms can be a frequent problem in the planning area and have been known to cause damage to utilities. The predicted wind speed given in wind warnings issued by the National Weather Service is for a one-minute average; gusts may be 25 to 30 percent higher. Under most conditions the County's highest winds come from the south or southwest.

Tornadoes are potentially the most dangerous of local storms, but they are not common in the planning area. If a major tornado were to strike within the populated areas of the county, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed. According to the National Climactic Data Center, 123 tornados were reported in Washington State between 1950 and 2018 (see Figure 10-6), with three recorded events in Whitman County, causing damage of approximately $50,000. There have been no reports of death in the County as a result of tornadoes. Washington has had six fatalities and over 300 injuries since 1950.

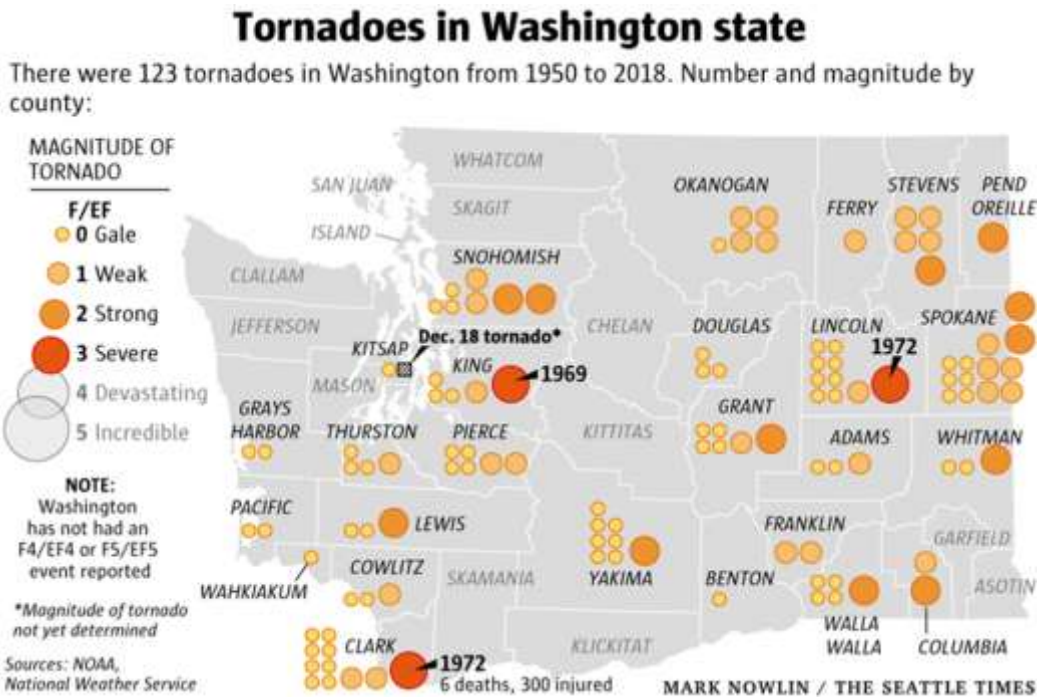


Figure 10-6. Tornado History in Washington 1950-2018
Source: NOAA National Weather Service as cited in the Seattle Times[7]

[7] https://www.seattletimes.com/seattle-news/weather/tornado-touches-down-on-kitsap-peninsula-rips-roof-off-home-weather-service-says/

Table 10-1.
Severe Weather Events Impacting Planning Area Since 2006

Date	Type	Deaths or Injuries	Property Damage
7/22/2016	Severe Storm	0	$50,000 (Crop)
Description: A Canadian cold front moved across northeast Washington during the early afternoon hours of the 12th of August. There were a few embedded thunderstorms with the front that brought severe weather to Whitman, Spokane, and Lincoln counties. In Whitman county, the severe storm caused numerous power outages along with some property damage due to fallen trees. Crop damage was estimated to be around fifty thousand dollars due to the severe thunderstorm's wind. In Spokane County, a severe thunderstorm dropped 3/4-inch diameter hail across eastern portions of the County. The severe thunderstorm also brought damaging winds that evening in Spokane. There were at least 29 fires started in Spokane county. An estimated 10,000 customers were without power along with numerous accidents due to visibilities reduced to less than a quarter of a mile in blowing dust. Numerous trees fell due to the severe wind causing property damage and a few injuries. The severe wind caused a fire to start in a mobile home Park near Silver Lake destroying five homes. Property damage throughout the county was estimated to be one hundred thousand dollars. In Lincoln county, the severe wind caused numerous power outages and some downed trees caused property damage. The wind also caused some crop damage. The width was estimated to be approximately 50 yards wide at its widest path. No injuries or fatalities were reported.			
11/12/15 DR 4249	Severe storms, winds, Flooding, Landslide	0	+$33M statewide; Whitman County ~$302,000
Description: This storm brought the highest wind recorded in much of the eastern portions of Washington. A large Pacific cyclone, the type of storm that customarily prevails from early autumn through early spring, reached wind gusts of 71 mph, slightly below the hurricane speed of 75 mph. What made the 2015 windstorm so damaging was the persistence of the lashing winds. The duration allowed damage to pile on top of damage. Below the high winds, a low-pressure system developed off the British Columbia coast and tracked inland. High winds cresting over the Cascades gained momentum as they crested the eastern slopes. Mild temperatures in the Columbia Basin allowed warm air to rise from the ground, creating a vacuum to draw the already ferocious winds swooping down from aloft. Wind gusts in the area included: Pullman/Moscow Regional Airport 69 mph; Garfield 57 mph, NW Pullman, 56 mph, SW Viola 46 mph, S. Uniontown 45 mph, and Colton, 31 MPH.			
7/16/2012	Hail	0	$7,000 (Crop)
Description: Public reported quarter to half dollar size hail. Storm total precipitation from 2100 to 0500 was 2.63 inches. Extensive crop damage due to hail. A small debris flow from the rainfall runoff covering the road and railroad track with 6 to 12 inches of debris.			
4/1/2012	Heavy rain/Snowmelt	0	$5,000
Description: Hayton Green Park in Palouse was flooded as well as the residence at 415 West Main Street near the park. Flooding was also observed up to the base of the house in the neighboring property. Damage was estimated.			
10/5/2011	Tornado	0	None reported
Description: A farmer in northern Whitman County spotted two funnel clouds the afternoon of October 5th approximately thirteen miles northwest of Saint John. One funnel cloud briefly touched down over open wheat fields.			
1/16/2011	Heavy Rain/snowmelt	0	$25,000
Description: The Palouse River at Palouse overflowed its banks inundating portions of downtown. The hardest hit were low lying areas, where water surrounded homes and covered nearly all of Hayton Green Park on the west end of town. A basement of a local resident and a former school gymnasium were flooded on Main Street. Additional flooding was reported along the Palouse River upstream in Latah County. The Palouse River at Potlach went above its flood stage of 15 feet at 16:30 PST on the 16th; crested at 16.5 feet at 5:30 PST on the 17th; and then went back below flood stage at 6:15 PST on the 18th.			

Table 10-1.
Severe Weather Events Impacting Planning Area Since 2006

Date	Type	Deaths or Injuries	Property Damage
11/16/2010	Thunderstorm Wind	0	$70,000
Description: A strong cold front brought high winds to portions of Central and Eastern Washington, with thunderstorms in the area extending south to the Palouse and Blue Mountains. Numerous power outages and downed trees were reported. The trees damaged several cars and homes. In Pullman, shingles were blown off homes. One tree in Pullman landed on a portion of a home, destroying a collectable car, boat, travel trailer, and golf cart. Estimated damage from this report was $40,000. In Albion shingles were blown off the post office roof. Lightning was abundant over the Palouse. Winds prior to the front gusted to 60 miles per hour in Pullman. Wind gusts reported during the storm include 85 miles per hour in Pullman and 63 miles per hour in Uniontown.			
6/10/2010	Lightning	0	$2,000
Description: A line of showers and thunderstorms in the Dusty area resulted in local damage. More than a foot of mud washed into a barn and yard after 1.4 inches of rain fell. In addition, lightning damaged a computer and knocked out phone and on-line services for some homes.			
8/18/2008	Thunderstorm Wind	0	None reported
Description: Strong outflow winds from a thunderstorm contributed to several downed power lines in Pullman with about 60 customers losing power. Six trees fell on roads, three trees fell on cars, and two power lines were downed.			
8/8/2008	Hail	0	None Reported
Description: Nickel to quarter sized hail lasted for 20 minutes and resulted in extensive crop damage. Three hundred acres of wheat were destroyed as well as 30 percent of the Barley crop. Several four inch diameter tree limbs snapped as well. Heavy rain of 1.46 in 30 minutes also trigger a mudslide of three feet deep.			
8/31/2007	Thunderstorm Wind	0	$10,000
Description: A strong outflow boundary from a thunderstorm resulted in damage to trees and power lines in Whitman and Asotin counties. Damage was reported in Pullman, Palouse, Albion, and Clarkston.			
5/8/2007	Thunderstorm Wind	0	$10,000
Description: A strong thunderstorm moving up from the southwest tracked across Whitman County, knocking out power to 4,000 customers in the west part of the county as well as Colfax. West county areas that lost power included Diamond, Ewan, Ralston, and Marengo. Two power posts were broken dear the Shawnee substation.			
3/21/2007	Hail	0	None reported
Description: A sudden hailstorm on Highway 195 at Hume Road intersection near Steptoe contributed to a collision after a vehicle hit a patch of slush and collided with a semi-truck. Three indirect injuries resulted from the collision.			

10.2.5 Warning Time

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

10.3 VULNERABILITY ASSESSMENT

10.3.1 Impact on Life, Health, and Safety

A lack of data separating severe weather damage from flooding and landslide damage prevented a detailed analysis for exposure and vulnerability. However, it can be assumed that the entire planning area is exposed to some extent and therefore vulnerable to severe weather events. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of

trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding.

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe weather events and could suffer more secondary effects of the hazard

10.3.2 Property

All property is vulnerable during severe weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. The frequency and degree of damage will depend on specific locations. Those in higher elevations and on ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

Based on U.S. Census data, it is estimated that ~30 percent of the residential structures were built without the influence of a structure building code with provisions for wind loads due to their age, and the adoption of building codes which address building-specific regulations.[8]

According to Hazus, there are in excess of 14,000 buildings in the census tracts that define the planning area, valued at $4,792 million dollars. Most of these buildings are residential. All of these buildings are considered to be exposed to the severe weather hazard to some degree.

10.3.3 Impact on Critical Facilities and Infrastructure

All critical facilities are exposed to severe weather. Facilities on higher ground may be exposed at a higher level to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water and sewer systems may not function. Roads may become impassable due to ice or snow or from secondary hazards such as landslides.

Incapacity and loss of roads are the primary transportation failures resulting from severe weather, mostly associated with secondary hazards. Landslides caused by heavy prolonged rains can block roads. High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Snowstorms in higher elevations can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly.

Prolonged obstruction of major routes due to landslides, snow, debris or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

[8] http://www.usa.com/whitman-county-wa-housing.htm

10.3.4 Impact on Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat. Storm surges can erode beachfront bluffs and redistribute sediment loads.

10.3.5 Impact on Economy

Prolonged obstruction of major routes due to severe weather can disrupt the shipment of goods and other commerce. Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing rain/snow on power and communication lines can cause them to break, disrupting electricity and communication, further impacting business within the region. Prolonged outages would impact consumer and tax base as a result of lost revenue, (food) spoilage, lack of production/manufacturing, exporting of agricultural products, etc. Large, prolonged storms can have negative economic impacts for an entire region.

Accommodation and food services account for 7.16 percent of the County's economy, while manufacturing accounts for 11.16, the highest NAICS Industry codes for employment in the County. Both of these occupation classes are vulnerable to impacts from severe weather events, and as such, would have a significant impact on the County's economy, particularly if an event lasted for several days, or the resulting impacts (e.g., power outage) continued for significant periods of time.

10.3.6 Impacts from Climate Change

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 10-7). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration and frequency of storm events. All of these impacts could have significant economic consequences.

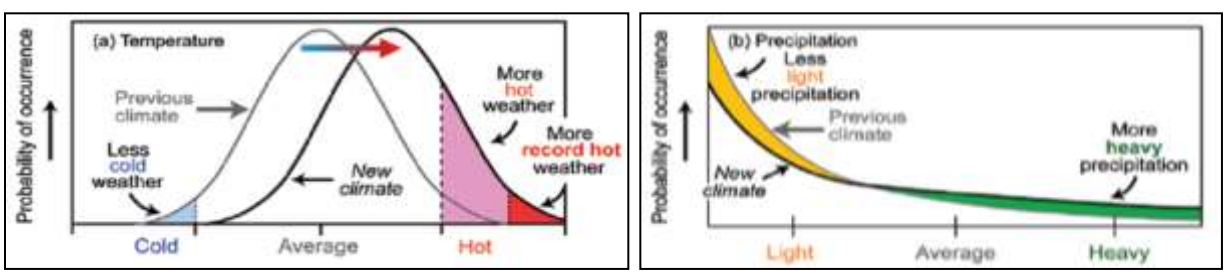


Figure 10-7. Severe Weather Probabilities in Warmer Climates

10.4 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, landslides and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

10.5 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The planning partners have adopted the International Building Code in response to Washington mandates. This code is equipped to deal with the impacts of severe weather events such as wind and snow loads. Land use policies identified in comprehensive plans within the planning area also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the planning partnership is well equipped to deal with future growth and the associated impacts of severe weather.

10.6 SCENARIO

Severe weather could occur during the winter when Chinook winds accompanied by heavy rains drop precipitation over frozen snow and cause heavy runoff and eventually flooding. This scenario could also generate freezing rain that can cause the accumulation of ice on power lines and other ice-related issues. The heavy rain may also knock down ice covered power lines. Also, during the winter, Whitman County may experience a blizzard that causes white-out conditions, blocking roads and isolating scattered rural homes and communities. During the summer, an isolated thunderstorm can produce a tornado that occurs near a population center and cause significant damage to property. Lightning strikes during the dry, hot summer can cause wildfires that may spread out of control. Wind events can knock down power and phone lines, cutting off communication and electricity.

10.7 ISSUES

Severe weather cannot be prevented, but measures can be taken to mitigate the effects. Critical infrastructure and utilities can be hardened to prevent damage during an event. The secondary effect of flooding can be addressed through decreasing runoff and water velocity. Important issues associated with a severe weather in the Whitman County planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- The county has numerous isolated population centers.
- Public education on dealing with the impacts of severe weather needs to be provided.
- Snow removal measures are required.
- Debris management (downed trees, etc.) must be addressed.

10.8 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from a severe weather event throughout the area is highly likely, as the area experiences some severe storm vent annually, but the impact is more limited with respect to geographic extent when removing resulting flood and landslide events from the severe weather category. While snow and ice do occur, impact is somewhat limited due to the County's preparedness factor. The more significant issue would be a severe storm which causes a landslide or flood event, isolating areas or blocking ingress and egress. Wind is also a significant factor, which can cause power outages, although historically such power outages have not been for a significant period of time. Based on the potential impact, the Planning Team determined the CPRI score to be 3.35, with overall vulnerability determined to be a high level.

Chapter 11.
VOLCANO

11.1 GENERAL BACKGROUND

Hazards related to volcanic eruptions are distinguished by the different ways in which volcanic materials and other debris are emitted from the volcano. The molten rock that erupts from a volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles. Ash and fragmented rock material can become airborne and travel far from the erupting volcano to affect distant areas.

Washington has five major volcanoes in the Cascade Range: Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens and Mount Adams. Mt Hood, in northern Oregon, can also affect the state. These volcanoes can lie dormant for centuries between eruptions, and the risk posed by volcanic activity is not always apparent. When they do erupt, high-speed avalanches of hot ash and rock called pyroclastic flows, lava flows, and landslides can devastate areas up to 10 miles away, while huge mudflows of volcanic ash and debris called lahars can inundate valleys more than 50 miles downstream. Falling ash from explosive eruptions, called tephra, can disrupt human activities hundreds of miles downwind, and drifting clouds of fine ash can cause severe damage to the engines of jet aircraft hundreds or thousands of miles away.

DEFINITIONS

Lahar—A rapidly flowing mixture of water and rock debris that originates from a volcano. While lahars are most commonly associated with eruptions, heavy rains, and debris accumulation, earthquakes may also trigger them.

Lava Flow—The least hazardous threat posed by volcanoes. Cascades volcanoes are normally associated with slow moving andesite or dacite lava.

Stratovolcano—Typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs, rising as much as 8,000 feet above their bases. The volcanoes in the Cascade Range are all stratovolcanoes.

Tephra—Ash and fragmented rock material ejected by a volcanic explosion

Volcano—A vent in the planetary crust from which magma (molten or hot rock) and gas from the earth's core erupts.

11.2 HAZARD PROFILE

11.2.1 Previous Occurrences

Figure 11-1 and Table 11-1 summarize past eruptions in the Cascades. In the 1980 Mount St. Helens eruption, 23 square miles of volcanic material buried the North Fork of the Toutle River and there were 57 human fatalities. Due to its great distance, and location across the crest of the Cascades, the lava and lahar flow from this eruption did not (and could not) affect Whitman County. The County though is almost directly downwind from the volcano, and thus saw about 3/4-inch of tephra (ash) fall. This tephra fall was more of a curiosity than a hazard. Schools and businesses were closed for day or so, but no major disruptions or harm were done to the County, especially after it was cleaned up within a few days.

11.2.2 Extent and Location

The Cascade Range extends more than 1,000 miles from southern British Columbia into northern California and includes 13 potentially active volcanic peaks in the U.S. Most of these volcanoes have the potential to produce a significant eruption, as well as probabilities of ***tephra*** accumulation from Cascade volcanoes in the Pacific Northwest.

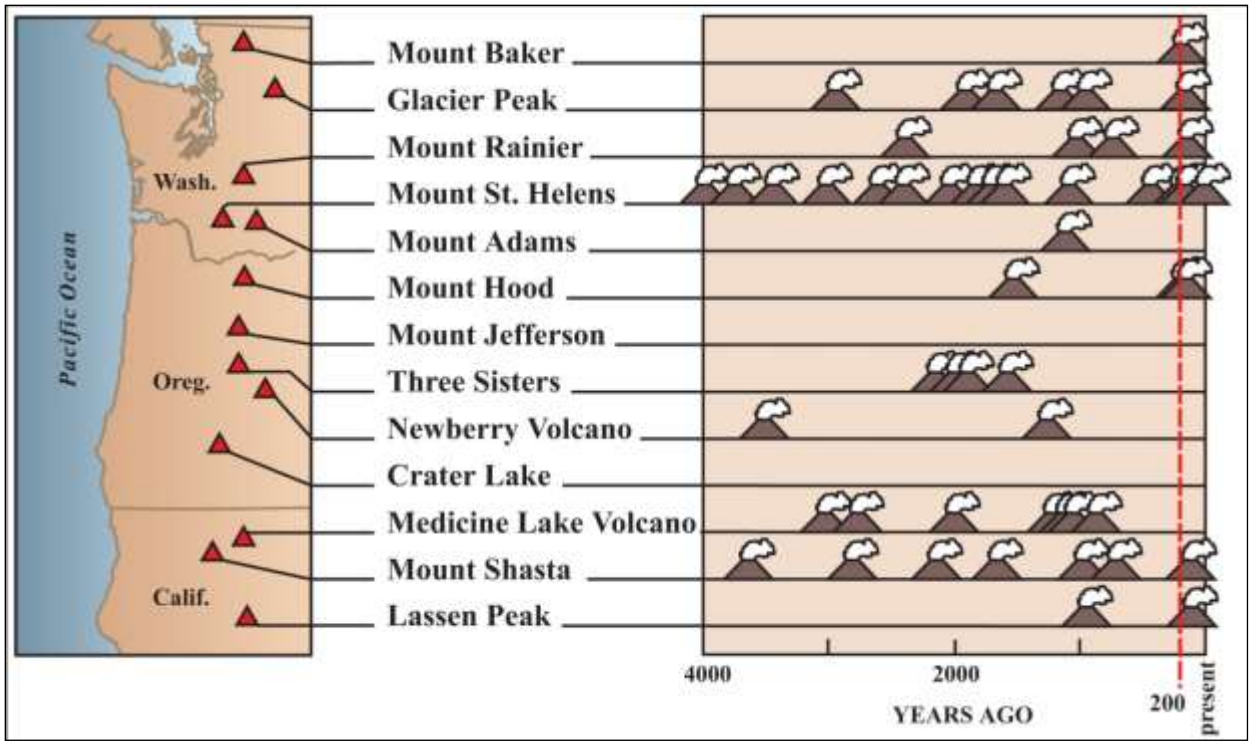


Figure 11-1. Past Eruptions in the Cascade Range

Table 11-1.
Past Eruptions in Washington

Volcano	Number of Eruptions	Type of Eruptions
Mount Adams	3 in the last 10,000 years, most recent between 1,000 and 2,000 years ago	Andesite lava
Mount Baker	5 eruptions in past 10,000 years; mudflows have been more common (8 in same time period)	Pyroclastic flows, mudflows, ash fall in 1843.
Glacier Peak	8 eruptions in last 13,000 years	Pyroclastic flows and lahars
Mount Rainier	14 eruptions in last 9000 years; also 4 large mudflows	Pyroclastic flows and lahars
Mount St Helens	19 eruptions in last 13,000 years	Pyroclastic flows, mudflows, lava, and ash fall

11.2.3 Frequency

Many Cascade volcanoes have erupted in the recent past and will be active again in the foreseeable future. Given an average rate of one or two eruptions per century during the past 12,000 years, these disasters are not part of our everyday experience; however, in the past hundred years, California's Lassen Peak and Washington's Mount St. Helens have erupted with terrifying results. The U.S. Geological Survey classifies Glacier Peak, Mt. Adams, Mt. Baker, Mt. Hood, Mt. St. Helens, and Mt. Rainier as potentially active volcanoes in Washington State. Mt. St. Helens is by far the most active volcano in the Cascades, with four major explosive eruptions in the last 515 years.

11.2.4 Severity

The explosive disintegration of Mount St. Helens' north flank in 1980 vividly demonstrated the power that Cascade volcanoes can unleash. A 1-inch deep layer of ash weighs an average of 10 pounds per square foot, causing danger of structural collapse. Ash is harsh, acidic and gritty, and it has a sulfuric odor. Ash may also carry a high static charge for up to two days after being ejected from a volcano. When an ash cloud combines with rain, sulfur dioxide in the cloud combines with the rainwater to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose and throat.

Based on USGS analysis, Whitman County has a 0.1 to 0.02 percent probability of ash or tephra collection in any given year (see Figure 11-2). Figure 11-3 shows areas of the U.S. that have been covered by volcanic ash.

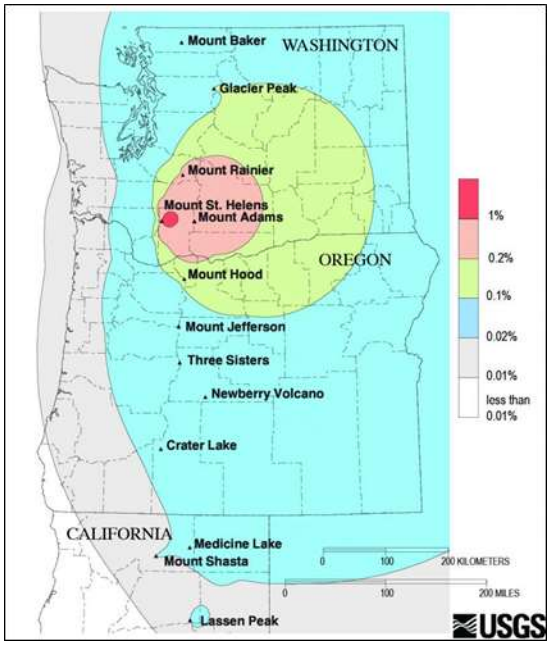


Figure 11-2. Probability of Tephra Accumulation in Pacific Northwest

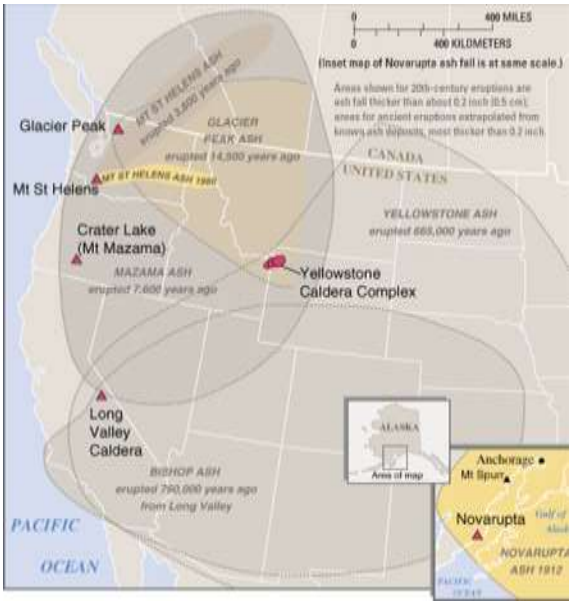


Figure 11-3. Defined Tephra Layers Associated with Historical Eruptions
Source: USGS. http://volcanoes.usgs.gov/vsc/multimedia/cvo_hazards_maps_gallery.html

11.2.5 Warning Time

Constant monitoring of all active volcanoes means that there will be more than adequate time for evacuation before an event. Since 1980, Mount St. Helens has settled into a pattern of intermittent, moderate and generally non-explosive activity, and the severity of tephra, explosions, and lava flows have diminished. All episodes, except for one very small event in 1984, have been successfully predicted several days to three weeks in advance. However, scientists remain uncertain as to whether the volcano's current cycle of explosive activity ended with the 1980 explosion. The possibility of further large-scale events continues for the foreseeable future.

11.3 VULNERABILITY

11.3.1 Overview

Whitman County is only moderately exposed to an eruption of a volcano. The County is generally downwind of four volcanoes, and could experience the impacts of a tephra fall from any of these. Using the latest eruption of Mount St. Helens as an indicator, a tephra fall in Whitman County would be anywhere from a half-inch to an inch. Nonetheless, some people, property and elements of the environment are vulnerable to the effects of a tephra fall, as discussed below.

11.3.2 Impact on Life, Health, and Safety

The whole population of Whitman County is exposed to the effects of a tephra fall. The populations most vulnerable to the effects of the tephra hazard are the elderly, the very young and those already experiencing ear, nose and throat problems. Homeless people, who may lack adequate shelter, are also vulnerable to the effects of a tephra fall, although Whitman County has few, if any, homeless people who would not be able to find adequate shelter or assistance during an event.

11.3.3 Impact on Property

All of the County would be exposed to tephra accumulation in the event of a volcanic eruption. Property vulnerable to the effects of a tephra fall includes equipment and machinery left out in the open, such as

combines, whose parts can be clogged by the fine dust. Since Whitman County receives snow every year, and roofs are built to withstand snow loads, most roofs are not vulnerable and would be able to withstand the potential load of ash. Infrastructure such as drainage systems are also potentially vulnerable to the effects of a tephra fall, since the fine ash can clog pipes and culverts. This may be more of a problem if an eruption occurs during winter or early spring when precipitation is highest and floods are most likely.

11.3.4 Impact on Critical Facilities

All critical facilities would be exposed to tephra accumulation in the event of a volcanic eruption. Transportation routes in the direction of wind would be vulnerable to tephra accumulations. Water treatment plants and wastewater treatment plants are vulnerable to contamination from ash fall.

11.3.5 Impact on Environment

The environment is highly exposed to the effects of a volcanic eruption. Even if the related ash fall from a volcanic eruption were to fall elsewhere, it could still be spread throughout the County by the surrounding rivers and streams. A volcanic blast would expose the local environment to many effects such as lower air quality, and many other elements that could harm local vegetation and water quality.

The treeless, rolling landscape of Whitman County leaves the environment, particularly animals, exposed to a tephra fall from a volcanic eruption. Whitman County does not serve as a major habitat for any protected species. Tephra runoff can also potentially damage stream habitats, although this was not observed in Whitman County after the Mount St. Helens eruption in 1980. The sulfuric acid contained in volcanic ash could be very damaging to area vegetation, waters, wildlife and air quality.

11.3.6 Impact on the Economy

In addition to the economic losses associated with the critical facilities and infrastructure on which the County and its planning partners rely, economic impact could result from other sources, including the potential agricultural losses, loss of tourism due to suspended travel and visitors to the area, structural losses, including businesses and governmental offices/buildings. Lost tax revenue from businesses disrupted by structural damage, fewer patrons, or loss of crops would impact the area's economy both in regional spending, and business and operating taxes.

11.3.7 Impact from Climate Change

Large-scale volcanic eruptions can reduce the amount of solar radiation reaching the Earth's surface, lowering temperatures in the lower atmosphere and changing atmospheric circulation patterns. The massive outpouring of gases and ash can influence climate patterns for years. Sulfuric gases convert to sub-micron droplets containing about 75 percent sulfuric acid. These particles can linger three to four years in the stratosphere. Volcanic clouds absorb terrestrial radiation and scatter a significant amount of incoming solar radiation, an effect that can last from two to three years following a volcanic eruption.

11.4 SECONDARY HAZARDS

Secondary hazards associated with volcanic eruptions are mud flows and landslides as well as traffic disruptions. The mudflow and landslide hazards are not typical for Whitman County, but there could be traffic disruption caused by tephra accumulation.

11.5 FUTURE TRENDS IN DEVELOPMENT

All future development has the potential of being impacted by ash fall generated from a volcanic event.

11.6 SCENARIO

The worst-case scenario for Whitman County would be a massive eruption from Mount Hood that sent a tephra cloud downwind to Whitman County (although Mount Hood is southwest of Whitman County, the prevailing southwest winds would blow ash directly over the County). No one would be injured or killed from the subsequent ash fall, but businesses and non-essential government would be closed for the period of time until the cloud passes. This could be a few days. People and animals without shelter would also be affected. Structures would be safe, but private property left out in the open, such as farm equipment, might be damaged by the fine ash dust.

11.7 ISSUES

Presently volcanic eruptions are not a major hazard issue in Whitman County. There are proper warning time and awareness mechanisms in place. The major issues that would come about, as with other disaster events, are clean-up costs.

11.8 RESULTS

Although the probability of a volcanic eruption is low, if an eruption were to occur, the greatest threat to life, property, infrastructure, and the environment in Whitman County would be from ash. The County is not within a lahar zone, but a significant ash fall would significantly impact the health and safety of its citizens, as well as its primary economy – agriculture.

As the number one producer in the State of Washington of wheat, grain, beans, as well as the top producer for milk from cows, a significant ashfall would be significant. In addition, the county is also a top producer of livestock, which also would be impacted by a significant ashfall. Machinery used in farming (and other industries) could also be impacted due to ash accumulating in intake valves, etc.

Problems related to ashfall could last for years due to the acidic nature, impacting the environment, which ultimately would impact the economy of the county. Mitigation efforts with respect to load capacities on roofs could potentially help reduce the number of structures at risk due to the weight of ash on the roofs; however, the County is more prepared in this respect than other counties due to the fact that it does receive a fair amount of snow annually, and building codes are in place to consider the extra weight associated with snow.

Based on review and analysis of the data, the Planning Team has determined that the probability for a future event is low; however, the impact at some level could be significant based on the economic factor and ash impacting health issues for vulnerable populations. Based on the potential impact, the Planning Team determined the CPRI score to be 1.70, with overall vulnerability determined to be a medium to low level.

Chapter 12.
WILDFIRE

12.1 GENERAL BACKGROUND

A wildfire is any uncontrolled fire on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use and arson. Wildfires occur when all of the necessary elements of a fire come together in a wooded or grassy area: an ignition source is brought into contact with a combustible material such as vegetation that is subjected to sufficient heat and has an adequate supply of oxygen from the ambient air.

A wildfire front is the portion of a wildfire sustaining continuous flaming combustion, where unburned material meets active flames. As the front approaches, the fire heats both the surrounding air and woody material through convection and thermal radiation. First, wood is dried as water in it is vaporized at a temperature of 212ºF. Next, the wood releases flammable gases at 450ºF. Finally, wood can smolder at 720ºF, and ignite at 1,000ºF. Before the flames of a wildfire arrive at a particular location, heat transfer from the wildfire front can warm the air to 1,470ºF, which pre-heats and dries flammable materials, causing them to ignite faster and allowing the fire to spread faster. High temperature and long-duration surface wildfires may encourage flashover or *torching*: the drying of tree canopies and their subsequent ignition from below.

Large wildfires may affect air currents by the stack effect: air rises as it is heated, so large wildfires create powerful updrafts that draw in new, cooler air from surrounding areas in thermal columns. Great vertical differences in temperature and humidity encourage fire-created clouds, strong winds, and fire whirls with the force of tornadoes at speeds of more than 50 mph. Rapid rates of spread, prolific crowning or spotting, the presence of fire whirls, and strong convection columns signify extreme conditions.

12.1.1 Wildfire Types

Wildfires generally can be characterized by their fuels as follows:

- **Ground fires** are fed by subterranean roots, duff and other buried organic matter. This fuel type is especially susceptible to ignition due to spotting. Ground fires typically burn by smoldering, and can burn slowly for days to months.
- **Crawling** or **surface fires** are fueled by low-lying vegetation such as leaf and timber litter, debris, grass, and low-lying shrubbery.

DEFINITIONS

Brush fire—A fast-moving fire that ignites grass, shrubs, bushes, scrub oak, chaparral, marsh grass (cattails), and grain fields. This is the type of wildfire most likely to affect Whitman County.

Conflagration—A fire that grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup and explosions are usually the elements behind a wildfire conflagration.

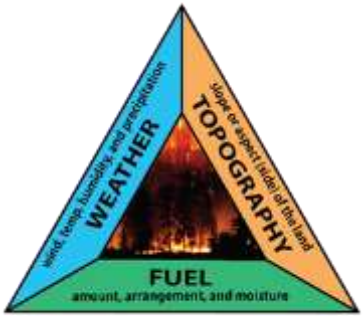
Firestorm—A fire that expands to cover a large area, often more than a square mile, when many individual fires grow together. Temperatures may exceed 1000°C. Superheated air and hot gases of combustion rise over the fire zone, drawing surface winds in from all sides, often at velocities approaching 50 miles per hour. Although firestorms seldom spread because of the inward direction of the winds, once started there is no known way of stopping them. Lethal concentrations of carbon monoxide, combined with the intense heat, poses a serious life threat to responding fire forces. In very large events, the rising column of heated air carries enough particulate matter into the upper atmosphere to cause cloud nucleation, creating a thunderstorm and the hazard of lightning strikes.

Interface Area—An area where vegetation susceptible to wildfires and urban or suburban development occur together.

Wildfire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

- **Ladder** fires consume material between low-level vegetation and tree canopies, such as small trees, downed logs and vines. Invasive plants that scale trees may encourage ladder fires.
- **Crown, canopy** or **aerial fires** burn suspended material at the canopy level, such as tall trees, vines and mosses. The ignition of a crown fire, termed *crowning*, is dependent on the density of the suspended material, canopy height, canopy continuity, and sufficient surface and ladder fires to reach the tree crowns.

12.1.2 Factors Affecting Wildfire Risk



Fire Behavior Triangle

Topography

Topography can have a powerful influence on wildfire behavior. The movement of air over the terrain tends to direct a fire's course. Gulches and canyons can funnel air and act as a chimney, intensifying fire behavior and inducing faster rates of spread. Saddles on ridge tops offer lower resistance to the passage of air and will draw fires. Solar heating of drier, south-facing slopes produces upslope thermal winds that can complicate behavior.

Slope is an important factor. If the percentage of uphill slope doubles, the rate of spread of wildfire will likely double. On steep slopes, fuels on the uphill side of the fire are closer physically to the source of heat. Radiation preheats and dries the fuel, thus intensifying fire behavior. Fire travels downslope much more slowly than it does upslope, and ridge tops often mark the end of wildfire's rapid spread.

Fuels

Fuels are classified by weight or volume (fuel loading) and by type. Fuel loading, often expressed in tons per acre, can be used to describe the amount of vegetative material available. If fuel loading doubles, the energy released also can be expected to double. Each fuel type is given a burn index, which is an estimate of the amount of potential energy that may be released, the effort required to contain a fire in a given fuel, and the expected flame length. Different fuels have different burn qualities. Some fuels burn more easily or release more energy than others. Grass, for instance, releases relatively little energy, but can sustain very high rates of spread.

Continuity of fuels is expressed in terms of horizontal and vertical dimensions. Horizontal continuity is what can be seen from an aerial photograph and represents the distribution of fuels over the landscape. Vertical continuity links fuels at the ground surface with tree crowns via ladder fuels.

Another essential factor is fuel moisture. Fuel moisture is expressed as a percentage of total saturation and varies with antecedent weather. Low fuel moistures indicate the probability of severe fires. Given the same weather conditions, moisture in fuels of different diameters changes at different rates. A 1,000-hour fuel, which has a 3- to 8-inch diameter, changes more slowly than a 1- or 10-hour fuel.

Weather

Of all the factors influencing wildfire behavior, weather is the most variable. Extreme weather leads to extreme events, and it is often a moderation of the weather that marks the end of a wildfire's growth and the beginning of successful containment. High temperatures and low humidity can produce vigorous fire activity. The cooling and higher humidity brought by sunset can dramatically quiet fire behavior.

Fronts and thunderstorms can produce winds that are capable of radical and sudden changes in speed and direction, causing similar changes in fire activity. The rate of spread of a fire varies directly with wind

velocity. Winds may play a dominant role in directing the course of a fire. The radical and devastating effect that wind can have on fire behavior is a primary safety concern for firefighters, with the most damaging firestorms usually marked by high winds.

12.1.3 Historical Fire Regime and Current Condition Classification

Land managers need to understand historical fire regimes (that is, fire frequency and fire severity prior to significant human settlement) to be able to define ecologically appropriate goals and objectives for an area. This understanding must include knowledge of how historical fire regimes vary across the landscape. Five historical fire regimes are classified based on average number of years between fires (fire frequency) and the severity of the fire (amount of replacement) on the dominant overstory vegetation:

- 0- to 35-year frequency and low (surface fires most common) to mixed severity (less than 75 percent of the dominant overstory vegetation replaced)
- 0- to 35-year frequency and high (stand replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced)
- 35- to 100-year frequency and mixed severity (less than 75 percent of the dominant overstory vegetation replaced)
- 35- to 100-year frequency and high (stand replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced)
- >200-year frequency and high (stand replacement) severity.

Understanding ecosystem departures (how ecosystem have changed over time) provides a context for managing sustainable ecosystems. Broad-scale alterations of historical fire regimes and vegetation conditions have occurred in many landscapes in the U.S. through the combined influence of land management practices, fire prevention, livestock grazing, insect and disease outbreaks, climate change, and invasion of non-native plant species. These departures result in changes to one or more of the following ecological components:

- Vegetation characteristics (species composition, structural stages, stand age, canopy closure and mosaic pattern)
- Fuel composition
- Fire frequency, severity, and pattern
- Associated disturbances (e.g. insect and disease mortality, grazing, and drought).

Characteristic vegetation and fuel conditions are those that occurred within the historical fire regime. *Uncharacteristic* conditions are those that did not occur within the historical fire regime, such as invasive species (e.g. weeds, insects, and diseases), “high graded” forest composition and structure (e.g. large trees removed in a frequent surface fire regime), or repeated annual grazing that reduces grassy fuels across relatively large areas to levels that will not carry a surface fire.

The fire regime condition class (FRCC) is a classification of a given area’s amount of departure from the historical fire regime. FRCCs categorize wildland vegetation and fuel conditions into one of the three condition classes, based on the degree of departure. The three classes indicate low (FRCC 1), moderate (FRCC 2) and high (FRCC 3) departure from the historical fire regime. Low departure is considered to be within the historical range of variability, while moderate and high departures are outside. Determination of the amount of departure is based on comparison of a composite measure of fire regime attributes to the central tendency of the historical fire regime. The amount of departure is then classified to determine the

fire regime condition class. Table 12-1 presents a simplified description of the fire regime condition classes and associated potential risks.

Table 12-1.
Fire Regime Condition Class Definitions

Description	Potential Risks
Fire Regime Condition Class 1	
Within the historical range of variability.	• Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation and fuel characteristics. • Composition and structure of vegetation and fuels are similar to the natural (historical) regime. • Risk of loss of key ecosystem components (e.g. native species, large trees and soil) is low.
Fire Regime Condition Class 2	
Moderate departure from the historical regime of variability.	• Fire behavior, effects, and other associated disturbances are moderately departed (more or less severe). • Composition and structure of vegetation and fuel are moderately altered. • Uncharacteristic conditions range from low to moderate. • Risk of loss of key ecosystem components is moderate.
Fire Regime Condition Class 3	
High departure from the historical regime of variability.	• Fire behavior, effects, and other associated disturbances are highly departed (more or less severe). • Composition and structure of vegetation and fuel are highly altered. • Uncharacteristic conditions range from moderate to high. • Risk of loss of key ecosystem components is high.

12.2 HAZARD PROFILE

According to the Washington State Department of Natural Resources (Washington State Department of Natural Resources, 2019), Whitman County, like much of the eastern half of the state, has been identified as having a level of Very High / Extreme wildfire danger.

The Planning Team, in reviewing the data, does not feel the risk in the County is as high as other areas of the state because 76 percent of the land is cultivated for crops and another 5 percent is urbanized. The County has few trees, and most large concentrations are along the eastern border near Idaho where the County receives more precipitation. The County is somewhat more vulnerable to brush fires. However, of consideration is the higher-than-average use of fertilizers and other chemicals in the production and protection of crops. The Planning Team did take this issue into consideration in completing this hazard analysis, as well as identifying such facilities as a critical (high hazard) facility, utilizing the 2018 Tier II reporting data from Washington State Department of Ecology.

12.2.1 Previous Occurrences

Whitman County does not have a history of wildfires. Every few years minor brush fires break out in some of the canyons along the Snake River or in areas adjacent to railroad tracks or roads. These are most often

caused by humans. The County was affected by the Eastern Washington Firestorm of 1991, which caused significant damage and injuries in the Spokane area. Six counties, including Whitman County, were declared federal disaster areas (Federal Disaster #922) and received $12.3 million in Stafford Act assistance. It is not known how much damage the County received, if any, as the 35,000 acres burned during the firestorm were confined primarily to the Spokane area. The 1991 fire was caused by high winds that downed power lines, igniting small fires, which in turn were spread and expanded by the high winds.

Limited fire statistics for Whitman County exist. Past-event statistics were captured from multiple sources, including Washington State Department of Natural Resources' Southeast Region and the USDA Forest Service MODIS (Moderate Resolution Imaging Spectroradiometer) data. Table 12-2 shows the number of fires in this region by type and acres burned for 2003 through 2018. Figure 12-1 illustrates the remote sensing fire detection map for Whitman County for the period 2012-2019 (September).

Table 12-2.
Fires in Whitman County, by Cause, 1970-2018

Cause	Acres Burned	Date	Name
Smoker	0	1970-08-09	
Debris Burn	90	1972-08-31	
Children	1	1974-09-01	
Miscellaneous	70	1981-09-09	
Debris Burn	160	1986-08-28	
Miscellaneous	2172	2008-08-18	ROCK LAKE
Miscellaneous	1	2009-05-19	WEAVER STRUCTURES
Debris Burn	0	2016-05-13	PINE SPRINGS
Arson	0	2017-10-04	ROSALIA
Undetermined	0	2018-07-04	NISQUALLY JOHN

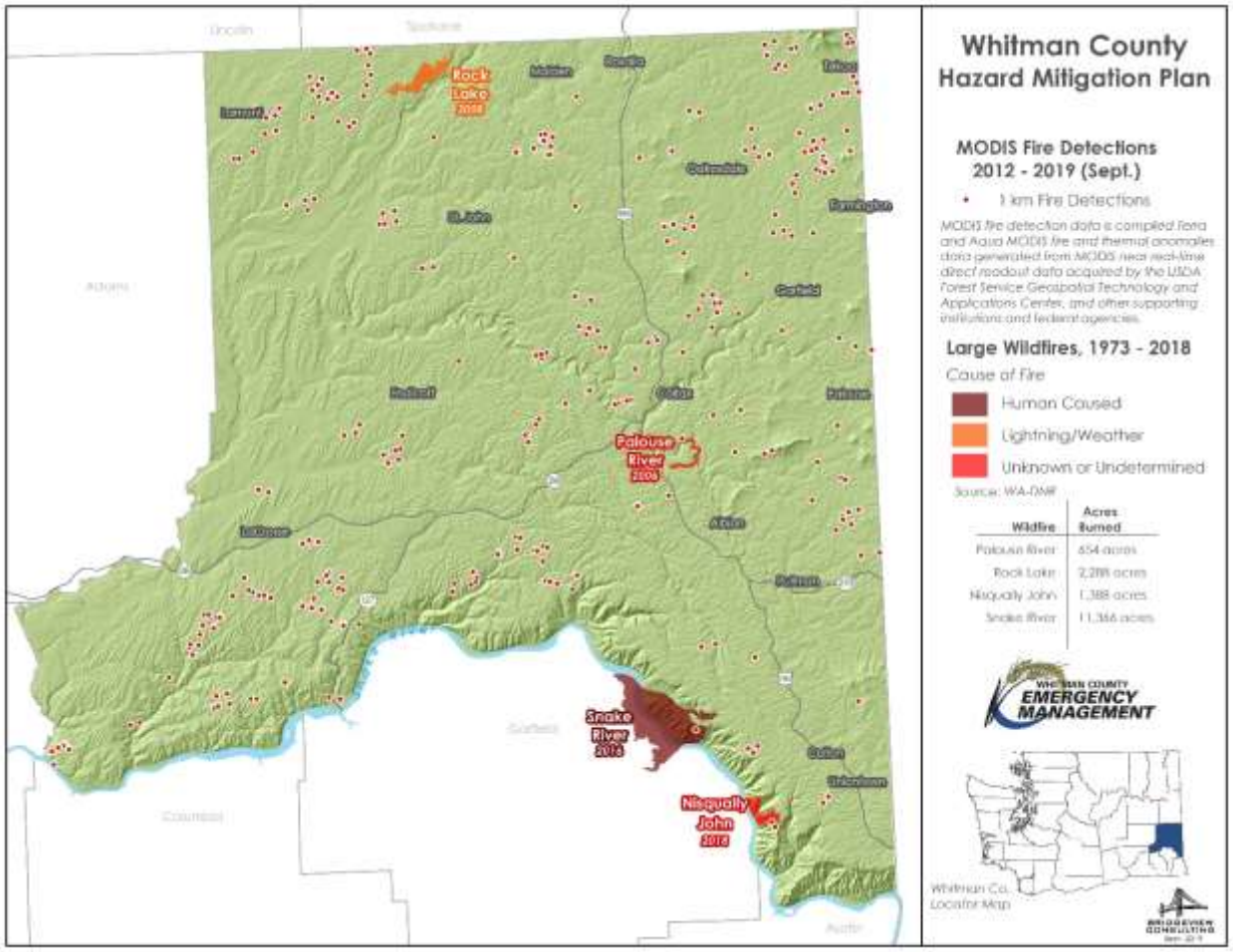


Figure 12-1. MODIS Fire Detection 2012-2019

12.2.2 Extent and Location

If a wildfire or major brush fire were to occur in Whitman County, it would most likely occur in the western part of the County where there is less precipitation and large areas of cultivated land are fallow because of participation in the Conservation Reserve Program (CRP). The CRP pays farmers to not cultivate lands that are highly erodible, thus extending the usable life of the soil. Wildfires can also occur on lands used as pasture or open range and in steep canyons near the Snake River and the scablands in the northwest part of the County. The Washington State Hazard Mitigation Plan designates the northern part of the County adjacent to the border to Spokane County as a wildfire risk area.

Three types of mapping to identify the location of the wildfire hazard are produced by the U.S. Forest Service and LANDFIRE (a shared program between the wildland fire management programs of the U.S. Forest Service and the U.S. Department of the Interior, under the direction of the Wildland Fire Leadership Council): fire regime mapping, burn probability mapping and flame length mapping.

Fire Regime Mapping

Figure 12-2 shows fire regimes in Whitman County based on LANDFIRE models. The LANDFIRE project produces maps of historical fire regimes and vegetation as well as maps of current vegetation and its departure from historical conditions. These maps support fire and landscape management planning outlined

in the goals of the National Fire Plan, Federal Wildland Fire Management Policy, and the Healthy Forests Restoration Act. As previously indicated, the maps categorize mean fire return intervals and fire severities into five fire regimes as follows (Hann et al. 2004):

- Fire Regime I: 0 to 35-year frequency, low to mixed severity
- Fire Regime II: 0 to 35-year frequency, replacement severity
- Fire Regime III: 35 to 200-year frequency, low to mixed severity
- Fire Regime IV: 35 to 200-year frequency, replacement severity
- Fire Regime V: 200+ year frequency, any severity

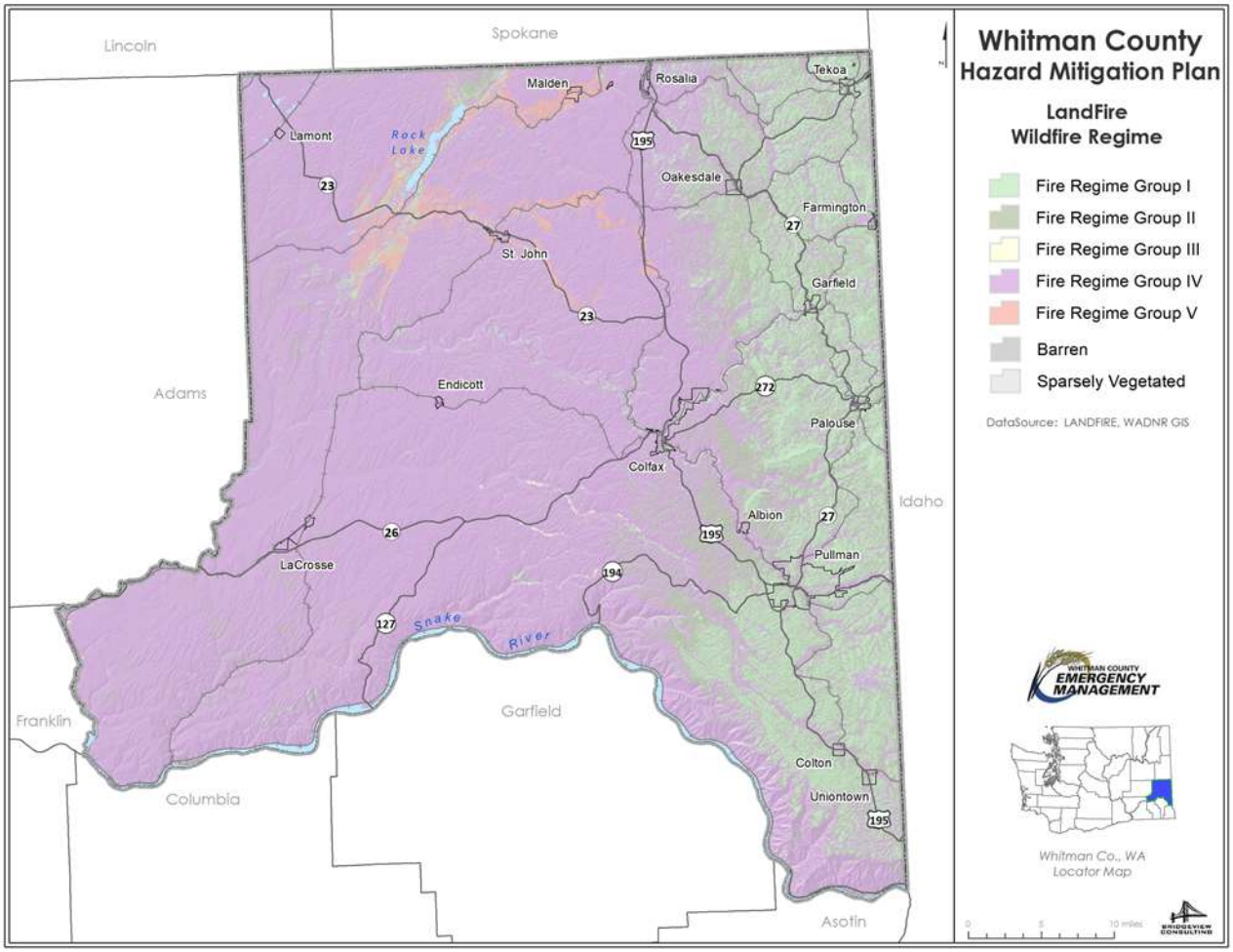


Figure 12-2. Whitman County Wildfire Regime Groups

Figure 12-3 identifies the Vegetation Condition Class (VCC). VCC represents a simple categorization of the associated Vegetation Departure layer and indicates the general level to which current vegetation is different from the simulated historical vegetation. The classes of variation range are low, medium and high. The variation of vegetation class directly influences fire through type of fuel, and the frequency at which such vegetation burns.

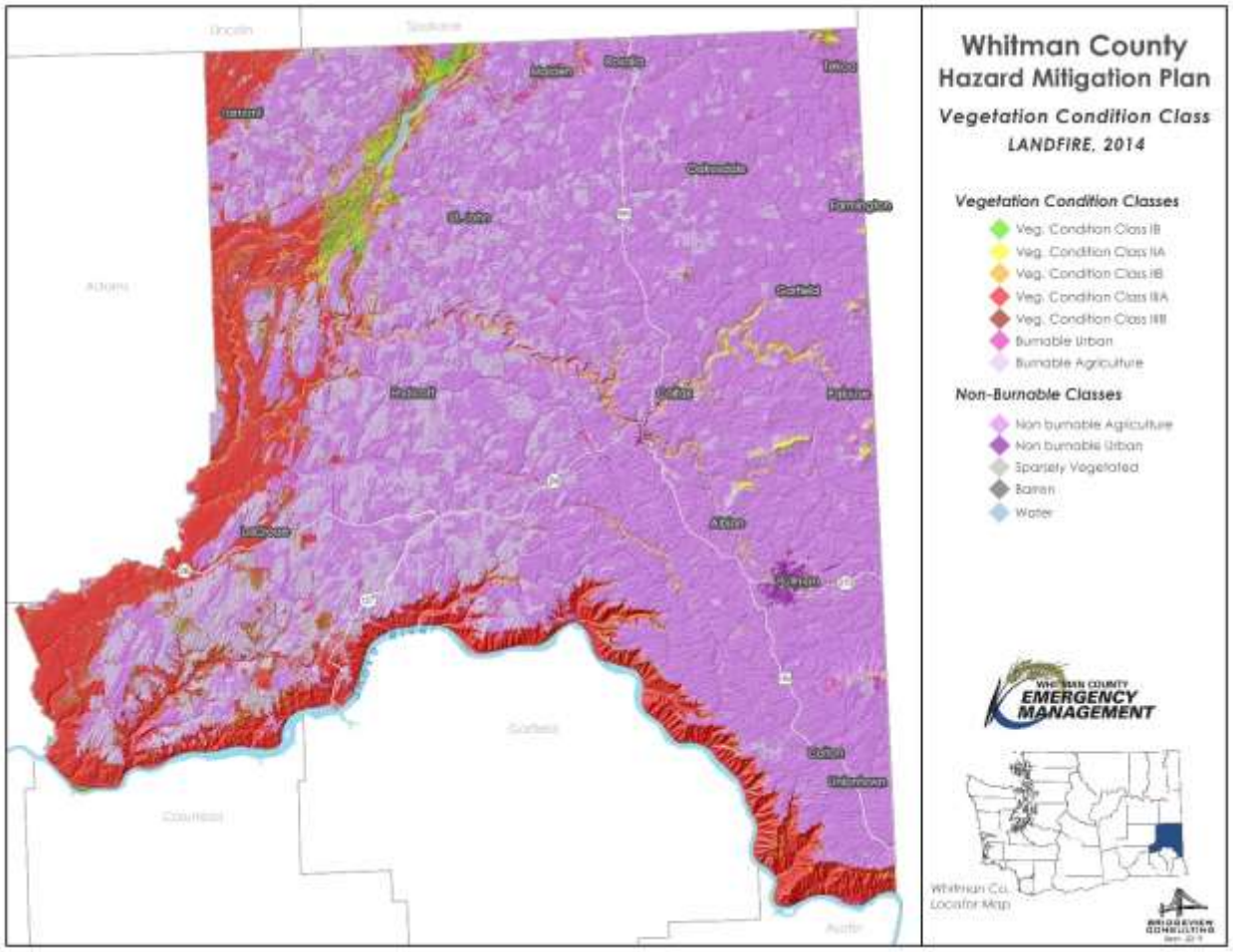


Figure 12-3. Vegetation Condition Class

12.2.3 Frequency

Small, minor brush fires, particularly in the remote canyons along the Snake River, can be expected at least every year, especially during the dry hot summer months. Many of these are caused by human carelessness, such as from fireworks or cigarettes tossed from vehicles. Passing trains are known to cause sparks that can trigger wildfires. There is no record of any major fires, so their frequency in Whitman County is not known.

The Mean Fire Return Interval (MFRI) layer quantifies the average period between fires under the presumed historical fire regime. MFRI is intended to describe one component of historical fire regime characteristics. The Mean Fire Return Interval for Whitman County is identified in Figure 12-4.

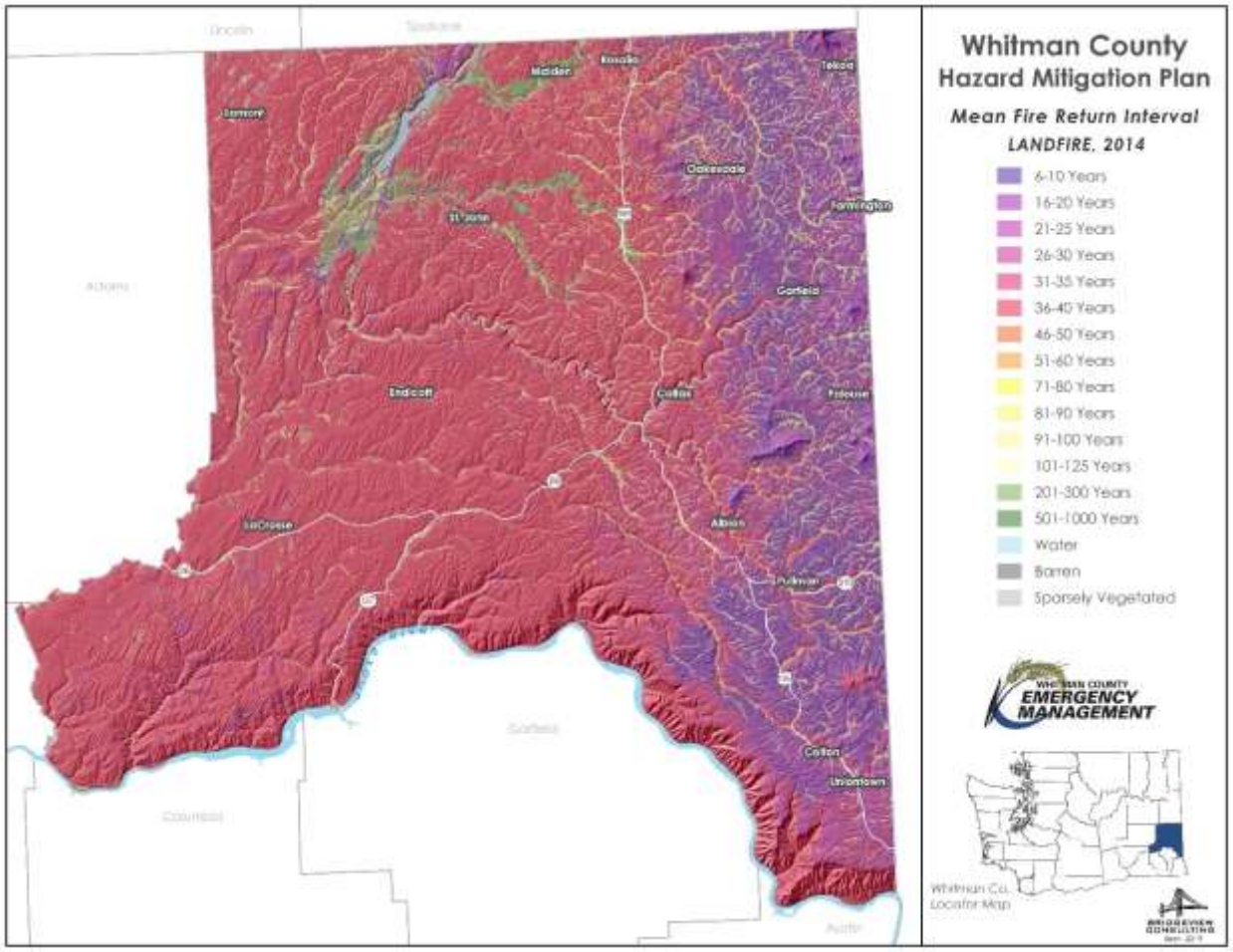


Figure 12-4. Mean Fire Return Interval

12.2.4 Severity

Wildfires in Whitman County tend to be small and usually confined to remote areas. There is no record of property or infrastructure being damaged by wildfires in the County. More than 99 percent of the fires recorded during a 10-year period covered 1 acre or less. Rarely, due to steep terrain, inaccessibility, late notification or a combination of the above, a fire has reached significant size (up to 3,000 acres).

Given the fast response times to fires, the likelihood of injuries and casualties is minimal. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. In addition, wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds.

12.2.5 Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can

be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm. If a fire does break out and spread rapidly, residents may need to evacuate within days or hours. Once a fire has started, fire alerting is reasonably rapid in most cases. The spread of cellular and two-way radio communications has contributed to a significant improvement in warning time.

12.3 VULNERABILITY

12.3.1 Overview

Whitman County's population, property and infrastructure have minimal exposure to potential wildfires. Scattered homes, ranches and communities in the western part of the County may be at higher risk, especially during the summer. Fallow lands under the CRP may be more vulnerable to wildfire. Most CRP land is also located in the western part of the County. The County does have a rail line which travels through the County, which also can increase wildfire risk both with respect to potential sparking as the trains travel through the area, but also with the contents being shipped.

Structures, above-ground infrastructure, critical facilities and natural environments are all vulnerable to the wildfire hazard. The County also maintains higher amounts of chemicals for agricultural purposes, increasing the potential risk associated with fire in general. Hazardous materials facilities meeting certain criteria are required to file reports annually with the Washington State Department of Ecology. Those facilities have been included in the risk analysis associated with the plan update.

12.3.2 Impact on Life, Health, and Safety

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Population could not be examined directly by wildfire regimes because census blocks do not coincide with those designations, and no GIS parcel data exists. As the County enhances its Assessor's data, better analysis with respect to population impacted will be conducted.

12.3.3 Impact on Property

Property damage from wildfires can be severe and can significantly alter entire communities. Loss estimations for the wildfire hazard are not based on damage functions, because no such damage functions exist. The number and value of homes in the various fire regime zones within the planning area cannot be ascertained due to the lack of parcel specific data. However, the acres exposed, and percent of total acres are summarized in Table 12-3.

Table 12-3.
Whitman County Acres in Wildfire Regime Groups

	Acres Exposed Regime 1	% of Total	Acres Exposed Regime 2	% of Total	Acres Exposed Regime 3	% of Total	Acres Exposed Regime 4	% of Total	Acres Exposed Regime 5	% of Total
Albion	10	3.97%	76	30.14%	0	0	162	64.57%	0	0
Colfax	242	10.10%	296	12.34%	73	3.04	1,779	74.25%	0	0
Colton	89	22.49%	118	29.88%	0	0	188	47.63%	0	0
Endicott	0	0.00%	3	1.62%	0	0	180	98.38%	0	0
Farmington	56	23.56%	81	34.20%	0	0	99	41.96%	0	0
Garfield	283	49.12%	113	19.62%	0	0	180	31.27%	0	0
LaCrosse	2	0.24%	38	4.02%	0	0	894	95.74%	0	0
Lamont	3	1.70%	23	12.19%	0	0	160	86.10%	0	0
Malden	32	6.80%	3	0.70%	0	0	120	25.07%	322	67.43
Oakesdale	69	10.30%	292	43.99%	0	0	304	45.70%	0	0
Palouse	276	41.40%	255	38.28%	0	0	135	20.32%	0	0
Pullman	2,760	39.34%	2,102	29.96%	0	0	2,153	30.69%	0	0
Rosalia	15	3.93%	45	11.69%	0	0	323	83.99%	1	0.39
St. John	12	2.82%	25	5.85%	0	0	367	87.31%	17	4.02
Tekoa	317	39.65%	269	33.67%	0	0	214	26.69%	0	0
Uniontown	95	16.05%	258	43.77%	0	0	235	39.72%	0	0
Unincorporated	191,543	13.91%	161,058	11.69%	3,675	0.27	981,788	71.29%	23,932	1.74
TOTAL	**195,803**	**14.05%**	**165,054**	**11.85%**	**3,718**	**0.27**	**989,281**	**71.00%**	**24,272**	**1.76**

12.3.4 Impact on Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk from wildfire because most poles are made of wood and susceptible to burning. In the event of a wildfire, pipelines could provide a source of fuel and lead to a catastrophic explosion. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct

impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods. Table 12-4 identifies critical facilities exposed to the wildfire hazard in the county based on their location in the various Fire Regime groups.

As an agricultural community, the County also maintains a higher-than average supply of fertilizers and other materials for crops and agricultural needs. During a wildfire event, hazardous materials may be released due to rupture related to excessive heat. Such material would act as fuel for the fire, causing rapid spreading and escalating the fire to unmanageable levels.

Table 12-4.
Critical Facilities Exposed to Wildfire Regimes

	Regime I	Regime II	Regime III	Regime IV	Regime V
Medical and Health Services	2	3	0	2	0
Government Function	1	1	0	2	0
Protective Function	4	8	0	16	1
Schools	7	9	0	11	0
Other Critical Function	2	0	0	8	0
Bridges	33	41	3	307	10
Water	9	11	0	11	0
Wastewater	1	2	0	9	0
Hazmat	10	18	0	27	1
Communications	4	2	0	7	0
Total	**73**	**95**	**3**	**400**	**12**

12.3.5 Impact on Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- Damaged Fisheries—Critical fisheries can suffer from increased water temperatures, sedimentation and changes in water quality.
- Soil Erosion—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- Spread of Invasive Plant Species—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- Disease and Insect Infestations—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.

- Destroyed Endangered Species Habitat—Catastrophic fires can have devastating consequences for endangered species.
- Soil Sterilization—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

12.3.6 Impact on Economy

The Whitman County economy is largely dependent on the agricultural industry. A large-scale wildfire could potentially destroy croplands, and structures used to store items prior to shipping. Loss of lands or the agricultural products would impact the tax base of the county.

Secondary impacts include erosion on burned slopes leading to runoff and contributing to flooding and landslides. Wildfires could destroy homes, hotels, restaurants, and other tourist facilities while wildfires in farmlands could destroy crops, farms, and structures.

12.3.7 Impacts from Climate Change

Fire in western ecosystems is determined by climate variability, local topography and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region. El Niño years bring drier conditions to the Pacific Northwest and more fires.

Climate scenarios project summer temperature increases between 2ºC and 5°C and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

12.4 FUTURE TRENDS IN DEVELOPMENT

The highly urbanized portions of the planning area have little or no wildfire risk exposure. Urbanization tends to alter the natural fire regime, and can create the potential for the expansion of urbanized areas into

wildland areas. The expansion of the wildland urban interface can be managed with strong land use and building codes. The planning area is well equipped with these tools, and this planning process has asked each planning partner to assess its capabilities with regards to the tools. As Whitman County experiences future growth, it is anticipated that the exposure to this hazard will remain as assessed or even decrease over time due to these capabilities.

12.5 SECONDARY HAZARDS

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

12.6 SCENARIO

A wildfire in Whitman County would most likely occur during an extremely hot, dry summer, perhaps during a period of prolonged drought. There could be numerous causes: people playing with fireworks, sparks from machinery, such as farm equipment or automobiles, or a lightning strike during a summer thunderstorm. Whatever the cause, a small local brush fire, fanned by heavy winds, could disperse embers, triggering more fires that could eventually merge into one or many large fires that don’t burn out on their own. These brush fires could eventually reach scattered homes and farms, or even spread to some of the small communities in the area, such as Hay, LaCrosse or Lamont. These fires could overwhelm emergency responders and resources and could lead to the evacuation of towns and possibly to some structures being destroyed.

The worst-case scenario would include an active fire season throughout the American west, spreading resources thin such as were experienced 2015-2019, particularly in California and other parts of Eastern Washington. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into rivers, permanently changing floodplains and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Floods that could be expected every 50 years may occur every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and floodplain elevations would increase.

12.7 ISSUES

The major issues for wildfire are the following:

- The perceived lack of wildfire activity in the planning area has resulted in a lack of planning for this hazard. Whitman County should consider the development of a Community Wildfire Protection Plan.
- There is a need for better hazard mapping within the planning area. Mapping assessments such as the National Fire Protection Administration 299 risk assessment program would be a significant enhancement to the wildfire risk assessment for the County.
- There is a significant need for digital information on general building stock at the parcel level.
- Public education and outreach to people living in or near fire hazard zones should include information about and assistance with mitigation activities such as defensible space and advance identification of evacuation routes and safe zones.
- Wildfires could cause landslides as a secondary natural hazard.
- Climate change could affect the wildfire hazard.
- Future growth into interface areas should continue to be managed.
- Area fire districts need to continue to train on wildland-urban interface events.
- Vegetation management activities should include enhancement through expansion of the target areas as well as additional resources.
- Regionally consistent higher building code standards are needed, such as residential sprinkler requirements and prohibitive combustible roof standards.
- Fire department water supply must be maintained in high-risk wildfire areas.
- Certifications and qualifications for fire department personnel should be expanded. All firefighters should be trained in basic wildfire behavior and basic fire weather, and all company officers and chief level officers should be trained to the wildland command and strike team leader level.

12.8 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Wildfire throughout the area is of medium likelihood. Thankfully, the area does not experience a significant number of wildfires annually. While for the most part the acreage burned has been more limited in nature, wildfires can spread quickly. With the continued potential for increased number of fires throughout not only the planning area, but the state as a whole, resources may become more limited in nature if an active wild season were to again occur, such as those within the last few years. That, when coupled with the existing drought situations occurring statewide, and the continued impact from climate change, it is anticipated that the wildfire risk will increase with time. Most of the firefighting capabilities within the County are volunteer in nature, which would hamper response capabilities.

Major rail lines travel through the area, delivering and picking up agricultural, chemical, fuel, etc., products on a daily basis. The trains pull a significant number of cars. As the trains travel along the tracks, they regularly stop traffic along the major arterials, sometimes for extended periods of time, potentially impacting response capabilities. Likewise, the grain elevators or train cars themselves, which carry are also of concern for combustion and potential toxic smoke plumes. Over the life cycle of this plan, there are four new housing areas (condominium/apartments) which have been identified for construction (one already underway). There are also three new commercial projects approved and underway.

Washington DNR does not identify WUI areas within the County, but the County does feel that identification of those areas should occur, and will be looking at potential grant opportunities to develop a Community Wildfire Protection Plan, within which it will identify its WUI areas. The County has little data to support wildfire analysis. LiDAR data would assist in identifying potential canopy/vegetation types.

Based on the potential impact, the Planning Team determined the CPRI score to be 2.70, with overall vulnerability determined to be a medium level.

Chapter 13.
PLANNING AREA RISK RANKING

13.1 CALCULATED PRIORITY RISK INDEX

In ranking the hazards, the Planning Team utilized the Calculated Priority Risk Index (CPRI) to complete the Risk Ranking Workbook for each hazard identified, enabling the scoring of the hazards based on impact criteria (see Chapter 5 for samples).

The CPRI examines five criteria for each hazard as discussed in detail in Chapter 5 (probability, magnitude/severity, extent/location, warning time, and duration), defines a risk value for each according to four levels (e.g., 1-4), and then applies a weighting factor based on the significance of the criteria. The result is a score that has been used to rank the hazards equitably countywide.

In order to complete this process, the Planning Team is provided the hazard profiles, a loss matrix for the various hazards which identify impact to people, property, economy and environment at the local level, and the critical facilities list which was developed by the Planning Partners, and which identifies impact to each facility for each hazard of concern.

All planning partners completed their own hazard rankings, using the same process. Table 13-1 presents the results of the Calculated Priority Risk Index scoring for all hazards impacting Whitman County. Table 13-2 is a summary of the hazard ranking results for the planning partners. Each jurisdictional annex contains the individual scores established.

Table 13-1.
County Calculated Priority Risk Index Ranking Scores

Hazard	Probability	Magnitude and/or Severity	Extent and Location	Warning Time	Duration	Calculated Priority Risk Index Score
Drought	3	3	4	1	4	2.95
Earthquake	2	2	2	4	1	2.25
Flood	3	3	2	3	2	2.55
Landslide	2	1	1	4	2	1.90
Severe Weather	4	3	3	3	2	3.35
Volcano	1	2	3	1	3	1.70
Wildfire	3	2	2	4	2	2.70

The Calculated Priority Risk Index scoring method has a range from 0 to 4. “0” being the least hazardous and “4” being the most hazardous situation.

Table 13-2.
Planning Partner Calculated Priority Risk Index Scores

Entity	Drought	Earthquake	Flood/ Dam	Landslide	Severe Weather	Volcano	Wildfire
County	2.95	2.25	2.55	1.9	3.35	1.70	2.70
Colton	2.5	2.25	3.55	1.85	3.35	1.50	2.5
Endicott	2.15	2.25	3.35	1.9	3.4	1.7	2.3
Oakesdale	1.95	2.45	3.15	1.50	3.35	1.70	1.9
Pullman	1.70	2.45	3.50	2.30	3.40	1.7	2.3
Whitman HMC	2.35	2.45	3.35	2.3	3.35	1.9	2.3

13.2 RISK RANKING

Once the CPRI calculations were determined, the Planning Team then prioritized the hazards of concern based on a numeric value. During this risk ranking process, Planning Team members were asked to consider their experience and knowledge in identifying items which are relevant, but not necessarily captured in other areas of the hazard profiles such as local capabilities, or gaps that may exist within their communities.

During the ranking process, in some cases, the hazards ranked equally even though their CPRI scores were different based on the application of subjectivity on the part of the team members. This provided an opportunity for the inclusion of information and detail that otherwise may not be included in the risk assessment. Each Planning Team Member identified those variations in their respective annex. The results of the analysis are contained in Table 13-3.

Table 13-3.
Planning Partner Countywide Hazard Ranking

Entity	Drought	Earthquake	Flood/ Dam	Landslide	Severe Weather	Volcano	Wildfire
County	4	3	2	2	1	5	1
Colton	6	4	1	5	2	7	3
Endicott*	5	4	2	6	1	7	3
Oakesdale	4	3	2	7	1	6	5
Pullman	6	3	1	5	2	7	4
Whitman HMC	4	3	2	6	1	7	5

NR = Not Ranked / NH= No Hazard /

*Included Additional Hazard: Train Derailment #5

The final step in the process provided for the application of a qualitative rating based on a priority of high, medium or low, etc. to allow for ease in application in identifying and prioritizing not only the hazards, but also when considering strategies. The Planning Team felt this summary was particularly beneficial when discussing the hazards of concern with the public, as it provided a manner in which to define the risk associated with the hazards in simple terminology.

The Planning Team established the following descriptors for application:

- Extremely Low—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- Low—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- Medium—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- High—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- Extremely High—Very widespread with catastrophic impact.

The end result of the process is illustrated in Table 13-4. This information was presented at various public outreach efforts to help identify risk countywide. Utilizing a process such as this is beneficial when discussing risk with the public and while attempting to gain their perspective of risk as it provides a means for the planning team to describe risk in a manner which is easily applied and understood, while also providing a mechanism of determining how citizens view risk to help validate the information established throughout the planning process from the view of the citizens, further validated by the surveys completed, which utilize a high/medium/low priority.

Table 13-4.
Planning Partner Countywide Risk Summary

Jurisdiction	Drought	Earthquake	Flood	Landslide	Severe Weather	Volcano	Wildfire
County	High	Medium	Medium	Medium	High	Low	Medium
Colton	Low	Medium	High	Medium	High	Low	Medium
Endicott*	Medium	Medium	High	Medium	High	Low	Medium
Oakesdale	Medium	Medium	High	Low	High	Low	Medium
Pullman	Medium	Medium	High	Medium	High	Low	Medium
Whitman HMC	Medium	Medium	High	Medium	High	Low	Medium

*Included additional hazards: Train Derailment - Medium

Chapter 14.
MITIGATION STRATEGY

The development of a mitigation strategy allows the community to create a vision for preventing future disasters. This is accomplished by establishing a common set of mitigation goals and objectives, a common method to prioritize actions, and evaluation of the success of such actions. Specific mitigation goals, objectives and projects were developed for Whitman County and its planning partners by the Planning Team in their attempt to establish an overall mitigation strategy by which the jurisdictions would enhance resiliency of the planning area.

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.6(c)(3)(i)). The Planning Team established a guiding principle, a set of goals and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The guiding principle, goals, objectives and actions in this plan all support each other. Goals were selected to support the guiding principle. Objectives were selected that met multiple goals. Actions were prioritized based on the action meeting multiple objectives.

14.1 GUIDING PRINCIPLE

A guiding principle focuses the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. A guiding principal was chosen for the initial planning effort, and after review, the Planning Team amended the guiding principle for this plan update as follows:

> Through public and private partnerships among local, state and federal partners, reduce the risk to natural hazards in order to ensure the health, safety, welfare and economic sustainability of the community.

14.2 GOALS

As was with the initial plan, the guiding principle, goals and objectives are linear. This means that all of these planning components directly support one another. Goals were selected that support the guiding principle. Objectives were selected that met multiple goals, and mitigation initiatives were prioritized based on meeting multiple objectives. This gives the plan more versatility in meeting multiple program requirements. After reviewing the initial plan goals, the Planning Team elected to make no revisions, and confirmed the goals for the 2020 plan update as follows:

1. Protect lives.
2. Protect property.
3. Enhance the public's awareness of and preparedness for the impacts of natural hazards.
4. Develop and implement natural hazard mitigation strategies that use public and private funds in a cost-effective manner.
5. Maintain, enhance, or restore the natural environment's capacity to deal with the impacts of natural hazard events.

The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved.

14.3 OBJECTIVES

Each selected objective meets multiple goals, serving as a stand-alone measurement of the effectiveness of a mitigation action, rather than as a subset of a goal. The objectives also are used to help establish priorities. As with the guiding principle and goals, the Planning Team reviewed the 2013 objectives from the previous plan and confirmed the goals for this update as follows (no revisions from the 2013 plan):

1. Consider the impacts of natural hazards on future land uses in Whitman County.
2. Educate the public on natural hazards and the risk they pose, with emphasis on preparation, mitigation, response and recovery activities.
3. Seek mitigation projects that will provide protection to property, including critical facilities, and/or mitigate impacts on the environment.
4. Enhance all facets of partnership emergency response capabilities, including mitigation of vulnerable critical facilities and infrastructure.
5. Seek mitigation projects that provide the highest degree of natural hazard protection at the least cost.
6. Create and maintain partnerships among all levels of government and the business community to coordinate mutually beneficial mitigation strategies.
7. Continually improve understanding of the location and potential impacts of natural hazards, the vulnerability of building types, community development patterns, and the measures needed to protect life safety.
8. Provide incentives to mitigate private property through programs such as the Community Rating System, Firewise and Storm Ready programs.
9. Seek appropriate land uses such as open space or agricultural uses of known high hazard areas within the planning area.
10. Strengthen codes so that new construction can withstand the impacts of identified natural hazards and lessen the impact of that development on the environment's ability to absorb the impact of natural hazards.

14.4 HAZARD MITIGATION ALTERNATIVES

After the goals and objectives were established, the Planning Team developed specific action items to further increase resilience. FEMA's 2013 catalog of *Mitigation Ideas* was presented to the Planning Team to provide ideas and concepts of possible action items. This document includes a broad range of alternatives to be considered for use in the planning area, in compliance with 44 CFR (Section 201.6.c.3.ii), and can be applied to both existing structures and new construction. The catalog provides a baseline of mitigation alternatives that are backed by a planning process, are consistent with the planning partners' goals and objectives, and are within the capabilities of the partners to implement. It presents alternatives that are categorized in two ways:

- By what the alternative would do:
  - Manipulate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
  - Increase the ability to respond to or be prepared for a hazard
- By who would have responsibility for implementation:

  - Individuals
  - Businesses
  - Government.

Hazard mitigation initiatives recommended in this plan were selected from among the alternatives presented in the catalogs, as well as projects identified by the planning partners and interested stakeholders specific to their jurisdiction. Some were carried over from the previous plan. Some may not be feasible based on the selection criteria identified for this plan, but are included nonetheless as the Planning Team felt they are viable actions to be taken to reduce hazard influence in some manner.

14.5 SELECTED MITIGATION INITIATIVES

For the 2020 update, particular attention was given to new and existing buildings and infrastructure, and developing appropriate mitigation strategies for these facilities. The Planning Team determined that some initiatives from the mitigation catalogs could be implemented to provide hazard mitigation benefits countywide. Many of these initiatives are also identified by other planning partners who support the effort. Table 14-1 identifies the recommended 2020 Whitman County initiatives.

14.6 ANALYSIS OF MITIGATION INITIATIVES

In addition to identifying potential funding sources available for each project, the Planning Team also developed strategies/action items that are categorized and assessed in several ways:

- By what the alternative would impact – new or existing structures, to include efforts which:
  - Manipulate/mitigate a hazard;
  - Reduce exposure to a hazard;
  - Reduce vulnerability to a hazard;
- By who would have responsibility for implementation:
  - Individuals;
  - Businesses;
  - Government (County, Local, State and/or Federal).
- By the timeline associated with completion of the project, based on the following parameters:
  - Short Term = to be completed in 1 to 5 years
  - Long Term = to be completed in greater than 5 years
  - Ongoing = currently being funded and implemented under existing programs.
- By who benefits from the initiative, as follows:
  - A specific structure or facility;
  - A local community;
  - County-level efforts;
  - Regional level benefits.
- By the initiative type, based on the Community Rating System scale, as follows:

- Prevention - Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. This includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- Public Information and Education - Public information campaigns or activities which inform citizens and elected officials about hazards and ways to mitigate them – a public education or awareness campaign, including efforts such as: real estate disclosure, hazard information centers, and school-age and adult education, all of which bring awareness of the hazards of concern.
- Structural Projects —Efforts taken to secure against acts of terrorism, manmade, or natural disasters. Types of projects include levees, reservoirs, channel improvements, or barricades which stop vehicles from approaching structures to protect.
- Property Protection – Actions taken that protect the properties. Types of efforts include: structural retrofit, property acquisition, elevation, relocation, insurance, storm shutters, shatter-resistant glass, sediment and erosion control, stream corridor restoration, etc. Protection can be at the individual homeowner level, or a service provided by police, fire, emergency management, or other public safety entities.
- Emergency Services / Response —Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities (e.g., sandbagging).
- Natural Resource Protection – Wetlands and floodplain protection, natural and beneficial uses of the floodplain, and best management practices. These include actions that preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- Recovery —Actions that involve the construction or re-construction of structures in such a way as to reduce the impact of a hazard, or that assist in rebuilding or re-establishing a community after a disaster incident. It also includes advance planning to address recovery efforts which will take place after a disaster. Efforts are focused on re-establishing the planning region in such a way as enhance resiliency and reduce impacts to future incidents. Recovery differs from response, which occurs during, or immediately after an incident. Recovery views long-range, sustainable efforts.

14.7 BENEFIT/COST REVIEW

The action plan must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

- **High**—Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds, grants and fee increases).

- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low**—The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Benefit ratings were defined as follows:

- **High—**Project will provide an immediate reduction of risk exposure for life and property.
- **Medium—**Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low—**Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly.

Table 14-1.
2020 Whitman County Initiatives

Applies to new or existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Sources of Funding	Timeline	Included in Previous Plan?	Initiative Type
Initiative #WC-1— (Was CW 9) Where appropriate, support retrofitting, purchase, or relocation of structures, infrastructure and critical infrastructure to protect structures and infrastructure from future damage, with repetitive loss and severe repetitive loss properties as priorities when applicable**.**								
Existing	All hazards	2, 3, 5, 6	Department of Public Works	High	Grant Funding: PDM/HMGP, FCAAP, Federal Bridge Replacement Program, DOT, US DOT	Long-term, ongoing	Modified	Structural, Natural Resource Protection, Emergency Services, Property Protection
Initiative #WC-2—Mitigate vulnerable roadways with historical erosion problems using slope-armoring, drainage improvements or roadway relocation, depending on which alternative is the most cost-beneficial.								
Existing	Flood, Dam Failure, Severe Weather	3, 5	Department of Public Works	High	County Roads Funding, Grant Funding: PDM, HMGP, FMA, FCAAP	Short-term, ongoing	Yes	Structural, Natural Resource Protection, Emergency Services, Property Protection
Initiative #WC-3—Restore the roadside drainage capacity of vulnerable facilities by removing the erosion sediment via standard drainage facility maintenance protocol.								
New and existing	Flood, Dam Failure, Severe Weather	3, 5	Department of Public Works	Medium	Gas tax, road levy, bond issue, Grant Funding: PDM, HMGP, FMA, FCAAP	Short-term, ongoing	Yes	Structural, Natural Resource Protection, Emergency Services, Property Protection

Table 14-1.
2020 Whitman County Initiatives

Applies to new or existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Sources of Funding	Timeline	Included in Previous Plan?	Initiative Type
Initiative #WC-4—Consider the adoption of regulatory provisions that require "buffers" or "setbacks" to attenuate the impacts of flooding and erosion on development within the county.								
New and Existing	Flood, Dam Failure, Severe Weather	1, 3, 9	Department of Public Works, Planning Division	Low	County General Fund	Short-term, ongoing	Yes	Property Protection, Structural Projects, Natural Resource Protection
Initiative #WC-5—Enhance the Whitman County emergency response plan to include: • Identification of critical transportation routes vulnerable to impacts of natural hazards and identification of alternative routes to be used during evacuation • Critical facility notification procedures • A post-disaster action plan • Coordination with County planning partners to establish a regional emergency response protocol.								
New and Existing	All Hazards	2, 4, 7	Department of Emergency Management	Medium	General Fund, Grant Funding: DHS/FEMA	Long-term, depends on funding	Yes	Emergency Services, Structural Projects
Initiative #WC-6—Utilize risk assessment data from this plan to identify (map) all structures susceptible to all hazards of concern within the entire County (including planning partners cities) to target public education and outreach on property protection and flood preparedness.								
New and Existing	All Hazards	2, 4, 7	Department of Emergency Management, Department of Public Works	Medium	General Fund, Grant Funding: PDM, HMGP, FMA, FCAAP	Short-term, ongoing	Yes	Emergency Services, Property Protection, Prevention, Public Information
Initiative #WC-7— Continue to maintain compliance and good standing under the National Flood Insurance Program. This will be accomplished through the implementation of floodplain management programs that, at a minimum, will meet the minimum requirements of the NFIP.								
New and Existing	Flood	1, 2, 3, 7	Department of Public Works	Low	General Fund	Ongoing	Modified	Emergency Services, Property Protection, Structural, Public Information
Initiative #WC-8—Consider voluntary participation in programs such as the Community Rating System and Firewise programs that will provide benefits/incentives to the citizens of Whitman County for hazard mitigation.								
New and existing	Flood, Wildfire	2, 6, 7, 8	Public Works	Low	General Fund	Long-term	Yes	Public Education, Emergency Services, Property Protection
Initiative #WC-9—Maintain and enhance the risk assessment of this plan with best available data and science and utilize this data to support wise land use within the planning area. Establish linkages between land use plans and the hazard mitigation plan where appropriate.								
New and Existing	All Hazards	1, 2, 3, 7	Whitman County Commissioners	Low	General Fund	Long-term	Yes	Public Information, Property Protection

Table 14-1.
2020 Whitman County Initiatives

Applies to new or existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Sources of Funding	Timeline	Included in Previous Plan?	Initiative Type
Initiative #WC-10—Obtain light detection and ranging (LIDAR) data for the planning area to support development and use of GIS applications for the County.								
New and Existing	All Hazards	2, 7	Public works, Information Technology	High	General Fund, FEMA RiskMAP, Ecology, Private Sector	Long-term, depends on funding	Yes	Emergency Services, Public Information
Initiative #WC-11 (Was CW-3) **—**Enhance County assessor data to a digital format to support future risk assessments for the planning area. Enhancements should include capturing the data in GIS format and capture parcel-based specific information including valuation, structure data (e.g., year built, number of stories, etc.), and land use information, etc.								
New and Existing	All Hazards	1, 2, 6, 7	County Assessor	High	General Fund	Long-term, depends on funding	Modified	Structural, Natural Resource Protection, Emergency Services, Property Protection
Initiative #WC-12—Where appropriate, support retrofitting, purchase or relocation of structures located in hazard-prone areas to protect them from future damage and ensure continuity of operations. Seek opportunities to leverage partnerships within the planning area in these pursuits.								
Existing	All Hazards	2, 3, 5, 6	Department of Public Works, Emergency Management	High	Grant Funding, Local funds	Long-term, depends on funding	No	Structural, Natural Resource Protection, Emergency Services, Property Protection
Initiative #WC-13—Coordinate with local fire agencies to develop more detailed and accurate fire risk maps that address the current and proposed future wildland urban interface from the jurisdictional level. Engage resources from the Washington Department of Natural Resources to assist with this process.								
New and Existing	Wildfire	2, 7	Emergency Management	Medium	General Fund, Fire Grants	Long – term, depends on funding	No	Public Information, Emergency Services, Property Protection
Initiative #WC-14 (Was CW 7)—Consider the development of a Community Wildfire Protection Plan for the County.								
New and Existing	Wildfire	1, 2, 4, 6, 7	Emergency Management	Medium	General Fund, Fire Grants	Long – term, depends on funding	Yes	Public Information, Emergency Services, Property Protection

14.8 ACTION PLAN PRIORITIZATION

For many of the strategies identified in this action plan, the partners may seek financial assistance under the HMGP or PDM programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the partners reserve the right to define "benefits" according to parameters that meet the goals and objectives of this plan.

Table 14-2 lists the priority of each identified initiative, utilizing the same parameters used by each of the planning partners in selecting their initiatives. A qualitative benefit-cost review was performed for each of these initiatives. The priorities are defined as follows:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).
- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM or other grant programs. Project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority**—A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the time line for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

Table 14-2.
2020 Mitigation Prioritization Schedule

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant-Eligible?	Can Project Be Funded Under Existing Programs/Budgets?	Priority[a]
WC-1	4	High	High	Yes	Yes	No	High
WC-2	2	High	High	Yes	Yes	Yes	High
WC-3	2	Medium	Medium	Yes	No	Yes	High
WC-4	3	Medium	Low	Yes	No	Yes	High
WC-5	3	High	Medium	Yes	Yes	No	Medium
WC-6	3	Medium	Low	Yes	No	Yes	High
WC-7	4	Medium	Low	Yes	No	Yes	High
WC-8	4	Medium	Low	Yes	No	No	Medium
WC-9	4	Medium	Low	Yes	Yes	No	Medium
WC-10	2	High	High	Yes	Yes	No	Medium
WC-11	4	High	High	Yes	Yes	No	High
WC-12	4	High	High	Yes	Yes	No	Medium
WC-13	2	High	Medium	Yes	Yes	No	Medium

Table 14-2.
2020 Mitigation Prioritization Schedule

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant-Eligible?	Can Project Be Funded Under Existing Programs/Budgets?	Priority[a]
WC 14	4	Medium	Medium	Yes	Yes	No	Medium

a. See Section 1.3.3 for explanation of priorities

14.9 2013 ACTION PLAN STATUS

A comprehensive review of the 2013 action plan was performed to determine which countywide actions were completed, which should carry over to the updated plan, and which were no longer feasible and should be removed from the plan. Table 14-3 and Table 14-4 identify the results of this review. Those identified as being carried over are listed in the 2020 Initiative Table. Each Planning Team member's respective annex update contains information concerning their previous strategies.

Table 14-3.
2020 Status of 2013 County-Specific Hazard Mitigation Action Plan Matrix

Applies to new or existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Sources of Funding	Timeline	Included in Previous Plan?	**2020 Status** Completed Removed No Longer Relevant Carried Forward
Initiative #WC-1—Retrofit critical infrastructure such as roads, bridges and large culverts that are vulnerable to the impacts of flood and earthquake hazards**.**								Some work has been done with grants. Ongoing and Carried Forward
Existing	Earthquake, Flood	3, 5	Department of Public Works	High	Gas Tax, Federal Bridge Replacement Program, Bond Issues, Grant Funding: PDM/HMGP, FCAAP	Short-term, ongoing	Yes	
Initiative #WC-2—Mitigate vulnerable roadways with historical erosion problems using slope-armoring, drainage improvements or roadway relocation, depending on which alternative is the most cost-beneficial.								Ongoing and Carried Forward
Existing	Flood, Dam Failure, Severe Weather	3, 5	Department of Public Works	High	County Roads Funding, Grant Funding: PDM, HMGP, FMA, FCAAP	Short-term, ongoing	Yes	
Initiative #WC-3—Restore the roadside drainage capacity of vulnerable facilities by removing the erosion sediment via standard drainage facility maintenance protocol.								Ongoing and Carried Forward

Table 14-3.
2020 Status of 2013 County-Specific Hazard Mitigation Action Plan Matrix

Applies to new or existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Sources of Funding	Timeline	Included in Previous Plan?	**2020 Status** Completed Removed No Longer Relevant Carried Forward
New and existing	Flood, Dam Failure, Severe Weather	3, 5	Department of Public Works	Medium	Gas tax, road levy, bond issue, Grant Funding: PDM, HMGP, FMA, FCAAP	Short-term, ongoing	Yes	
Initiative #WC-4—Consider the adoption of regulatory provisions that require "buffers" or "setbacks" to attenuate the impacts of flooding and erosion on development within the county.								Carried Forward
New and Existing	Flood, Dam Failure, Severe Weather	1, 3, 9	Department of Public Works, Planning Division	Low	County General Fund	Short-term, ongoing	Yes	
Initiative #WC-5—Utilize the risk assessment data of this plan to consider appropriate higher regulatory standards that will mitigate the impacts of natural hazards through the County's annual review of its codes and ordinances.								Completed. The County regularly reviews the hazard areas as a standard of practice when updating its codes and regulatory authority.
New and Existing	All Hazards	1, 3, 9	Department of Public Works, Planning Division, Department of Emergency Management	Low	County General fund	Short-term, ongoing	Yes	
Initiative #WC-6—Create remote emergency response capability by developing a mobile command unit that can be utilized as an emergency operations center in isolated portions of the County during hazard events.								Completed. Purchased a 28' command trailer
New and existing	All Hazards	2, 4, 7	Department of Emergency Management	High	DHS Grant Funding	Long-term, depends on funding	Yes	
Initiative #WC-7—Enhance the Whitman County emergency response plan to include: • Identification of critical transportation routes vulnerable to impacts of natural hazards and identification of alternative routes to be used during evacuation • Critical facility notification procedures • A post-disaster action plan • Coordination with County planning partners to establish a regional emergency response protocol.								Carried Forward
New and Existing	All Hazards	2, 4, 7	Department of Emergency Management	Medium	General Fund, Grant Funding: DHS/FEMA	Long-term, depends on funding	Yes	
Initiative #WC-8—Utilize risk assessment data from this plan to identify (map) all structures susceptible to all hazards of concern within the entire County (including planning partners cities) to target public education and outreach on property protection and flood preparedness.								Carried forward to 2020 Plan Update but revised and combined with other similar strategies.

Table 14-3.
2020 Status of 2013 County-Specific Hazard Mitigation Action Plan Matrix

Applies to new or existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Sources of Funding	Timeline	Included in Previous Plan?	**2020 Status** Completed Removed No Longer Relevant Carried Forward
New and Existing	All Hazards	2, 4, 7	Department of Emergency Management, Department of Public Works	Medium	General Fund, Grant Funding: PDM, HMGP, FMA, FCAAP	Short-term, ongoing	Yes	
Initiative #WC-9— Continue to maintain compliance and good standing under the National Flood Insurance Program. This will be accomplished through the implementation of floodplain management programs that, at a minimum, will meet the minimum requirements of the NFIP, which include the following: • Enforcement of the adopted flood damage prevention ordinance, • Participating in floodplain identification and mapping updates, and • Providing public assistance/information on floodplain requirements and impacts								Carried forward
New and Existing	Flood	1, 2, 3, 7	Department of Public Works	Low	General Fund	Ongoing	No	
Initiative #WC-10—Consider voluntary participation in programs such as the Community Rating System and Firewise programs that will provide benefits/incentives to the citizens of Whitman County for hazard mitigation.								Carried Forward
New and existing	Flood, Wildfire	2, 6, 7, 8	Public Works	Low	General Fund	Long-term	Yes	
Initiative #WC-11—Maintain and enhance the risk assessment of this plan with best available data and science and utilize this data to support wise land use within the planning area. Establish linkages between land use plans and the hazard mitigation plan where appropriate.								The County regularly utilizes hazard risk data when it updates its ordinances and regulatory authority.
New and Existing	All Hazards	1, 2, 3, 7	Whitman County Commissioners	Low	General Fund	Long-term	No	
Initiative #WC-12—Obtain light detection and ranging (LIDAR) data for the planning area to support development and use of GIS applications for the County.								Carried forward to 2020 Plan Update.
New and Existing	All Hazards	2, 7	Public works, Information Technology	High	General Fund, FEMA RiskMAP, Ecology, Private Sector	Long-term, depends on funding	No	
Initiative #WC-13—Enhance County assessor data to support future risk assessments for the planning area. Enhancements could include but are not limited to the following: • Obtain GIS-format data on all structures within the County. • Capture information such as date of construction, construction class, area, occupancy class, foundation type and building permit history. • Collect building photographs. • Create map interfaces intersecting hazard information with building information.								Carried forward to 2020 Plan Update.
New and Existing	All Hazards	2, 7	County Assessor	High	General Fund	Long-term, depends on funding	No	

Table 14-3.
2020 Status of 2013 County-Specific Hazard Mitigation Action Plan Matrix

Applies to new or existing assets	Hazards Mitigated	Objectives Met	Lead Agency	Estimated Cost	Sources of Funding	Timeline	Included in Previous Plan?	**2020 Status** Completed Removed No Longer Relevant Carried Forward
Initiative #WC-14—Where appropriate, support retrofitting, purchase or relocation of structures located in hazard-prone areas to protect them from future damage and ensure continuity of operations. Seek opportunities to leverage partnerships within the planning area in these pursuits.								Carried forward to 2020 Plan Update.
Existing	All Hazards	2, 3, 5, 6	Department of Public Works, Emergency Management	High	Grant Funding, Local funds	Long-term, depends on funding	No	
Initiative #WC-15—Support the countywide initiatives identified in Volume 1 of this plan.								Removed. Tables merged. No longer relevant.
New and Existing	All	All	Whitman County	Low	Local funds	Short-term, ongoing	Yes	
Initiative #WC-16—Continue to support the implementation, monitoring, maintenance, and updating of this plan, as defined in Volume 1.								Removed: This is the plan maintenance strategy for the plan.
New & Existing	All Hazards	All	Whitman County	Low	General Funds, FEMA Mitigation Grant Funding for 5-year update	Short-term, ongoing	No	
Initiative #WC-17—Coordinate with local fire agencies to develop more detailed and accurate fire risk maps that address the current and proposed future wildland urban interface from the jurisdictional level. Engage resources from the Washington Department of Natural Resources to assist with this process.								Carried forward to 2020 Plan Update.
New and Existing	Wildfire	2, 7	Emergency Management	Medium	General Fund, Fire Grants	Long – term, depends on funding	No	

Table 14-4.
2020 Status of 2013 Countywide Mitigation Initiatives

Hazards Addressed	Lead Agency	Possible Funding Sources or Resources	Time Line[a]	Objectives	**2020 Status**
CW-1— Enhance the Whitman County Emergency Response Plan so that it can be implemented uniformly in a coordinated effort throughout the planning area. This should include a post-disaster action plan that defines responsibilities and actions, leveraging all resources in the planning area.					Complete, covered in the CEMP
All Hazards	Whitman County Emergency Management	Department funding, DHS grants	Short-term	3, 4, 6	

Table 14-4.
2020 Status of 2013 Countywide Mitigation Initiatives

Hazards Addressed	Lead Agency	Possible Funding Sources or Resources	Time Line[a]	Objectives	2020 Status
CW-2— Integrate the Hazard Mitigation Plan Steering Committee with the Local Emergency Planning Committee to ensure implementation of the plan maintenance strategy.					Removed: The County for the 2020 update did not utilize a Steering Committee, but rather a planning team with all parties equal.
All Hazards	Whitman County Emergency Management	Department funding	Short-term, Ongoing	2, 3, 4, 6	
CW-3— Enhance the County Assessor data to a full digital format to better support a parcel-based risk assessment for future updates to this plan.					Carried forward into the 2020 Plan Update, but merged with other data-enhancement strategies.
All Hazards	Whitman County Assessor	General Fund	Long-term	1, 2, 6, 7	
CW-4— Continue to maintain a countywide hazard mitigation plan website to present the plan and plan updates, in order to provide the public an opportunity to monitor plan implementation and progress. Each planning partner may support the initiative by including an initiative in its action plan and creating a web link to the website.					Completed for the 2013 edition of the HMP; carried forward for the 2020 update.
All Hazards	Whitman County Emergency Management	Department funding	Short-term, Ongoing	2, 6, 7	
CW-5— Leverage public outreach partnering capabilities to inform and educate the public about hazard mitigation and preparedness.					Completed for the 2013 edition, but this strategy will be carried forward for the 2020 update to ensure information continues to be provided to citizens.
All Hazards	Whitman County Emergency Management, All Planning Partners	General Fund, Planning Partner contributions, FEMA Grant funding	Short-term-Ongoing	2, 6, 7	
CW-6—Coordinate all mitigation planning and project efforts, including grant application support, to maximize all resources available to the planning partnership.					Ongoing and Carried Forward
All Hazards	Whitman County Emergency Management	FEMA Grant Funding	Long-term	3, 5, 6, 7	
CW-7— Consider the development of a Community Wildfire Protection Plan for Whitman County					Carried Forward
Wildfire	Whitman County Emergency Management	FEMA Grant Funding, general Fund	Long term	1, 2, 4, 6, 7	
CW-8— Support the collection of improved data (hydrologic, geologic, topographic, volcanic, historical, etc.) to better assess risks and vulnerabilities.					Carried forward for 2020 plan update, but combined with other data enhancement strategies.
All Hazards	Whitman County Department of Public Works	General Fund, FEMA mitigation grants	Short term/ ongoing	1, 2, 4, 6, 7	
CW-9—Where appropriate, support retrofitting, purchase, or relocation of structures or infrastructure located in hazard-prone areas to protect structures and infrastructure from future damage, with repetitive loss and severe repetitive loss properties as priorities when applicable.					No action completed since 2013 plan was completed; however, this initiative is carried forward for the 2020 update.
All Hazards	All Planning Partners	FEMA mitigation grants	Long term	2, 3, 5, 6	

14.10 FUNDING OPPORTUNITIES

Although a number of the mitigation projects listed may not be eligible for FEMA funding, Skagit County and its planning partners may secure alternate funding sources to implement these projects in the future including federal and state grant programs, and funds made available through the county. In order to be eligible for some of those grant funds, completion of a hazard mitigation plan may be required. Table 14-5 identifies some of those grant requirements. Additional funding sources identified in Table 14-6 are also available which support various types of mitigation efforts on a countywide basis.

Alternate funding sources which may further support mitigation efforts of various types include, but are not limited to, the following:

- **U.S. Department of Housing and Urban Development, Community Development Block Grants (CDBG)—**The CDBG program is a flexible program that provides communities with resources to address a wide range of community development needs. CDBG money can be used to match FEMA grant money. More information: http://www.hud.gov/offices/cpd/communitydevelopment/programs/
- **U.S. Fish & Wildlife Service Rural Fire Assistance Grants—** The U.S. Fish & Wildlife Service (USF&W) provides Rural Fire Assistance grants to fire departments to enhance local wildfire protection, purchase equipment, and train volunteer firefighters. USF&W staff also assist with community projects. These efforts reduce the risk to human life and better permit US F&W firefighters to interact with community fire organizations when fighting wildfires. The Department of the Interior receives a budget each year for the Rural Fire Assistance grant program. The maximum award per grant is $20,000. The assistance program targets rural and volunteer fire departments that routinely help fight fire on or near Department of Interior lands. More information: http://www.fws.gov/fire/ living_with_fire/rural_fire_assistance.shtml
- **U.S. Department of Homeland Security—**Enhances the ability of states, local and tribal jurisdictions, and other regional authorities in the preparation, prevention, and response to terrorist attacks and other disasters, by distributing grant funds. Localities can use grants for planning, equipment, training and exercise needs. These grants include, but are not limited to areas of critical infrastructure protection, equipment and training for first responders, and homeland security. More information: http://www.dhs.gov/
- **FEMA, Hazard Mitigation Grant Program (HMGP)—**The HMGP provides grants to states, Indian tribes, local governments, and private non-profit organizations to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. More information: http://www.fema.gov/ government/grant/hmgp/
- **FEMA, Pre-Disaster Mitigation (PDM) Competitive Grant Program—**The PDM program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds. More information: http://www.fema.gov/government/grant/pdm/index.shtm
- **U.S. Bureau of Land Management (BLM), Community Assistance Program—**BLM provides funds to communities through assistance agreements to complete mitigation projects,

education and planning within the wildland urban interface. More information: http://www.blm.gov/nifc/st/en/prog/fire/community_assistance.html

- **U.S. Department of Agriculture Community Facilities Loans and Grants**—Provides grants (and loans) to cities, counties, states and other public entities to improve community facilities for essential services to rural residents. Projects can include fire and rescue services. Funds have been provided to purchase fire-fighting equipment for rural areas. No match is required.
- **General Services Administration Sale of Federal Surplus Personal Property**—This program sells property no longer needed by the federal government. The program provides individuals, businesses and organizations the opportunity to enter competitive bids for purchase of a wide variety of personal property and equipment. Normally, there are no restrictions on the property purchased. More information: http://www.gsa.gov/portal/category/21045
- **FEMA Readiness, Response and Recovery Directorate, Fire Management Assistance Grant Program**—Program provides grants to states, tribal governments and local governments for the mitigation, management and control of any fire burning on publicly (non-federal) or privately owned forest or grassland that threatens such destruction as would constitute a major disaster. The grants are made in the form of cost sharing with the federal share being 75 percent of total eligible costs. Grant approvals are made within 1 to 72 hours from time of request. More information is available at: http://www.fema.gov/government/grant/fmagp/index.shtm
- **Hazardous Materials Emergency Preparedness Grants**—Grant funds are passed through to local emergency management offices and Hazmat teams having functional and active local emergency planning committees. More information: http://www.phmsa.dot.gov/hazmat/grants

Table 14-5.
Grant Opportunities

Program	Enabling Legislation	Funding Authorization	Hazard Mitigation Plan Requirement	
			Grantee	Sub-Grantee
Public Assistance, Categories A-B (e.g., debris removal, emergency protective measures)	Stafford Act	Presidential Disaster Declaration	☐	☐
Public Assistance, Categories C-G (e.g., repair of damaged infrastructure, publicly owned buildings)	Stafford Act	Presidential Disaster Declaration	☑	☐
Individual Assistance (IA)	Stafford Act	Presidential Disaster Declaration	☐	☐
Fire Management Assistance Grants	Stafford Act	Fire Management Assistance Declaration	☑	☐
Hazard Mitigation Grant Program (HMGP) Planning Grant	Stafford Act	Presidential Disaster Declaration	☑	☐
HMGP Project Grant	Stafford Act	Presidential Disaster Declaration	☑	☑
Pre-Disaster Mitigation (PDM) Planning Grant	Stafford Act	Annual Appropriation	☐	☐
PDM Project Grant	Stafford Act	Annual Appropriation	☑	☑

Table 14-5.
Grant Opportunities

Program	Enabling Legislation	Funding Authorization	Hazard Mitigation Plan Requirement	
			Grantee	Sub-Grantee
Flood Mitigation Assistance (FMA)	National Flood Insurance Act	Annual Appropriation	☑	☑
Severe Repetitive Loss (SRL)	National Flood Insurance Act	Annual Appropriation	☑	☑
Repetitive Flood Claims (RFC)	National Flood Insurance Act	Annual Appropriation	☑	□
Homeland Security	Dept. of Homeland Security	Annual Appropriation	☑	□

☑ = Hazard Mitigation Plan Required

□ = No Hazard Mitigation Plan Required

Table 14-6.
Countywide Fiscal Capabilities Supporting Mitigation Efforts

Financial Resources	Accessible or Eligible to Use?
Community Development Block Grants	Yes
Capital Improvements Project Funding	No
Authority to Levy Taxes for Specific Purposes	Yes
User Fees for Water, Sewer, Gas or Electric Service	No
Incur Debt through General Obligation Bonds	Yes, but not likely to occur
Incur Debt through Special Tax Bonds	Yes
Incur Debt through Private Activity Bonds	Yes
Withhold Public Expenditures in Hazard-Prone Areas	No
State Sponsored Grant Programs	Yes
Development Impact Fees for Homebuyers or Developers	Yes

14.11 CAPABILITIES ASSESSMENT

14.11.1 Laws and Ordinances

Existing laws, ordinances and plans at the federal, state and local level can support or impact hazard mitigation initiatives identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). Pertinent federal and state laws are described below. Each

planning partner has individually reviewed existing local plans, studies, reports and technical information in its jurisdictional annex, presented in Volume 2.

14.11.2 Federal Level Capabilities

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program funds are available to communities. This Plan is designed to meet the requirements of DMA, improving the planning partners' eligibility for future hazard mitigation funds.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- **Section 4: Listing of a Species**—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- **Section 7: Consultation**—Federal agencies must ensure that any action they authorize, fund or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must

propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.

- **Section 9: Prohibition of Take—**It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- **Section 11: Citizen Lawsuits**—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

With the listing of various species as threatened or endangered, the ESA has impacted most of the Pacific Coast states. Although some of these areas have been more impacted by the ESA than others due to the known presence of listed species, the entire region has been impacted by mandates, programs and policies based on the presumption of the presence of listed species. Most West Coast jurisdictions must now take into account the impact of their programs on habitat.

The Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. The County and most of the partner cities for this plan participate in the NFIP and have adopted regulations that meet the NFIP requirements. At the time of the preparation of this plan, all participating jurisdictions in the partnership were in good standing with NFIP requirements.

14.11.3 State Level Capabilities

Washington State Enhanced Mitigation Plan

The Washington State Enhanced Hazard Mitigation Plan approved by FEMA in 2018 provides guidance for hazard mitigation throughout Washington. The plan identifies hazard mitigation goals, objectives, actions and initiatives for state government to reduce injury and damage from natural hazards. By meeting

federal requirements for an enhanced state plan (44 CFR parts 201.4 and 201.5), the plan allows the state to seek significantly higher funding from the Hazard Mitigation Grant Program following presidential declared disasters (20 percent of federal disaster expenditures vs. 15 percent with a standard plan).

Growth Management Act

In 1990, the Washington Legislature adopted the Growth Management Act (GMA; Revised Code of Washington (RCW) Chapter 36.70A). The GMA requires local jurisdictions to adopt ordinances that classify, designate and regulate land use to protect critical areas, which include wetlands; areas with a critical recharging effect on aquifers used for potable water; fish and wildlife habitat conservation areas; frequently flooded areas; and geologically hazardous areas (RCW 36.70A.030).

Because its population has remained under GMA planning thresholds, Whitman County is not required to plan under the GMA. Nonetheless the County has a comprehensive plan that emphasizes maintaining its rural agricultural environment, while allowing for growth around the incorporated areas of the County.

Shoreline Management Act

The 1971 Shoreline Management Act (RCW 90.58) was enacted to manage and protect the shorelines of the state by regulating development in the shoreline area. A major goal of the act is to prevent the "inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Its jurisdiction includes the Pacific Ocean shoreline and the shorelines of Puget Sound, the Strait of Juan de Fuca, and rivers, streams and lakes above a certain size. It also regulates wetlands associated with these shorelines.

Washington State Building Code

The Washington State Building Code Council adopted the 2006 editions of national model codes with some amendments. The Council also adopted changes to the Washington State Energy Code and Ventilation and Indoor Air Quality Code. Washington's state-developed codes are mandatory statewide for residential and commercial buildings. The residential code exceeds the 2006 International Energy Conservation Code standards for most homes, and the commercial code meets or exceeds standards of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE 90.1-2004). For residential construction covered by ASHRAE 90.1-2007 (buildings with four or more stories), the state code is more stringent. The 2015 IBC went into effect as the Washington model code on July 1, 2019.

Comprehensive Emergency Management Planning

Washington's Comprehensive Emergency Management Planning law (RCW 38.52) establishes parameters to ensure that preparations of the state will be adequate to deal with disasters, to ensure the administration of state and federal programs providing disaster relief to individuals, to ensure adequate support for search and rescue operations, to protect the public peace, health and safety, and to preserve the lives and property of the people of the state. It achieves the following:

- Provides for emergency management by the state and authorizes the creation of local organizations for emergency management in political subdivisions of the state.
- Confers emergency powers upon the governor and the executive heads of political subdivisions of the state.
- Provides for the rendering of mutual aid among political subdivisions of the state and with other states and for cooperation with the federal government with respect to the carrying out of emergency management functions.
- Provides a means of compensating emergency management workers who may suffer any injury or death, who suffer economic harm including personal property damage or loss, or who incur

expenses for transportation, telephone or other methods of communication, and the use of personal supplies as a result of participation in emergency management activities.

- Provides programs, with intergovernmental cooperation, to educate and train the public to be prepared for emergencies.

It is policy under this law that emergency management functions of the state and its political subdivisions be coordinated to the maximum extent with comparable functions of the federal government and agencies of other states and localities, and of private agencies of every type, to the end that the most effective preparation and use may be made of labor, resources and facilities for dealing with disasters.

Washington Administrative Code 118-30-060(1)

Washington Administrative Code (WAC) 118-30-060 (1) requires each political subdivision to base its comprehensive emergency management plan on a hazard analysis, and makes the following definitions related to hazards:

- Hazards are conditions with potential to threaten human life, resulting from three factors:
  - Natural conditions, such as weather and seismic activity
  - Human interference with natural processes, such as a levee that displaces the natural flow of floodwater
  - Human activity and its products, such as homes on a floodplain.
- The definitions for hazard, hazard event, hazard identification, and flood hazard note that hazards are extreme events and may be connected to human activity.
- Hazards generally pose a risk of damage, loss, or harm to people and/or their property

Washington State Floodplain Management Law

Washington's floodplain management law (RCW 86.16, implemented through WAC 173-158) states that prevention of flood damage is a matter of statewide public concern and places regulatory control with the Department of Ecology. RCW 86.16 is cited in floodplain management literature, including FEMA's national assessment, as one of the first and strongest in the nation. A major challenge to the law in 1978, Maple Leaf Investors v. Ecology, is cited in legal references to floodplain management issues. The court upheld the law, declaring that denial of a permit to build residential structures in a floodway is a valid exercise of police power and did not constitute a taking. RCW Chapter 86.12 (Flood Control by Counties) authorizes county governments to levy taxes, condemn properties and undertake flood control activities directed toward a public purpose.

Flood Control Assistance Account Program

Washington's first flood control maintenance program was passed in 1951, and was called the Flood Control Maintenance Program. In 1984, RCW 86.26 (State Participation in Flood Control Maintenance) established the Flood Control Assistance Account Program (FCAAP), which provides funding for local flood hazard management. FCAAP rules are found in WAC 173-145. Ecology distributes FCAAP matching grants to cities, counties and other special districts responsible for flood control. This is one of the few state programs in the U.S. that provides grant funding to local governments for floodplain management. The program has been funded for $4 million per biennium since its establishment, with additional amounts provided after severe flooding events.

To be eligible for FCAAP assistance, flood hazard management activities must be approved by Ecology in consultation with the Washington Department of Fish and Wildlife. A comprehensive flood hazard

management plan must have been completed and adopted by the appropriate local authority or be in the process of being prepared in order to receive FCAAP flood damage reduction project funds. This policy evolved through years of the Flood Control Maintenance Program and early years of FCAAP in response to the observation that poor management in one part of a watershed may cause flooding problems in another part.

Local jurisdictions must participate in the NFIP and be a member in good standing to qualify for an FCAAP grant. Grants up to 75 percent of total project cost are available for comprehensive flood hazard management planning. Flood damage reduction projects can receive grants up to 50 percent of total project cost, and must be consistent with the comprehensive flood hazard management plan. Emergency grants are available to respond to unusual flood conditions. FCAAP can also be used for the purchase of flood-prone properties, for limited flood mapping and for flood warning systems. Funding currently is running about 60 percent for planning and 40 percent for projects.

Washington State Farmland Preservation

Washington State, through the Department of Revenue, provides tax incentives for open space enrollment of designated as farmlands. The program is one tool for making farmland more affordable, thus keeping it out of development.

Current use classification lowers the taxable value of farm and agricultural lands and other resource lands relative to other land uses. Land that would be assessed at $10,000 an acre for its "highest and best use" might be valued at perhaps $3,000 an acre as farmland. The effect of this lower valuation is to lower the tax assessed on lands classified as "current use," thereby making the land more affordable to keep in farm production.

14.11.4 Local Capability Assessment

Regulatory, Technical, Community Organizations, Programs and Social Systems

Each planning partner has prepared a jurisdiction-specific annex to this plan (see Volume 2). In preparing these annexes, each partner completed a capability assessment that looked at its regulatory, technical and financial capability to carry out proactive hazard mitigation. Refer to these annexes for a review of regulatory codes and ordinances applicable to each planning partner. In addition to those items listed above, Table 14-7 identifies the Legal and Regulatory Capability in place within Whitman County. Table 14-8 identifies the Administrative and Technical Capabilities as they exist within Whitman County which support mitigation efforts.

Table 14-7.
Legal and Regulatory Capability

	Local Authority	State or Federal Prohibitions	Other Jurisdictional Authority	State Mandated	Comments
Codes, Ordinances & Requirements					
Building Code	Y	N	Y	Y	International Building Code (IBC), WC Title 17
Zoning	Y	N	N	N	Title 19, adopted 8/16/2010
Subdivisions	Y	N	N	N	Title 18, adopted 10/2003

Stormwater Management	N	N	N	N	
Real Estate Disclosure	Y	N	N	Y	Revised Code of Washington 64.06
Growth Management	Y	N	N	Y	Resource Lands Only
Site Plan Review	Y	N	N	Y	Part of IBC
Special Purpose (flood management, critical areas)	Y	N	N	N	Flood Damage Prevention Ordinance, Title 19, (19.50), Adopted March 2012 Critical Areas Ordinance, Title 9, Adopted 2006
Planning Documents					
General or Comprehensive Plan	Y	N	N	N	Initial adoption July 31, 1978, Amended October 4, 2010
Floodplain or Basin Plan	Y	N	N	N	Whitman County Hazard Mitigation Plan serves as the floodplain management plan for the County.
Stormwater Plan	N	N	N	N	
Capital Improvement Plan	N	N	N	N	
Emergency Response Plan	Y	N	N	N	January 2010
Shoreline Management Plan	Y	N	N	Y	Adopted 1974
Post Disaster Recovery Plan	N	N	N	N	

Table 14-8.
Administrative and Technical Capability

Staff/Personnel Resources	Available?	Department/Agency/Position
Planners or engineers with knowledge of land development and land management practices	Y	One Staff Planner, two Assistant Planners
Engineers or professionals trained in building or infrastructure construction practices	Y	Mark Storey, Whitman County Engineer
Planners or engineers with an understanding of natural hazards	Y	Mark Storey, Whitman County Engineer Mark Bordsen, Director of Planning
Staff with training in benefit/cost analysis	Y	Mark Storey, Whitman County Engineer Mark Bordsen, Director of Planning
Floodplain manager	Y	
Surveyors	N	Engineering Department has two non-licensed surveyors on staff. County contracts for services when a licensed surveyor is needed.
Personnel skilled or trained in GIS applications	Y	Mark Storey, Whitman County Engineer
Scientist familiar with natural hazards in local area	Y	Bill Tensfeld,, Whitman County Emergency Management

Emergency manager	Y	Bill Tensfeld, Whitman County Emergency Management
Maintain Elevation Certificates	N	
Grant writers	N	Can contract for this service

Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income). The County and its planning partners can use existing social systems as resources for implementing such communication-related activities because these service providers already work directly with the public on a number of issues, one of which could be natural hazard preparedness and mitigation.

The following highlights organizations and programs that are active within Whitman County, which may be potential partners for implementing mitigation actions. The various tables include information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods are defined below.

- Education and outreach – organizations could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination – organizations could partner with the community to provide hazard-related information to target audiences.
- Plan/project implementation – organizations may have plans and/or policies that may be used to implement mitigation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions. Table 14-9 identifies several of the ongoing efforts which assist in notification and social service programs, further enhancing the resilience of the County.

Table 14-9.
Education and Outreach

Program/Organization	Available ?	Department/Agency/Position and Brief Description
Local citizen groups or non-profit organizations focused on emergency preparedness?	Y	CERT and SAR trained personnel
Local citizen groups or non-profit organizations focused on environmental protection?	N	
Organization focused on individuals with access and functional needs populations	N	
Ongoing public education or information program (e.g., StormReady programs, responsible water use, fire safety, household preparedness, environmental education)	Y	Various agencies at the federal, county and state levels which promote educational efforts such as NOAA's StormReady Program, Forestland-Urban Interface Fire Protection Act, and Fire Adapted Communities from the National Cohesive Wildfire Strategy.
Natural disaster or safety related school programs?	Y	Pursuant to the RCW, schools are required to develop and exercise hazard-specific response plans.

Table 14-9.
Education and Outreach

Program/Organization	Available ?	Department/Agency/Position and Brief Description
Public-private partnership initiatives addressing disaster-related issues?	Y	Various public education outreach; provide information and presentations; NFIP insurance; outreach for continuity planning.
Multi-seasonal public awareness program?	Y	The County maintains information on its website to address specific hazards at issue; also, as situations arise, the website, email lists and local area broadcasting provides public service announcements and information.

14.12 WASHINGTON STATE RATING BUREAU LEVELS OF SERVICE

In Washington, the Washington State Rating Bureau (WSRB) helps determine standards on which insurance rates are set. WSRB, like most other states, utilizes the Insurance Service Office, Inc. (ISO) to determine levels of protection based on a prescribed level of service. Two such levels of services assessed are the Public Protection Classification Program and the Building Code Effectiveness Grading Schedule.

14.12.1 Public Protection Classification Program

The Public Protection Classification (PPC) program recognizes the efforts of communities to provide fire protection services for citizens and property owners. A community's investment in fire mitigation is a proven and reliable predicator of future fire losses. Insurance companies use PPC information to help establish fair premiums for fire insurance — generally offering lower premiums in communities with better protection. By offering economic benefits for communities that invest in their firefighting services, the program provides an additional incentive for improving and maintaining public fire protection.

In order to establish appropriate fire insurance premiums for residential and commercial properties, insurance companies utilize up-to-date information about the Community's fire-protection services. Through analysis of relevant data, communities are able to evaluate their public fire-protection services, and secure lower fire insurance premiums for communities with better protection. This program provides incentives and rewards in those areas with improved firefighting services. This program has gathered extensive information on more than 46,000 fire-response jurisdictions. Once all of the data is reviewed and analyzed, communities are assigned a PPC from 1 to 10. Class 1 generally represents superior property fire protection, while Class 10 indicates that the area's fire-suppression program is not as robust.

The most significant benefit of the PPC program is its effect on losses. Statistical data on insurance losses bears out the relationship between excellent fire protection — as measured by the PPC program — and low fire losses. PPC helps communities prepare to fight fires effectively. The program also provides help for fire departments and other public officials as they plan, budget for, and justify improvements. Table 14-10 identifies the Public Protection Classification for Whitman County.

Table 14-10.
Countywide Public Protection Classification

Community	Protection Class Grade
Albion	6

Table 14-10.
Countywide Public Protection Classification

Community	Protection Class Grade
Colfax	6
Colton	7
Endicott	8
Farmington	8
Garfield	7
Lacrosse	9
Lamont	9
Malden	7
Oakesdale	7
Palouse	6
Port of Wilma	6
Pullman	4
Rosalia	7
Saint John	7
Tekoa	7
Union Town	7
Whitman County F.P.D. 1	7
Whitman County F.P.D. 10	8
Whitman County F.P.D. 11	7
Whitman County F.P.D. 12	7
Whitman County F.P.D. 13	10
Whitman County F.P.D. 14	7
Whitman County F.P.D. 2	8
Whitman County F.P.D. 3	8
Whitman County F.P.D. 4	7
Whitman County F.P.D. 5	9
Whitman County F.P.D. 6	8
Whitman County F.P.D. 7	7
Whitman County F.P.D. 8	9

Data effective as of August 1, 2019

14.12.2 Building Code Effectiveness Grading Schedule

The Building Code Effectiveness Grading Schedule (BCEGS) assesses building codes and amendments adopted in a community and evaluates that community's commitment to enforce them. The concept is simple: Municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The prospect of reducing damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously. Table 14-11 identifies the BCEGS for the planning partnership.

Table 14-11.
Countywide Building Code Effectiveness Grading

Community	Commercial	Dwelling
Albion	3	3
Colfax	4	4
Colton	3	3
Endicott	3	3
Farmington	3	3
Garfield	3	3
Lacrosse	6	6
Lamont	3	3
Malden	6	6
Oakesdale	3	3
Palouse	3	3
Port of Wilma	3	3
Pullman	2	3
Rosalia	6	6
Saint John	5	5
Tekoa	5	5
Union Town	4	4
Whitman County F.P.D. 1	3	3
Whitman County F.P.D. 10	3	3
Whitman County F.P.D. 11	3	3
Whitman County F.P.D. 12	3	3
Whitman County F.P.D. 13	3	3
Whitman County F.P.D. 14	3	3
Whitman County F.P.D. 2	3	3
Whitman County F.P.D. 3	3	3
Whitman County F.P.D. 4	3	3
Whitman County F.P.D. 5	3	3
Whitman County F.P.D. 6	3	3
Whitman County F.P.D. 7	3	3
Whitman County F.P.D. 8	3	3
Data effective as of August 1, 2019		3

14.12.3 Public Safety Programs

Access and Functional Needs

One of the most important roles of local government is to protect their citizens from harm, including helping people prepare for and respond to emergencies. Making local government emergency preparedness and response programs accessible to people with special needs is a critical part of this responsibility. Whitman County Department of Emergency Management (DEM) has the mission to assess and plan for all hazards

and emergencies, and works with other public safety and local government agencies to ensure public welfare for all of its citizens.

Whitman County is a StormReady® County

Whitman County is also a recognized StormReady® County under the National Weather Service Program. Achieving such status requires a significant level of effort. Being part of a Weather-Ready Nation is about preparing for your community's increasing vulnerability to extreme weather events. The program helps arm America's communities with the communication and safety skills needed to save lives and property--before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.

Response Plans

Whitman County and several of its jurisdictions have developed various response plans to be utilized during incident-specific events. Such plans provide guidance to first responders and community members in what actions need to be taken during such event. These plans go through a training and exercise phase to help ensure quick response when the plans are activated.

14.13 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.6(c)(5)). For multi-jurisdictional plans, each jurisdiction requesting approval must document that is has been formally adopted. This plan will be submitted for a pre-adoption review to FEMA and the Washington Emergency Management Division (EMD) prior to adoption. Once pre-adoption approval has been provided, all planning partners will formally adopt the plan. All partners understand that DMA compliance and its benefits cannot be achieved until the plan is adopted. Copies of the resolutions adopting this plan for all planning partners can be found in Appendix D of this volume.

Chapter 15.
PLAN MAINTENANCE STRATEGY

In accordance with 44 CFR Section 201.6(c)(4)): A hazard mitigation plan must present a plan maintenance process that includes the following:

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

This chapter details the formal process that will ensure that the Whitman County Hazard Mitigation Plan remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this Plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The Plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

15.1 MONITORING, EVALUATION AND UPDATING THE PLAN

15.1.1 Progress Report - 2013 Plan Status

The 2013 Hazard Mitigation Plan identified a maintenance strategy which included regular reviews during the life cycle of the plan. To a large extent, those reviews did occur through various formats, although the planning partnership was not convened specifically for the intent of completing the annual report. The planning partnership did discuss impacts from hazards of concern as events occurred since the 2013 plan was completed, as well as identify and seek grant funding for mitigation projects, such as the grant received for the 2020 update. Nonetheless, the planning team does remain confident that the maintenance strategy and annual reporting process identified remains a valid option. The County and its planning partners have held various outreach efforts to educate the citizens about the hazards of concern, and provides information to support mitigation activities for its citizens such as defensible space, flood awareness, and severe weather protocols to ensure the safety of its citizens.

15.1.2 Plan Implementation

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into partner jurisdictions' existing plans, policies and programs. Together, the action items in the Plan provide a framework for activities that the Partnership can implement over the next 5 years. The planning team has established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies and programs.

Whitman County Department of Emergency Management will have lead responsibility for overseeing the Plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared

responsibility among all planning partnership members and agencies identified as lead agencies in the mitigation action plans (see planning partner annexes in Volume 2 of this plan).

15.1.3 Annual Progress Report

The minimum task of each planning partner will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation.

A template has been created to help guide the planning partners in preparing a progress report (see Appendix C). The planning partners will utilize that template to prepare a formal annual report on the progress of the plan. The report should be used as follows:

- Posted on the Emergency Management website page dedicated to the hazard mitigation plan
- Provided to the local media through a press release
- Presented to planning partner governing bodies to inform them of the progress of actions implemented during the reporting period
- For those planning partners that participate in the Community Rating System, the report can be provided as part of the CRS annual re-certification package. The CRS requires an annual recertification to be submitted by October 1 of every calendar year for which the community has not received a formal audit. To meet this recertification timeline, the planning team will strive to complete progress reports between June and September each year.

Uses of the progress report will be at the discretion of each planning partner. Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance the planning partnership's opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize a planning partner's compliance under the DMA, it may jeopardize its opportunity to partner and leverage funding opportunities with the other partners. Each planning partner was informed of these protocols at the beginning of this planning process (in the "Planning Partner Expectations" package provided at the start of the process), and each partner acknowledged these expectations when with submittal of a letter of intent to participate in this process.

15.1.4 Plan Update

Local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). The Whitman County partnership intends to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life
- A comprehensive update of the County or participating city's comprehensive plan

It will not be the intent of future updates to develop a completely new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a planning team.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plans will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new partnership policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The partnership governing bodies will adopt their respective portions of the updated plan.

15.1.5 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Emergency Management website and by copies of annual progress reports provided to the media. Each planning partner has agreed to provide links to the County hazard mitigation plan website on their individual jurisdictional websites to increase avenues of public access to the plan. Whitman County Emergency Management has agreed to maintain the hazard mitigation plan website. This site will not only house the final plan, it will become the one-stop shop for information regarding the plan, the partnership and plan implementation. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new Planning Team. This strategy will be based on the needs and capabilities of the planning partnership at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

15.1.6 Implementation Through Existing Programs

The information on hazard, risk, vulnerability and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The Whitman County Comprehensive Plan and the comprehensive plans of the partner cities are considered to be integral parts of this plan. The County and partner cities, through adoption of comprehensive plans and zoning ordinances, have planned for the impact of natural hazards. The plan development process provided the County and the cities with the opportunity to review and expand on policies contained within these planning mechanisms. The planning partners used their comprehensive plans and the hazard mitigation plan as complementary documents that work together to achieve the goal of reducing risk exposure to the citizens of the Whitman County. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

All municipal planning partners are committed to creating a linkage between the hazard mitigation plan and their individual comprehensive plans by identifying a mitigation initiative as such and giving that initiative a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Partners' emergency response plans
- Capital improvement programs

- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Master fire protection plans.

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

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APPENDIX A.
ACRONYMS AND DEFINITIONS

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ACRONYMS AND DEFINITIONS

ACRONYMS

CFR—Code of Federal Regulations

cfs—cubic feet per second

CRS—Community Rating System

DMA —Disaster Mitigation Act of 2000

EMD—Emergency Management Division (a division of the Washington State Military Department)

ESA—Endangered Species Act

FCAAP —Flood Control Account Assistance Program

FEMA—Federal Emergency Management Agency

FIRM—Flood Insurance Rate Map

FPU—Fire planning unit

GMA—Growth Management Act

GIS—Geographic Information System

HAZUS-MH—Hazards, United States-Multi Hazard

HMGP—Hazard Mitigation Grant Program

IBC —International Building Code

MM—Modified Mercalli Scale

NEHRP—National Earthquake Hazards Reduction Program

NFR —Natural Fire Rotation

NFIP—National Flood Insurance Program

NOAA—National Oceanic and Atmospheric Administration

OFM —Office of Financial Management (WA State)

PDM—Pre-Disaster Mitigation Grant Program

PDI—Palmer Drought Index

PGA—Peak Ground Acceleration

PHDI—Palmer Hydrological Drought Index

RCW—Revised Code of Washington

SFHA—Special Flood Hazard Area

SHELDUS—Special Hazard Events and Losses Database for the U.S.

SPI—Standardized Precipitation Index

UBC—Uniform Building Code

USGS—U.S. Geological Survey

WAC —Washington Administrative Code

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most federal and state agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce

losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events, and
- Public and private utilities, infrastructure and transportation systems that are vital to maintaining or restoring normal services to areas damaged by hazard events
- Public gathering places that could be used as evacuation centers during large scale disasters.
- Government and educational facilities central to governance and quality of life along with response and recovery actions taken as a result of a hazard event

Cubic Feet per Second (cfs): Discharge or river flow is commonly measured in cfs. One cubic foot is about 7.5 gallons of liquid.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Avalanche: Volcanoes are prone to debris and mountain rock avalanches that can approach speeds of 100 mph.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65 percent.

Disaster Mitigation Act of 2000 (DMA); The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the

FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the Special Flood Hazard Area (SFHA).

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour (mph)) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes and local governments to implement hazard mitigation actions after a major disaster

declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damage and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mass movement: A collective term for landslides, mudflows, debris flows, sinkholes and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property and the economy. Risk estimates for the City are based on the methodology that the City used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, its contents, and the economic value of its functions. Like indirect damage, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

Whitman County
Hazard Mitigation Plan Update

APPENDIX B.
PUBLIC OUTREACH

APPENDIX B.
PUBLIC OUTREACH

Survey Introduction

A partnership of local governments and others stakeholders in Whitman County are working together to update the Whitman County Multi-Jurisdictional Hazard Mitigation Plan. This plan was created in 2013 in response to Federal programs that enable the partnership to use pre- and post-disaster financial assistance to reduce the exposure of County residents to risks associated with natural hazards.

In order to identify and plan for future natural disasters, we need your assistance. This questionnaire is designed to help us gauge the level of knowledge local citizens already have about natural disaster issues and to find out from local residents about areas vulnerable to various types of natural disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

The survey consists of various questions plus an opportunity for any additional comments at the end. The survey should take less than 10 minutes to complete and is anonymous, unless you decide to provide contact information. When you have finished the survey, please click "Done" on the final page.

The Whitman County Hazard Mitigation Planning Partnership thanks you for taking the time to participate in this information-gathering process.

1. Do you live in Whitman County?

- ◯ Yes
- ◯ No

2. How long have you lived or worked in Whitman County?

- ◯ Do not live in the County
- ◯ Less than 1 year
- ◯ 1 to 5 years
- ◯ 6 to 10 years
- ◯ 11 to 20 years
- ◯ More than 20 years

* 3. Where in Whitman County do you live?

- ☐ Albion
- ☐ Colfax
- ☐ Colton
- ☐ Endicott
- ☐ Farmington
- ☐ Garfield
- ☐ LaCrosse
- ☐ Lamont
- ☐ Malden
- ☐ Oaksdale
- ☐ Palouse
- ☐ Pullman
- ☐ Rosalia
- ☐ St. John
- ☐ Tekoa
- ☐ Unincorporated County

Other (please specify)

4. How concerned are you about the following natural hazards in Whitman County? (Check one response for each hazard)

	Not Concerned	Somewhat Concerned	Concerned	Very Concerned	Extremely Concerned
Climate Change	○	○	○	○	○
Dam/Levee Failure	○	○	○	○	○
Disease/Epidemic	○	○	○	○	○
Drought	○	○	○	○	○
Earthquake	○	○	○	○	○
Flood	○	○	○	○	○
Hazardous Materials Incident	○	○	○	○	○
Ice Storm	○	○	○	○	○
Landslide	○	○	○	○	○
Severe Weather	○	○	○	○	○
Volcanic Eruption	○	○	○	○	○
Wildland Fire	○	○	○	○	○
Urban Fire	○	○	○	○	○
Other	○	○	○	○	○

Other (please specify)

* 5. Which of the following natural hazard events have you or has anyone in your household experienced in the past 20 years? (Check all that apply)

- ☐ Avalanche
- ☐ Dam/Levee Failure
- ☐ Disease Epidemic
- ☐ Drought
- ☐ Earthquake
- ☐ Flood
- ☐ Hazardous Material Incident
- ☐ Ice Storm
- ☐ Other (please specify)
- ☐ Landslide
- ☐ Severe Weather (excessive heat/cold, wind, lightning, snow/winter storm, etc.)
- ☐ Civil Disturbance
- ☐ Volcanic Eruption (lahar, ash fall)
- ☐ Wildland Fire
- ☐ Urban Fire
- ☐ None

Natural Hazard Preparedness

* 6. How prepared is your household to deal with a natural hazard event?

	Not at all prepared	Somewhat prepared	Adequately prepared	Well prepared	Very well prepared
Check one:	○	○	○	○	○

7. Which of the following have provided you with useful information to help you be prepared for a natural hazard event?

- ☐ Emergency preparedness information from a government source (e.g. federal, state, or local emergency management)
- ☐ Personal experience with one or more natural hazards/disasters?
- ☐ Locally provided news or other media information
- ☐ Schools and other academic institutions
- ☐ Attended meetings that have dealt with disaster preparedness
- ☐ Community Emergency Response Team (CERT)
- ☐ Church
- ☐ None
- ☐ Other (please specify)

* 8. Which of the following methods do you think are most effective for providing hazard and disaster information? (Check all that apply)

- [ ] Newspaper
- [ ] Radio News
- [ ] Books
- [ ] Telephone Book
- [ ] Radio Ads
- [ ] Chamber of Commerce
- [ ] Informational Brochures
- [ ] Internet
- [ ] Academic Institutions
- [ ] City/County Newsletters
- [ ] Outdoor Advertisements
- [ ] Public Library
- [ ] Public Meetings
- [ ] Fire Department/Rescue
- [ ] Red Cross Information
- [ ] Workshops
- [ ] Church (faith-based institutions)
- [ ] Community Safety Events
- [ ] Schools
- [ ] Law Enforcement
- [ ] Fair Booths
- [ ] TV News
- [ ] CERT Classes
- [ ] Word of Mouth
- [ ] TV Ads
- [ ] Public Awareness Campaign (e.g., Flood Awareness Week, Winter Storm Preparedness Month)
- [ ] Social Media (Twitter, Facebook, LinkedIn)
- [ ] Other (please specify)

9. Please indicate how you feel about the following statement:

Information about the risks associated with natural hazards is readily available and easy to locate.

	Strongly Disagree	Somewhat Disagree	Neither Agree of Disagree	Somewhat Agree	Strongly Agree
Choose one	○	○	○	○	○

10. Which of the following steps has your household taken to prepare for a hazard event? (Check all that apply)

- ☐ Developed a household emergency response plan addressing a variety of hazards
- ☐ Received First Aid/CPR training
- ☐ Made a fire escape plan
- ☐ Designated a meeting place
- ☐ Identified utility shutoffs
- ☐ Sand bags
- ☐ Prepared a disaster supply kit
- ☐ Installed smoke detectors on each level of the house
- ☐ Stored food and water
- ☐ Other (please specify)
- ☐ Stored flashlights and batteries
- ☐ Stored a battery-powered radio
- ☐ Stored a fire extinguisher
- ☐ Stored medical supplies (first aid kit, medications)
- ☐ Planted fire resistent landscaping
- ☐ Natural hazard insurance (Flood, Earthquake, Wildfire)
- ☐ Removed / Reduced vegetation 100 feet from the immediate are of house
- ☐ None

11. Is your property located in or near a FEMA designated floodplain?

○ Yes ○ No ○ Not Sure

12. Is your property located near an earthquake fault?

○ Yes ○ No ○ Not Sure

13. Is your property located in or near a landslide area?

○ Yes ○ No ○ Not Sure

* 14. When you moved into your home, did you consider the impact a natural disaster could have on your home?

○ Yes ○ No ○ Not Sure

15. Do you have any type of special hazard insurance? Please check all that apply.

- [ ] Flood Insurance
- [ ] Earthquake Insurance
- [ ] Landslide Insurance
- [ ] Wildfire Insurance
- [ ] General insurance policy only.
- [ ] Renter's Insurance
- [ ] Other (please specify)

16. Is your property located in an area at risk for wildfires?

○ Yes ○ No ○ Not Sure

17. What type of roof does your home have?

- ○ Composite (most common roofing material)
- ○ Wood Shake/Shingles
- ○ Ceramic Tiles
- ○ Aluminum, Tim, or Other Metal
- ○ Other (please specify)

18. Do you have a lawn (grass) surrounding your home?

○ Yes ○ No

19. Do livestock (cattle, horses, sheep) graze the grasses and shrubs around your home?

○ Yes ○ No

20. If the primary access to your home were cut off because of wildfire or other hazard, would you have an alternate escape route?

○ Yes ○ No

21. Do you conduct periodic fuels reduction activities near your home site such as:

- ☐ Cleaning and removing brush
- ☐ Clearing and removing downed tree limbs on your property
- ☐ Trimming tree branches away from your home
- ☐ Removing trees that are dead or infested that pose a risk to your home

Natural Hazard Mitigation

22. Was the presence of a natural hazard risk zone (e.g., dam failure zone, flood zone, landslide hazard area, high fire risk area) disclosed to you by a real estate agent, seller, or landlord before you purchased or moved into your home?

◯ Yes ◯ No ◯ Not Sure

23. Please indicate how you feel about the following statement:

Information about the risks associated with natural hazards is readily available and easy to locate.

	Strongly Disagree	Somewhat Disagree	Neither Agree of Disagree	Somewhat Agree	Strongly Agree
Choose one	◯	◯	◯	◯	◯

24. Would the disclosure of this type of natural hazard risk information influence your decision to buy or rent a home?

◯ Yes ◯ No ◯ Not Sure

25. Which of the following incentives would encourage you to spend money to retrofit your home to protect against natural disasters? (Check all that apply)

☐ Insurance premium discount

☐ Mortgage discount

☐ Low interest rate loan

☐ Grant funding

☐ None

☐ Other (please specify)

26. If your property were located in a designated "high hazard" area or had received repetitive damages from a natural hazard event, would you consider a "buyout" offered by a public agency?

◯ Yes ◯ No ◯ Not Sure

27. Would you support regulations (restrictions) on land use within known high hazard areas?

◯ Would support

◯ Would not support

28. Please indicate how you feel about the following statement:

It is the responsibility of government (local, state, and federal) to provide education and programs that provide citizen actions that will reduce exposure to the risks associated with natural hazards.

	Strongly Disagree	Somewhat Disagree	Neither Agree of Disagree	Somewhat Agree	Strongly Agree
Choose one	○	○	○	○	○

General Household Information

29. Please indicate your age range:

- ◯ Under 18
- ◯ 18 to 30
- ◯ 31 to 40
- ◯ 41 to 50
- ◯ 51 to 60
- ◯ 61 or older

30. Please indicate your gender:

- ◯ Male
- ◯ Female
- ◯ Other

31. Please indicate your highest level of education.

- ◯ Grade school/No schooling
- ◯ Some high school
- ◯ High school graduate/GED
- ◯ Other (please specify)
- ◯ Some college/Trade school
- ◯ College degree
- ◯ Graduate degree

32. How much is your gross household income?

- ◯ $20,000 or less
- ◯ $20,001 to $49,999
- ◯ $50,000 to $74,999
- ◯ $75,000 to $99,999
- ◯ $100,00 or more

33. Do you have regular access to the Internet?

- ◯ Yes
- ◯ No
- ◯ Not Sure

Comments (Optional)

If you have additional information you would like to share about your knowledge and experience regarding local natural hazards and disasters, we invite you to provide your information on this page. This survey and your comments are completely confidential and greatly appreciated.

Thank you for your time!

34. Comments

Whitman County
Hazard Mitigation Plan Update

APPENDIX C.
ANNUAL PROGRESS REPORT TEMPLATE

APPENDIX C.
ANNUAL PROGRESS REPORT TEMPLATE

Whitman County
Hazard Mitigation Plan Update
Annual Progress Report
Reporting Period: (Insert reporting period)

Background: Whitman County and participating cities and special purpose districts in the county developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the participating partners organized resources, assessed risks from natural hazards within the county, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, these jurisdictions maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

http://www.whitmancounty.org/page.aspx?pn=Emergency+Management

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 20____, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before _____, 2025. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted __ hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ initiatives reported ongoing action toward completion.
- __ initiatives were reported as being complete.
- __ initiatives reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Whitman County Hazard Mitigation Plan Update. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of the partner jurisdictions. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of Whitman County)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Hazard Mitigation Planning Team: The Hazard Mitigation Planning Team, made up of planning partners and stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 20__. It was determined through the plan's development process that a

Planning Team would remain in service to oversee maintenance of the plan. At a minimum, the Planning Team will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Planning Team membership is as indicated in Table 1.

TABLE 1.
PLANNING TEAM MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- _____
- _____

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

- *Was any element of the initiative carried out during the reporting period?*
- *If no action was completed, why?*
- *Is the timeline for implementation for the initiative still appropriate?*
- *If the initiative was completed, does it need to be changed or removed from the action plan?*

TABLE 2.
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				

TABLE 2. ACTION PLAN MATRIX				
Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				

Completion status legend:
✓= Project Completed
O = Action ongoing toward completion
X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Planning Team, the following recommendations will be noted for future updates or revisions to the plan:

- _____
- _____
- _____
- _____
- _____
- _____

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the governing boards of all planning partners and to local media outlets and the report is posted on the Whitman County Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here

APPENDIX D.
PLAN ADOPTION RESOLUTIONS FROM PLANNING PARTNERS

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To Be Provided With Final Release