RESOLUTION NO. 2016-011

A RESOLUTION OF THE CITY COUNCIL OF NIXA, MISSOURI, ADOPTING THE CHRISTIAN COUNTY MULTI-JURISDICTIONAL NATURAL HAZARD MITIGATION PLAN (UPDATED 2015)

WHEREAS, the City Council of Nixa, Missouri, recognizes the threat that natural hazards pose to people and property within the City of Nixa; and

WHEREAS, the City Council of Nixa, Missouri, has participated in the preparation of a multi-hazard mitigation plan, hereby known as the Christian County Multi-Jurisdictional Hazard Mitigation Plan (Updated 2015), hereafter referred to as the Plan, in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS, the Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the City of Nixa from the impacts of future hazards and disasters; and

WHEREAS, the City Council of Nixa, Missouri, recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the City of Nixa will endeavor to integrate the Plan into the comprehensive other local planning processes; and

WHEREAS, adoption by the City Council of Nixa, Missouri, demonstrates their commitment to hazard mitigation and achieving the goals outlined in the Plan.

NOW THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF NIXA, MISSOURI, in the State of Missouri, THAT:

Section 1. In accordance with Nixa Home Rule Charter, the City Council of Nixa, Missouri, adopts the final FEMA-approved plan.

Section 2. This resolution shall be in full force and effective immediately after it is approved by the City Council and signed by the Mayor.

Passed and approved this 19th day of January, 2016.

_____
MAYOR

ATTEST:

_____
CITY CLERK

CHRISITAN COUNTY

MISSOURI

Multi-Jurisdictional

Natural Hazards Mitigation Plan

Draft

December 2015

Southwest Missouri
Council of Governments

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Christian County Mitigation Planning Committee

Jurisdictional Representatives

Name	Title	Jurisdiction/Agency/Organiz
Ray Weter	Presiding Commissioner	Christian County
Bill Barnett	Western Commissioner	Christian County
Sue Ann Childers	Eastern Commissioner	Christian County
Miranda Beadles	Highway Administrator	Christian County
Richard Teague	Supervisor	Christian County
Todd Wisehan	Administrator/ Flood Plain	Christian County
Phil Amtower	Director	Christian County
Linda Barger	Asst. Director	Christian County
Danny Gray	Assessor	Christian County
Amy York	Clerk GIS	Christian County
Danny Garbee	Supervisor	Billings Special Rd Dist.
Bud Pierce	Mayor	City of Billings
David Taylor	Chief	City of Billings
David Aldrich	Superintendent	Chadwick R-I Schools
Jaclyn Aldrich	Asst. Superintendent	Chadwick R-I Schools
Benjy Fenske	Safety Coordinator	Clever R-V Schools
Kristy Keithley	Clerk	City of Clever
Ronnie Keithley	Supervisor	City of Clever
Randall Bruce	Chief	City of Clever
Jennifer Wheeler	Elementary Principal	Spokane R-VII Schools
Cynthia Brandt	Superintendent	Billings R-IV Schools
Travis Cosey	Planning & Development Director	City of Nixa
Aron Peterson	City Councilman	City of Nixa
Larry Martin	Director	City of Ozark
Tom Tobin	Mayor	City of Fremont Hills
Jeanette Curtiss	Deputy Clerk	City of Fremont Hills
Jeff Jochems	Campus President	OTC
Jerome Ransom	Campus Safety	OTC
Clint Ellingsworth	Mayor	City of Highlandville
Zac Rantz	Chief Communication Officer	Nixa R-II Schools
Brenda Rantz	Director of Finance	Nixa R-II Schools
Kevin Patterson	Superintendent	Ozark R-VI Schools
Chris Bauman	Executive Director of Operations	Ozark R-VI Schools
Kasha Driscoll	Executive Administrator	CC Ambulance Dist.

Stakeholder Representatives

Name	Title	Agency/Organization
Brian Loula	Fire Chief	Sparta FPD
Whitney Weaver	Fire Chief	Nixa FPD
Darla Boice	Supervisor	OACAC-CCNC
Nancy Gailey	Admin. Asst.	OACAC-CCNC
David Hoover	EMS Specialist	CoxEMS-CCAD
Gordon Carriker	Coordinator	Missouri University Ext.
Rance Duffy	Director	CC 911
Cindy Bilyeu	Director	CC Health Dept.
Dawn Cook	Epidemiologist	CC Health Dept.

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The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. Christian County, participating local governments, and school/special districts developed this multi-jurisdictional local hazard mitigation plan update to reduce future losses from hazard events to the County and its communities and school/special districts. The plan is an update of a plan that was approved on June 17, 2011. The plan and the update were prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 to result in eligibility for the Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Grant Programs.

The County Multi-Hazard Mitigation Plan is a multi-jurisdictional plan that covers the following 15 jurisdictions that participated in the planning process:

- Christian County
- The City of Clever
- The City of Fremont Hills
- The City of Highlandville
- The City of Nixa
- The City of Ozark
- Billings R-II
- Chadwick R-I
- Clever R-V
- Nixa R-II
- Ozark R-III
- Spokane R-VII
- Ozarks Technical Community College
- Christian County Ambulance District
- Billings Special Road District

The Village of Saddlebrooke, The City of Sparta, The City of Highlandville and Sparta R-VI School District were invited to participate in the planning process, but did not meet all of the established requirements for official participation. When the future five-year update is developed for this plan, this school district again will be invited again to participate.

Christian County and the entities listed above developed a Multi-Jurisdictional Hazard Mitigation Plan that was approved by FEMA on June 17, 2011. This current planning effort serves to update that previously approved plan.

The plan update process followed a methodology prescribed by FEMA, which began with the formation of a Mitigation Planning Committee (MPC) comprised of representatives from Christian County, participating jurisdictions, and stakeholder organizations. The MPC updated the risk assessment that identified and profiled hazards that pose a risk to Christian County and analyzed jurisdictional vulnerability to these hazards. The MPC also examined the capabilities in place to mitigate the hazard damages, with emphasis on changes that have occurred since the previously approved plan was adopted. The MPC determined that the planning area is vulnerable to several hazards that are identified, profiled, and analyzed in this plan. Riverine and flash flooding, winter storms, severe thunderstorms/hail/lightning/high winds, and tornadoes are among the hazards

that historically have had a significant impact. Based upon the risk assessment, the MPC updated goals for reducing risk from hazards. The goals are listed below:

Goal 1 – Protect the lives and livelihoods of all citizens.

- **Objective 1.1 –** Promote education, outreach, research and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation

- **Objective 1.2** - Provide adequate warning and communications systems to alert the public to severe hazard events

- **Objective 1.3** - Provide and promote safe refuge areas during weather extremes

Goal 2 - Reduce the potential impact of natural disasters to property, infrastructure, and the local economy.

- **Objective 2.1** - Protect structures, contents and critical lifelines from the impacts of natural hazard occurrence

- **Objective 2.2** - Ensure that future development in the county is as hazard proof as possible

Goal 3 - Ensure continued operation of government, emergency functions and critical infrastructure in a disaster.

- **Objective 3.1** - Improve the efficiency, timing, and effectiveness of response and recovery efforts for natural hazard disasters

- **Objective 3.2** - Design, enhance, or amend policies that will work to limit the impact of natural hazards

- **Objective 3.3** - Increase the capabilities to mitigate the impact of natural hazards

To advance the identified goals, the MPC developed recommended mitigation actions, which are detailed in Chapter 4 of this plan. The MPC developed an implementation plan for each action, which identifies priority level, background information, and ideas for implementation, responsible agency, timeline, cost estimate, potential funding sources, and more.

44 CFR requirement 201.6(c)(5): The local hazard mitigation plan shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

This plan has been reviewed by and adopted with resolutions or other documentation of adoption by all participating jurisdictions and schools/special districts. The documentation of each adoption is included in Appendix A. The following jurisdictions participated in the development of this plan and have adopted the multi-jurisdictional plan:

- Christian County
- The City of Clever
- The City of Fremont Hills
- The City of Nixa
- The City of Ozark
- Billings R-II
- Chadwick R-I
- Clever R-V
- Nixa R-II
- Ozark R-III
- Spokane R-VII
- Ozarks Technical Community College – Richwood Valley Campus
- Christian County Ambulance District
- Billings Special Road District

1 INTRODUCTION AND PLANNING PROCESS

1.1 Purpose

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Mitigation activities may be implemented prior to, during or after an incident. However it has been demonstrated that hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs (http://www.fema.gov/what-mitigation).

FEMA has implemented the various hazard mitigation planning provisions through the Code of Federal Regulations (CFR) at 44 CFR Part 201. The CFR provisions set forth the mitigation plan requirement for local and Tribal governments as a condition of receiving FEMA hazard mitigation assistance. Under 44 CFR §201.6, local governments, schools or other publicly funded districts must have adopted an FEMA-approved local hazard mitigation plan in place in order to apply for hazard mitigation project grants. Section 322 of the Robert T. Stafford Relief and Emergency Assistance Act (P.L. 93-288), as amended by the Disaster Mitigation Act of 2000 (DMA) (P.L. 106-390), provides for States, Tribes and local governments to undertake a risk-based approach to reducing risks to natural hazards through mitigation planning.

1.2 Background and Scope

As required by 44 CFR §201.6(d)(3), local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts and changes in priorities and resubmit it for approval every five (5) years in order to continue to be eligible for mitigation project grant funding. The 2016 Christian County Multi-Jurisdictional Natural Hazard Mitigation Plan, heron referred to as the Plan, is a revision of the previous five-year update adopted on June 17, 2011, which was the first five year update of the original plan completed in 2005.

The Plan is a major rewrite of the 2011 Plan that reflects changes in priorities and development and the continued commitment of local governments to mitigate the impact of natural hazards in Christian County. Local jurisdictions that participated in the 2011 Plan and are continuing participation in the 2016 include:

- Christian County
- The City of Billings
- The City of Clever
- The City of Fremont Hills
- The City of Highlandville
- The City of Nixa
- The City of Ozark
- Billings R-II School District
- Chadwick R-I School District
- Clever R-V School District

- Nixa R-II School District
- Ozark R-III School District
- Spokane R-VII School District
- Ozarks Technical Community College – Richwood Valley Campus

Local jurisdictions that did not participate in the 2011 Plan but participated in 2015 include:

- Billings Special Road District
- Christian County Ambulance District
- Christian County 911

Local jurisdictions that were invited but did not participate in the Plan include:

- The Village of Saddlebrooke
- The City of Sparta
- Sparta R-VI

The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Information in the plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future.

1.3 Plan Organization

Set forth the outline of the plan. If there are changes in the format from the previously approved plan, explain what they are and why the changes were made.

- Chapter 1: Introduction and Planning Process
- Chapter 2: Planning Area Profile and Capabilities
- Chapter 3: Risk Assessment
- Chapter 4: Mitigation Strategy
- Chapter 5: Plan Implementation and Maintenance
- Appendices

Table 1.1 summarizes the changes made in The Plan by chapter.

Table 1.1. Changes Made in Plan Update

Plan Chapter	Summary of Changes Made
Introduction	• Added public involvement section describing advertised public meetings and opportunity for neighboring communities and agencies to be involved in the planning process • Added minimum participation requirements for local jurisdictions • Included a record of participation describing how each jurisdiction participated in the process • Updated list of plan participants • Updated planning methodology and plan timeline • Added table of local officials who attended meetings
Profile & Capabilities	• Updated demographic information • Updated critical, vulnerable and government facilities information • Incorporated revisions to community profiles as draft sections were reviewed by local officials • Incorporate information from the local jurisdiction data collection questionnaire
Risk Assessment	• Included events for each hazard that occurred from 2010-2015 • Incorporated low water crossings map for flood and wildland urban interface hazard area map for wildfire • Included new profile for sinkhole hazard • Added likely locations subsections for each hazard • Developed hazard identification and analysis methodology • Added overall summary of hazard vulnerability by jurisdiction • Added vulnerability assessment tables for each hazard and each participating jurisdiction
Mitigation Strategy	• Updated mitigation actions development process • Included actions eliminated and reason for removal • Updated progress made towards mitigation goals from earlier plan • Updated cost benefit review method using STAPLEE and simple scores • Discussed funding sources, lead agencies and status of continuing, revised and new actions
Plan Maintenance	• LEPC responsibilities for plan monitoring, evaluation, and

1.4 Planning Process

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

The Southwest Missouri Council of Governments (SMCOG) contracted to facilitate the entire plan development process. SMCOG staff met with the Christian County EMD during an initial scoping meeting to develop contact information for area stakeholders and local jurisdiction representatives to establish the Mitigation Planning Committee (MPC). Potential meeting locations and schedule were discussed as well as strategies for including the public. The planning process included the kick-off meeting and three subsequent MPC meetings. SMCOG staff were also producing the draft and final plan update in a FEMA-approvable document, and coordinating with the Missouri State Emergency Management Agency (SEMA) and FEMA plan reviews.

Specific information about agenda items for the MPC meetings are presented in Section 1.4.2. SMCOG was also responsible for soliciting public involvement in the planning process. The MPC meetings on April 29, 2015, June 25, 2015, and October 29, 2015 were advertised as open meetings in the Christian County Headliner, the newspaper of widest distribution in the County. Meeting dates for and items to be discussed for all meetings, including the kick-off meeting on March 26, 2015, were posted on the SMCOG website in advance and a draft was also posted on the website for public comment during the drafting of the Plan and prior to the Plan being submitted for approval. Appendix C provides documentation of the planning process including public involvement solicitations and meeting notices.

The preliminary draft of the plan was posted on the SMCOG website for public review and comment on October 19, 2015. A final draft of the Plan was posted on the SMCOG website on December 1, 2015 before the Plan was submitted for SEMA/FEMA approval. On both occasions a press release was sent to the Christian County Headliner and The Nixa Express notifying news outlets that Plan was available for public comment. Input from city and county officials was solicited through distribution of drafts of plan elements for discussion and review at scheduled meetings and other communications with individual community representatives and elected officials.

Neighboring jurisdictions were notified via email and letters, a notification was sent to adjacent county Emergency Management Directors, Chambers of Commerce, local and regional agencies, such as; OACAC, and the University of Missouri Extension office. A complete listing of neighboring agencies invited to participate in the planning process and what meetings they were invited to attend is included in Appendix D.

Table 1.2 shows the representatives from local jurisdictions and stakeholders that attended meetings and participated on MPC. All participating jurisdictions, including school districts, are represented on the MPC, whether it's by direct or indirect participation. Indirect participation is used, set forth the parameters established for ensuring that the jurisdiction represented is kept apprised of MPC events and milestones. If indirect participation occurred, indicate this in Table 1.2.

Table 1.2. Jurisdictional Representatives Christian County Mitigation Planning Committee

Name	Title	Jurisdiction/Agency /Organization
Ray Weter	Presiding Commissioner	Christian County
Bill Barnett	Western Commissioner	Christian County
Sue Ann Childers	Eastern Commissioner	Christian County
Miranda Beadles	Highway Administrator	Christian County
Richard Teague	Supervisor	Christian County
Todd Wisehan	Administrator/ Flood Plain Manager	Christian County
Phil Amtower	Director	Christian County
Linda Barger	Asst. Director	Christian County
Danny Gray	Assessor	Christian County
Amy York	Clerk GIS	Christian County
Danny Garbee	Supervisor	Billings Special Rd Dist.
Bud Pierce	Mayor	City of Billings
David Taylor	Chief	City of Billings
Chris Hopkins	Treasurer	City of Billings
David Aldrich	Superintendent	Chadwick R-I Schools
Jaclyn Aldrich	Asst. Superintendent	Chadwick R-I Schools
Benjy Fenske	Safety Coordinator	Clever R-V Schools
Kristy Keithley	Clerk	City of Clever
Ronnie Keithley	Supervisor	City of Clever
Randall Bruce	Chief	City of Clever
Jennifer Wheeler	Elementary Principal	Spokane R-VII Schools
Cynthia Brandt	Superintendent	Billings R-IV Schools
Travis Cosey	Planning and Development Director	City of Nixa
Aron Peterson	Councilman	City of Nixa
Larry Martin	Director	City of Ozark
Tom Tobin	Mayor	City of Fremont Hills
Jeanette Curtiss	Deputy Clerk	City of Fremont Hills
Jeff Jochems	Campus President	OTC
Jerome Ransom	Campus Safety	OTC
Clint Ellingsworth	Mayor	City of Highlandville
Zac Rantz	Chief Communication Officer	Nixa R-II Schools
Brenda Rantz	Director of Finance	Nixa R-II Schools
Kevin Patterson	Superintendent	Ozark R-VI Schools
Chris Bauman	Executive Director of Operations	Ozark R-VI Schools
Brian Loula	Fire Chief	Sparta FPD
Whitney Weaver	Fire Chief	Nixa FPD
Darla Boice	Supervisor	OACAC-CCNC
Nancy Gailey	Administrative Asst.	OACAC-CCNC
David Hoover	EMS Specialist	CoxEMS-CCAD
Kasha Driscoll	Executive Administrator	CC Ambulance Dist.
Gordon Carriker	Coordinator	Missouri University Ext.
Rance Duffy	Director	CC 911
Cindy Bilyeu	Director	CC Health Dept.
Dawn Davis	Epidemiologist	CC Health Dept.

1.4.1 Multi-Jurisdictional Participation

44 CFR Requirement §201.6(a)(3): Multi-jurisdictional plans may be accepted, as appropriate, as long as each jurisdiction has participated in the process and has officially adopted the plan.

The Plan serves as a written document of the planning process. Active participation of local jurisdiction representatives and stakeholders in the hazard mitigation planning process is essential if the Plan is to have value. To be eligible for mitigation funding, local governments must adopt the FEMA-approved update of the Plan. The participation of the local government stakeholders in the planning process is considered critical to successful implementation of this plan. Each jurisdiction that is seeking approval for the plan must have its governing body adopt the updated plan, regardless the degree of modifications. SMCOG collaborated with the local governments in Christian County to assure participation in the planning process and the development of a plan that represents the needs and interests of Christian County and its local jurisdictions. Appendix A contains sample resolutions for jurisdictions adopting the *Plan*.

County Commissioners, incorporated communities, public school and special districts, and various other stakeholders in mitigation planning were invited a kick-off meeting for the Plan update on March 25, 2015. A list of contacts invited to the kick-off meeting is included in Appendix C. At this meeting it was explained that the DMA requires each jurisdiction participating in the planning process officially adopt the plan. The criteria for participation that each jurisdiction must meet in order to be considered a "participant" in the Plan was established at this meeting and include the following:

- Participation in a at least two (2) MPC meetings, by either direct participation or authorized representation;
- Each participating jurisdiction must provide to the MPC sufficient information to support plan development by completion and return of Data Collection Questionnaires and validating/correcting critical facility inventories;
- Identification and Cost/Benefit Review of Mitigation Actions
- Review and comment on plan drafts;
- Provide documentation to show time donated to the planning effort

In order to be included in the plan as a participating jurisdiction each jurisdiction was required to send a representative to two (2) meetings and completion of data collection questionnaire as a minimum requirements. If, however, a representative was not able to attend at least two meetings they were encouraged to arrange for a one-to-one meeting with SMCOG staff or contact the SMCOG offices to obtain information presented at any of the planning meetings. Although not required, a set of standards for participation were developed in order for each jurisdiction to participate in the planning process and account for the variability of resources within each jurisdiction. This set of standards included; Identifying and cost/benefit review of mitigation actions, reviewing and commenting on plan draft materials, and providing documentation to show time donated to the planning effort. Jurisdictions that met at least one (1) of the minimum requirements and any combination of additional three standards are considered to have satisfactorily participated in the planning process.

Table 1.3 shows the representation of each participating jurisdiction at the planning meetings and the provision of responses to the Data Collection Questionnaire. All jurisdictions participating in the Plan either reviewed or commented on the draft Plan, participated in the

update/development of mitigation actions, or documented the donation of time. Meeting sign-in sheets are located in Appendix B.

Table 1.3. Jurisdictional Participation in Planning Process

Jurisdiction	Kick-Off Meeting	Meeting #2	Meeting #3	Meeting #4	Data Collection Questionnaire Response
Christian County	X	X	X	X	X
The City of Clever	X		X		X
The City of Fremont Hills	X	X	X	X	X
The City of Highlandville		X			
The City of Nixa	X	X	X		X
The City of Ozark	X	X		X	X
The Village of Saddlebrooke					
The City of Sparta					
Billings R--II	X		X	X	X
Chadwick R-I	X	X		X	X
Clever R-V	X	X	X	X	X
Nixa R-II	X	X		X	X
Ozark R-III	X	X			X
Sparta R-VI					
Spokane R-VII	X			X	
OTC-Richwood Valley		X	X	X	X
CC Ambulance District	X	X		X	X
Billings Special Road District	X	X			X

1.4.2 The Planning Steps

FEMA's Local Mitigation Planning Handbook (March 2013), Local Mitigation Plan Review Guide (October 1, 2013), and Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials (March 1, 2013) were used as the sources for developing the Plan update process. The development of the plan followed the 10-step planning process adapted from FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. The 10-step process allows the Plan to meet funding eligibility requirements of the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, Community Rating System, and Flood Mitigation Assistance Program. Table 1.4 shows how the CRS process aligns with the Nine Task Process outlined in the 2013 Local Mitigation Planning Handbook.

Following **Table 1.4** is a summary of how SMCOG staff used the Nine Task Process to develop the update to the Plan.

Table 1.4. County Mitigation Plan Update Process

Community Rating System (CRS) Planning Steps (Activity 510)	Local Mitigation Planning Handbook Tasks (44 CFR Part 201)
Step 1. Organize	Task 1: Determine the Planning Area and Resources
	Task 2: Build the Planning Team 44 CFR 201.6(c)(1)
Step 2. Involve the public	Task 3: Create an Outreach Strategy 44 CFR 201.6(b)(1)
Step 3. Coordinate	Task 4: Review Community Capabilities 44 CFR 201.6(b)(2) & (3)
Step 4. Assess the hazard	Task 5: Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)
Step 5. Assess the problem	
Step 6. Set goals	Task 6: Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i); 44 CFR 201.6(c)(3)(ii); and 44 CFR 201.6(c)(3)(iii)
Step 7. Review possible activities	
Step 8. Draft an action plan	
Step 9. Adopt the plan	Task 8: Review and Adopt the Plan
Step 10. Implement, evaluate, revise	Task 7: Keep the Plan Current
	Task 9: Create a Safe and Resilient Community 44 CFR 201.6(c)(4)

Step 1: Organize the Planning Team (Handbook Tasks 1 & 2)

In December 2014, SMCOG entered into cooperative agreements with SEMA and Christian County to prepare this multi-jurisdictional plan for public entities in Christian County. Discussions on the development of the Christian County Multi-Jurisdictional Natural Hazard Mitigation Plan began on February 18, 2015 with an introductory scoping meeting attended by SMCOG staff and the County Emergency Management Director. This meeting was conducted to discuss the timeline for developing the hazard mitigation plan, the planning process, identification of stakeholders and community organizations to include in the planning process and a date for the Kick-Off meeting for March 26, 2015 to initiate participation of jurisdictions and public entities in the planning process. The EMD and SMCOG staff identified prospective participant representatives and stakeholders and a contact list was prepared for mailing an invitation letter to the Kick-Off Meeting. The list of invitees included local elected officials, municipal government staff, county government staff, emergency services personnel, public school administrators, members from health and social services organizations, utility providers, Missouri University Extension staff, EMDs from adjacent counties, and volunteer organizations. A complete list of invitees is in Appendix C.

The MPC met on several occasions from March through October 2015 to collaborate on the development of the Plan update. Participants assisted in data collection; reviewed and revised the Plan's goals, objectives and mitigation strategies; and provided reviews and comments on the plan throughout the update process. Communication with MPC members occurred throughout the planning process through face-to-face meetings, phone interviews, and email correspondence in addition to committee meetings. **Table 1.5** shows the meeting schedule and items discussed for MPC meetings.

Table 1.5. Schedule of MPC Meetings

Meeting	Topic	Date
Informational Meeting	• Prospective participants and stakeholders identified, EMD to prepare and review contact list • Schedule Kick-Off meeting date and venue • SMCOG staff to draft invitation letters and to begin update of community profiles and storm event data	2/18/2015
Kick-off Meeting	• Raising awareness for mitigation strategy/ increase countywide resilience to natural hazards • The Disaster Mitigation Act of 2000 • Mitigation Planning Process • Local Plan Participation • Project Timeline	3/26/2015
Planning Meeting #2	• Local Plan Participation • Hazard Identification and Vulnerability • Risk Assessment • Assess progress towards actions from the 2011 Plan	4/29/2015
Planning Meeting #3	• Local Plan Participation • Mitigation Strategy Implementation • Goals and Objectives • 2016 Mitigation Action Ideas	6/25/2015
Planning Meeting #4	• Discussed STAPLEE criteria for cost/benefit review of revised action items • Discussion of lead agencies and funding sources for each of the action items, timelines for implementation and measurable outcomes • Revised actions ranked and prioritized according to STAPLEE with simple scores method	10/29/2015

Step 2: Plan for Public Involvement (Handbook Task 3)

44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

Options for soliciting public input on the Plan were discussed at the MPC Kick-Off Meeting held on March 26, 2015. SMCOG staff explained the importance of public involvement during the planning process. It was determined that SMCOG staff would advertise MPC meetings through legal notices published in the Christian County Headliner. In addition, meeting dates and invitations were posted on the SMCOG website along with drafts of the Plan for public comment during the drafting stage and prior to submission of the Plan to SEMA for approval. Press releases were sent to local news publications when the drafts of the Plan were posted to the SMCOG website for public comment during the drafting stage on October 15, 2015 and on November 30, 2015 prior to the final draft was submitted to SEMA for approval. Copies of affidavits of publication for legal notices, Screen captures of the SMCOG website, and copies

of press releases are included in Appendix C.

It was also discussed at the Kick-Off meeting that informal solicitation of public input would be sought by members of the MPC through announcements at gatherings and other public meetings such as board of alderman and local emergency planning committee meetings. This plan for public involvement did not result in any public comment on the Plan. The reasons for lack of public comment is likely due to lack of effectiveness of legal notices and web postings which would be viewed by a limited number of people as well as the complexity of local hazard mitigation plans.

Step 3: Coordinate with Other Departments and Agencies and Incorporate Existing Information (Handbook Task 3)

44 CFR Requirement 201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process. (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

As stated in Section 1.4, neighboring communities, businesses, academia, and other non-profit interests were notified via email and letters, a notification was sent to adjacent county Emergency Management Directors, Chambers of Commerce, local and regional agencies, such as; OACAC, and the University of Missouri Extension office. A complete listing of neighboring agencies invited to participate in the planning process and what meetings they were invited to attend is included in Appendix D.

Integration of Other Data, Reports, Studies, and Plans

A significant amount of information presented in the plan has been updated and revised based on the review and incorporation of existing plans, studies, reports and technical information. Appendix B contains a listing of references to plans, studies, reports and technical information to incorporate into hazard profiles, risk assessment, profile and capability sections. A few examples of information incorporated from the review of existing plans, etc. include:

- Christian County Emergency Operations Plan
- 2013 Missouri State Hazard Mitigation Plan
- State Department of Natural Resources (DNR) dam information, the National Inventory of Dams (NID), dam inspection reports,
- Missouri Department of Conservation (MDC) wildfire statistics
- Wildland/Urban Interface and Intermix areas from the SILVIS Lab - Department of Forest Ecology and Management - University of Wisconsin

Step 4: Assess the Hazard: Identify and Profile Hazards (Handbook Task 5)

At the second MPC meeting on April 29, 2015, profiles of identified hazards from the 2011 Plan were presented. Storm event data from the National Climatic Data Center for the five year period since the adoption of the 2011 Plan were included in the hazard profiles. The presentation incorporated data from studies, reports, and technical information on the available through internet research. During the process of identifying hazards the MPC reviewed:

- Previous disaster declarations in the county
- Hazards in the most recent State Hazard Mitigation Plan
- Hazards identified in the previously approved hazard mitigation plan.

The MPC was asked to prioritize the identified hazards based on probability of occurrence, human impact, property impact, and likely functional downtime of facilities and businesses. Additional information about the conclusions drawn at this meeting can be found in the Risk Assessment chapter of the Plan.

Step 5: Assess the Problem: Identify Assets and Estimate Losses

Identified assets in the planning area include population, structures, critical facilities and infrastructure, and other important assets that may be at risk to hazards. The inventory of assets for each jurisdiction were derived from parcel data from the Christian County Assessor, the Christian County Structures dataset, local jurisdiction data collection questionnaires, and HAZUS MH 2.2. Potential losses to existing development were estimated based on hazard event scenarios. In most cases the county assessor's appraised improved values were used to estimate structure losses in impacted areas for structure occupancy types. The methodology for estimating losses varies by hazard. Loss estimates are included in each hazard profile of the Risk Assessment chapter.

Step 6: Set Goals (Handbook Task 6)

The MPC conducted a discussion session during their third meeting on June 25, 2015 to review and update the plan goals. To ensure that the goals developed for this update were comprehensive and supported State goals, the 2013 State Plan goals were reviewed. The MPC also reviewed the goals from current surrounding county plans.

In the 2011 Plan, the organization of the actions included broad goals and a set of objectives linking the actions the goals. The MPC opted to keep the goals from the 2011 Plan while agreeing with modifications to the objective statements based on language from several surrounding area plans. The Plan update goals and objectives are as follows:

Goal 1 – **Protect the lives and livelihoods of all citizens.**

- **Objective 1.1** – Promote education, outreach, research and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation

- **Objective 1.2** - Provide adequate warning and communications systems to alert the public to severe hazard events

- **Objective 1.3** - Provide and promote safe refuge areas during weather extremes

Goal 2 - **Reduce the potential impact of natural disasters to property, infrastructure, and the local economy.**

- **Objective 2.1** - Protect structures, contents and critical lifelines from the impacts of natural hazard occurrence

- **Objective 2.2** - Ensure that future development in the county is as hazard proof as possible

Goal 3 - **Ensure continued operation of government, emergency functions and critical infrastructure in a disaster.**

- **Objective 3.1** - Improve the efficiency, timing, and effectiveness of response and recovery efforts for natural hazard disasters

- **Objective 3.2** - Design, enhance, or amend policies that will work to limit the impact of natural hazards

- **Objective 3.3** - Increase the capabilities to mitigate the impact of natural hazards

Step 7: Review Possible Mitigation Actions and Activities

The focus of the MPC meeting on June 25, 2015 was update of the mitigation strategy. For a comprehensive range of mitigation actions to consider, the MPC reviewed the following information during the meeting:

- A list of actions proposed in the previous mitigation plan, the current State Plan, and approved plans in surrounding counties,
- Key issues from the risk assessments, including the Problem Statements concluding each hazard profile and vulnerability analysis,
- State priorities established for Hazard Mitigation Assistance grants, and
- Input during meetings, responses to Data Collection Questionnaires

Jurisdiction representatives on the MPC were encouraged to review the details of the risk assessment vulnerability analysis specific to their jurisdiction. They were also provided a link to the FEMA's publication, *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (January 2013).* This document was developed by FEMA as a resource for identification of a range of potential mitigation actions for reducing risk to natural hazards and disasters. SMCOG staff provided a draft of the goals and mitigation alternatives to the MPC at this meeting based on the review of progress towards 2011 actions at the MPC meeting on May 6, 2015.

Step 8: Draft an Action Plan

At the final MPC meeting on October 29, 2015 all proposed actions subjected to a cost/benefit review using a modified STAPLEE scoring method. The STAPLEE scoring method is discussed in the Mitigation Strategy chapter. The method was used to develop a priority score for proposed actions. Several lower scoring actions were discarded. This meeting also included action worksheets to clarify what department or position would be responsible for implementing the action, potential funding sources, timeline, and local planning mechanisms for implementation. The action plans are listed for each jurisdiction in the Mitigation Strategy chapter.

Step 9: Adopt the Plan (Handbook Task 8)

Once the Plan is approved by SEMA and FEMA then the governing body of each jurisdiction must adopt the plan by resolution to be eligible for hazard mitigation assistance. Adoption resolutions will be collected and submitted with the final plan to SEMA and FEMA. Adoption resolutions are included in Appendix A.

Step 10: Implement, Evaluate, and Revise the Plan (Handbook Tasks 7 & 9)

At the final MPC meeting on October 29, 2015 the MPC developed and agreed upon an overall strategy for plan implementation and for monitoring and maintaining the plan over time. The overall strategy has been updated and is presented in the Plan Maintenance chapter.

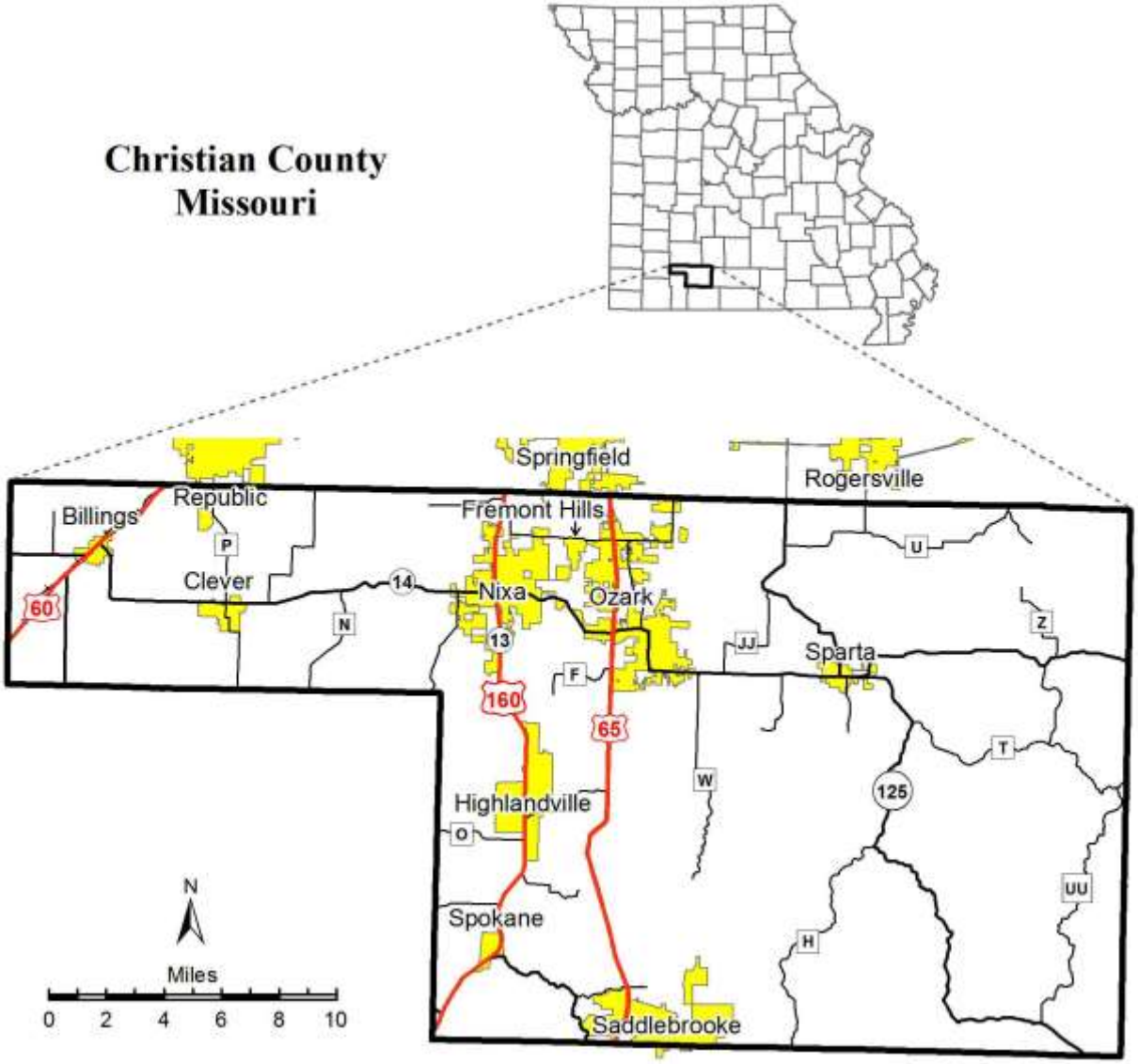
2 PLANNING AREA PROFILE AND CAPABILITIES

2.1 Christian County Planning Area Profile

Christian County is bordered by Greene, Lawrence, Stone, Taney, Douglas, and Webster Counties in southwest Missouri. Christian County is one of the fastest growing counties in the State of Missouri and is considered part of the Springfield Metropolitan Statistical Area.

Incorporated communities include the cities of Billings, Clever, Fremont Hills, Highlandville, Nixa, Ozark, Sparta and the Village of Saddlebrooke. Of these cities, Nixa and Ozark are the largest with estimated 2014 populations of 20,570 and 18,881, respectively. Saddlebrooke, which incorporated in 2002, is the smallest community with an estimated population of 231. **Figure 2.1** is a map of the county's location in Missouri.

Figure 2.1. Map of Christian County's Location in Missouri



According to the U.S. Bureau of the Census July 1, 2014 Population Estimates, the population of Christian County was 82,101. At the time of the 2000 U.S. Census the population of the county was 54,285. The percentage of population growth from 2000 to 2014 in the county was 51.2% compared to 8.37% and 13.3% for Missouri and the United States, respectively. American Community Survey five year estimates, median household income for Christian County in 2013 had risen to $52,838 from $38,085 in 2000. The percent growth in median income from 2000 to 2013 was 38.7% compared to 24.9% and 26.3% for Missouri and the United States, respectively. The median house value in the county rose 45.6% from 2000 to 2013 compared to 52.4% and 47.7% for Missouri and the United States, respectively. Christian County was the fastest growing county in Missouri from 2000 to 2010, while median household income has grown nearly equal with the median household income in the United States, growth in median house value is slightly less than Missouri and the United States in terms of growth percent.

2.1.2 Geography, Geology and Topography

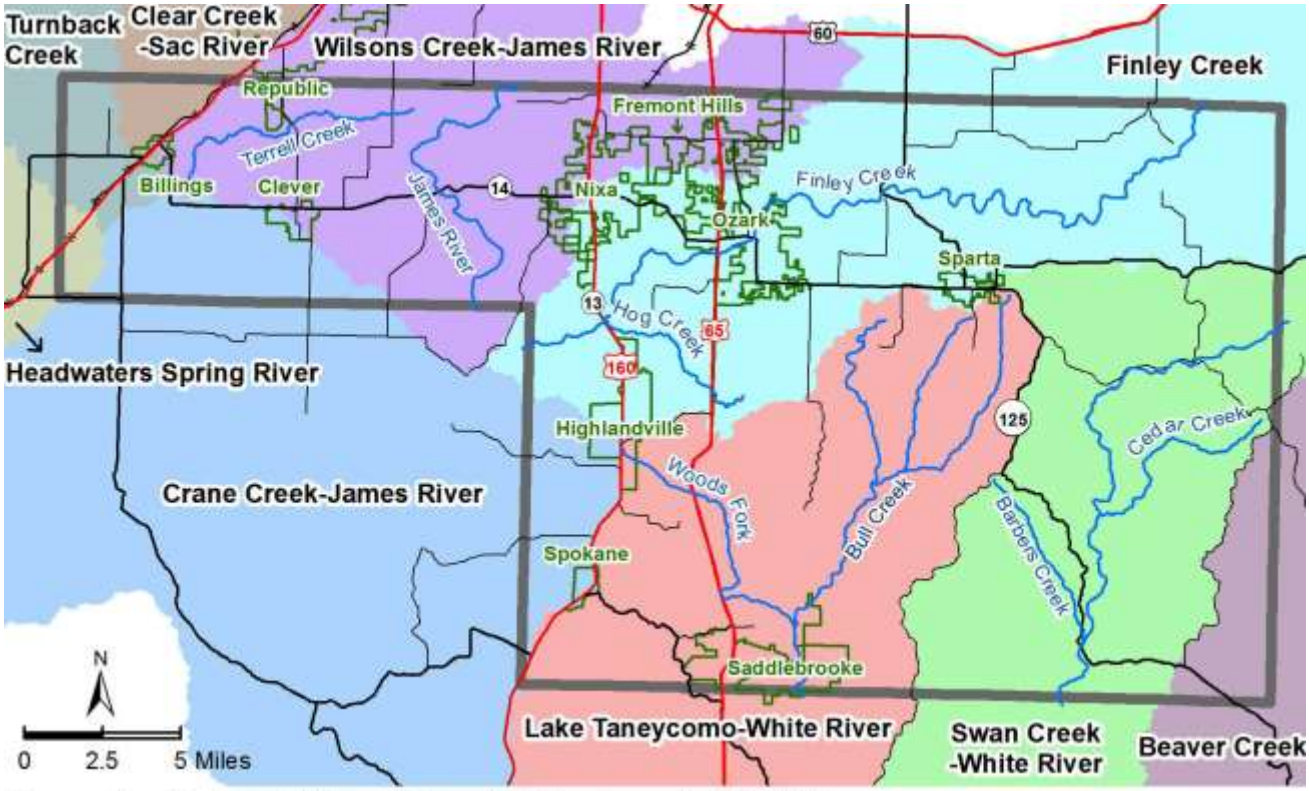
Christian County comprises 564 square miles in southwest Missouri. Of the total square miles, 99.998% is land area and .002% is water area. The county is located in the southwest portion of the Ozark Highlands ecoregion in Missouri. According to Nature Conservancy, the Ozark Highlands is diverse biologically and geographically with rugged hills, prairies, savannas, and open woodlands. The predominant underlying bedrock is carbonate (limestone and dolomite), giving rise to karst topographic features such as caves, underground streams, springs and sinkholes (TNC, 2003).

Christian County lies within the Osage River Basin, the Upper White River Basin, and the Spring River Basin. A small portion of the western panhandle of Christian County, including the City of Billings, lies within the Sac River watershed, which drains northwest to the Osage River. Also, a small portion of the panhandle area west of MO Highway 13 and south of the City of Billings lies within the Spring River Basin. Most of the county lies within the James River Basin and the Bull Shoals Lake Basin, sub-basins of the Upper White River Basin.

The northern third of the county is located in the James River Basin. From its headwaters in Webster County, the James traverses nearly ninety-nine miles through southern Greene County and Christian County, flowing in a southerly direction to where it is impounded in Table Rock Lake in Stone County. Major tributaries to the James flowing in Christian County include Finley Creek, Flat Creek, Terrell Creek, and Wilson's Creek.

There are four intermittent streams with permanent pools located in the Christian County portion of the James River Basin. "Intermittent" refers to a stream that has intervals of flow interspersed with intervals of no flow. These streams include Stewart Creek, Terrell Creek, and two unnamed laterals to Finley Creek. There are also 62 losing stream reaches. Losing stream reaches, a feature of karst topography, means the surface water goes underground (Kiner and Vitello, n.d.). **Figure 2.2** is a map of watershed boundaries is Christian County.

Figure 2.2. Christian County Watersheds



Prepared by: Southwest Missouri Council of Governments, 8/21/2015

The Ozarks Highlands are divided into subsections of ecological land types that have a similar geology, topography, climate, and vegetation patterns (Nigh and Schroeder, 2002). Christian County straddles the Springfield Plain and White River Hills Subsections of the Ozarks Highlands. Characteristics of these land types are described in The Atlas of Missouri Ecoregions:

Springfield Plain

Topography – gently undulating plain with generally low relief.

Substrate – Extensive Missipian aged Burlington Limestones with abundant chert; soils are primarily cherty silt loams and loams with a loess component; there are localized of clay fragipan soils.

Ecological System – Extensive tall grass prairie areas in the higher flat regions with open savannas and oak woodlands, some on the high-base substrates, in dissected terrain and embedded limestone glades.

White River Hills

Topography – Deeply dissected basin with extensive bedrock exposures and high-relief, steep slopes.

Substrate – Thick-bedded, shaley and cherty Ordivician dolomites with localized areas of Ordivician sandstones; high-base clayey or loamey soils derived from dolomite and some weathered acidic soils on uplands.

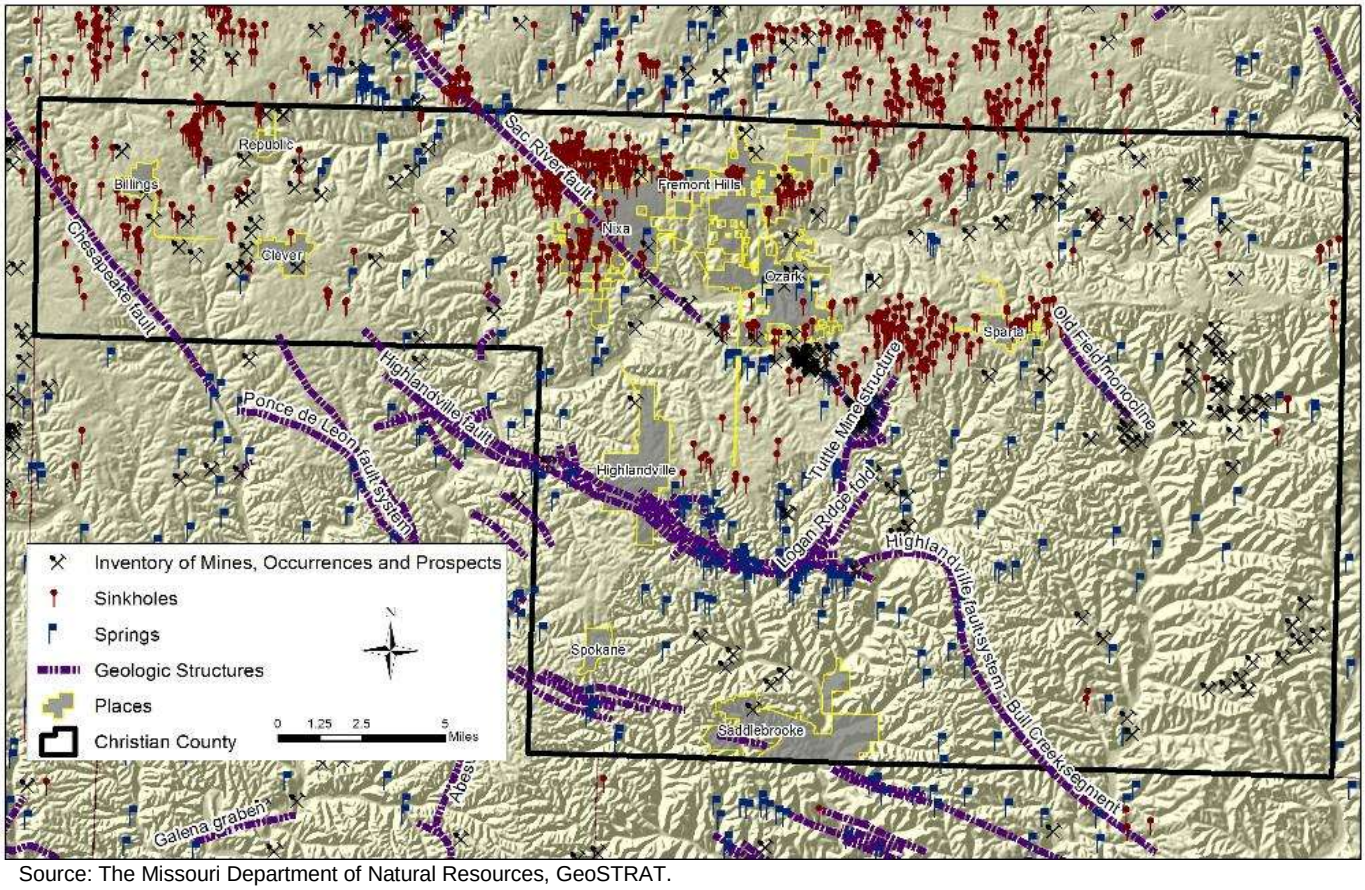
Ecological System – Extensive dolomite glades and high-base woodland complexes with stranded mesophytic woodlands on cherty ridges; pine, oak, and acid deciduous woodland

complexes on sandstone derived substrates.

Much of Christian County is considered a sensitive karst region. Karst topography occurs in regions underlain by calcium-rich limestone or dolomite bedrock. Calcium is easily dissolved by carbonates in the air and surface waters that enter fractures and joints in the bedrock. Sinkholes, caves and losing streams are produced, which after time form a vast underground drainage network connecting surface water with underlying groundwater. Karst features represent a threat to groundwater quality as surface pollutants can easily enter the groundwater system with little filtration.

Christian County has numerous sinkholes ranging in size from a few yards in diameter to several acres in area. The most extensive region of sinkholes lies just north and west of the City of Nixa. The largest sinkholes in this area are the Aven and Deffenderfer Sinks. The north central and northwestern parts of Christian County are classified by the Missouri Department of Natural Resources as a sensitive area for well construction due to the karst topography (Southwest Missouri Council of Governments, 1993). **Figure 2.3** is a map depicting geologic structures, inventory of mines, sinkholes, and springs within Christian county.

Figure 2.3. Geologic Structures and Karst Features in Christian County.



Source: The Missouri Department of Natural Resources, GeoSTRAT.

2.1.3 Climate

Christian County lies within a temperate continental climate region. This region is characterized by warm summers and moderately cool winters with heavy precipitation distributed throughout the year. Snow falls nearly every winter but the snow cover usually lasts for only a few days.

Historical surface observations from 1962 to 2013 compiled at the National Weather Service cooperative observation network site in Billings report an annual average temperature of 66.6° F. January is the coldest month with an average high temperature 41.9° F and an average low temperature of 20.3° F. July is the warmest month with an average high temperature of 88.6° F and an average low temperature of 66.4° F. Total annual precipitation is 43.23 inches. The average seasonal snowfall is approximately 16 inches. (High Plains Regional Climate Center)

2.1.4 Population/Demographics

Table 2.1 provides population information for Christian County and both the unincorporated part and incorporated places from 2000 to 2014. During this time period, 27,806 people were added to the population. The population percent change provides an indication of the rate of growth, overall the county grew 51.2% during this timeframe to 82,101 residents. Population of the cities of Nixa and Ozark increased by 8,446 and 9,206 people from 2000 to 2014, respectively. Population growth in these communities account for 63% of the increase in the county population from 2000. In addition, 7,533 people were added to the unincorporated part of the county increasing 27.1% from 2000. The city of Clever was the fastest growing community in the county, which grew 141% from 2000 to 2014 more than doubling the population to 2,434. The only other community to grow faster than the county as a whole was Marshfield, which added 1,257 people. Other communities that experienced significant growth in population were Fremont Hills and Sparta with population change percentages of 43.3% and 56.2%, respectively. The city of Billings was the only community to lose population from 2000 to 2014, population declined in Billings by 1.6% or 18 people from 2000 to 2014. The Village of Saddlebrooke was incorporated in 2002 with an estimated population of 72. Portions of Saddlebrooke lie in Taney County but the majority of its population reside in Christian County. The Saddlebrooke population living outside of Christian County was not estimated for 2014 or subtracted from in unincorporated population total for that year and may not be completely accurate.

Table 2.1. Christian County Population 2000-2014 by Community

Jurisdiction	2000 Population	2014 Population	2000-2014 # Change	2000-2014 % Change
Christian County	54,285	82,101	27,806	51.2%
Unincorporated Part	27,792	35,345	7,533	27.1%
Billings	1,091	1,073	-18	-1.6%
Clever	1,010	2,434	1,424	141%
Fremont Hills	597	856	259	43.3%
Highlandville	872	934	62	7.11%
Nixa	12,124	20,570	8,446	69.6%
Ozark	9,665	18,871	9,206	95.2%
Saddlebrooke*	-	231	231	N/A
Sparta	1,144	1,787	643	56.2%

Source: U.S. Bureau of the Census, Decennial Census 2000.

Table 2.2 provides the number of Christian County residents within specific age groups and a comparison of percentages with the state of Missouri and the United States. The percentage of population in Christian County under 5 years of age was estimated to be 7.2% according to the

American Community Survey Five–Year Estimates 2009 – 2013. This age group along with ages 5 to 9 and 10 to 14 years old were significantly higher than the percentage for Missouri and the United States at 6.4% for each. While the percentage of 15 to 19 years of olds was slightly less than Missouri and the United States, the percentage of the population from 20 to 24 years of age was significantly less than the state and national percentages for this age group. This indicates that younger populations are migrating out of the county after secondary school to seek opportunities for post-secondary employment in the Springfield metro area and elsewhere. The larger youth population and higher percentages of 35 to 54 year old population indicate that families with children are migrating into the county attracted by affordable housing and schools.

People estimated to be over 65 years of age in the county in 2013 made up 12.9% of the population compared to 14.4% and 13.4% for Missouri and the United States, respectively. The median age of county residents in 2013 was 36.9 compared to Missouri and the United States at 38 and 37.3 years of age, respectively. In 2013, there were an estimated 29,652 households in Christian County with an average household size of 2.63 compared to 2.47 and 2.63 for the state of Missouri and the United States, respectively.

Table 2.2. Christian County Population Age Composition, Missouri and United States Comparison

Age Group	# of People	Percent	Percent Missouri	Percent United States
Persons under 5 years old	5,660	7.2%	6.4%	6.4%
Persons 5 to 9 years old	6,119	7.8%	6.5%	6.6%
Persons 10 to 14 years old	6,005	7.6%	6.6%	6.6%
Persons 15 to 19 years old	5,203	6.6%	6.9%	7.0%
Persons 20 to 24 years old	4,185	5.3%	7.0%	7.1%
Persons 25 to 34 years old	10,295	13.1%	13.1%	13.4%
Persons 35 to 44 years old	11,024	14%	12.3%	13.1%
Persons 45 to 54 years old	11,075	14.1%	14.5%	14.3%
Persons 55 to 59 years old	4,668	5.9%	6.6%	6.5%
Persons 60 to 64 years old	4,359	5.5%	5.8%	5.6%
Persons 65 to 74 years old	6,085	7.7%	7.8%	7.4%
Persons 75 to 84 years old	3,205	4.1%	4.6%	4.2%
Persons 85 and older	841	1.1%	2.0%	1.8%
Total Population	78,724	-	-	-
Median age	36.9		38.0	37.3

Source: U.S. Bureau of the Census, American Community Survey, 2009 – 2013 5-Year Estimates

The University of South Carolina developed an index to evaluate and rank the ability to respond to, cope with, recover from, and adapt to disasters. The index synthesizes 30 socioeconomic variables which research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. SoVI® data sources include primarily those from the United States Census Bureau.

The Social Vulnerability Index is a composite of factors including personal wealth, age, density of the built environment, single-sector economic dependence, housing stock and tenancy, race, ethnicity, occupation, and infrastructure dependence. The 2010 SoVI® Index value for Christian

County was -3.822881. A lower value equates to lower hazard vulnerability while higher values equal greater vulnerability. Christian County's value is classified as low compared to the rest of the counties in the nation ranking in the 6.3 percentile. Values below the 20th percentile are considered to have low vulnerability while counties ranking in the top 20th percentile have high vulnerability to hazard events (Hazards and Vulnerability Research Institute).

Table 2.3 provides additional demographic and economic indicators for Christian County and incorporated communities compared to the state of Missouri and the United States. Christian County as whole had a significantly lower percentage of population unemployed and percentage of families living in poverty than the state of Missouri or the United States. In terms of education, the percentage of high school graduates were higher than the Missouri and the United States at 91.6%. The percentage of the population with a bachelor's degree or higher is slightly less than Missouri and The United States. In addition, spoken language other than English throughout the county is significantly lower than the state and national populations. The percentage of the population with a bachelor's degree or higher is significantly less.

Table 2.3. Unemployment, Poverty, Education, and Language Percentage Demographics, Christian County, Missouri

Jurisdiction	Total in Labor Force	Percent of Population Unemployed	Percent of Families Below the Poverty Level	Percentage of Population (High School graduate)	Percentage of Population (Bachelor's degree or higher)	Percentage of population (spoken language other than English
Christian County	40,409	7.6%	7.9%	91.6%	25.9%	2.3%
Billings	455	10.3%	19.7%	87.4%	15.9%	0.4%
Clever	1,076	4.1%	13.9%	91.8%	21.7%	1.6%
Fremont Hills	325	5.2%	2.9%	96.8%	56.1%	1.1%
Highlandville	626	8.9%	16.3%	89.8%	18.8%	0.7%
Nixa	10,178	7.3%	12.6%	93.6%	24%	2%
Ozark	8,644	6.8%	15.5%	90.3%	27.8%	3.7%
Saddlebrooke	150	26%	16.1%	100%	34%	1.3%
Sparta	934	8.8%	13.3%	83.1%	12.8%	2.7%
State	3,058,024	8.8%	11.1%	87.6%	26.2%	6.1%
Nation	158,301,426	9.7%	11.3%	86%	28.8%	20.7%

Source: U.S. Census Bureau, 2009-2013 5-Year American Community Survey.

The percent of population unemployed in the 2009 - 2013 American Community Survey five year estimates indicates the percentage of population that reported being unemployed at any time in the previous 12 months. The highest percentage of unemployed population was in Saddlebrooke at 26% and the lowest was in Clever at 4.1%. All incorporated communities with the exception of Fremont Hills had a significantly greater percentage of families living below the poverty level than Christian County, the state of Missouri, and the United States. Fremont Hills and the Village of Saddlebrooke have a very high percentage of the population with a bachelor's degree or higher at 56.1% and 34%, respectively. With the exception Fremont Hills, the Village of Saddlebrooke and Ozark, all other populations in the county had a lower percentage of residents with a bachelor's degree or higher. All incorporated communities and unincorporated parts of the county had a very small percentage of population that spoke another language than English.

2.1.5 History

When the first European trappers and hunters entered the Southwest Missouri region in the early 1800s, the Christian County area was occupied by the Osage Indians. The region passed from the control of the Osage to the Spanish and French until it became a territory of the United States through the Louisiana Purchase of 1803 (Christian County Centennial, 1959, p. 1). Henry Rowe Schoolcraft explored the region in 1819 and the first permanent settlers arrived within two years. The area's rivers served as the avenues for exploration and focal point for the development of the first permanent communities, such as the City of Ozark, which developed along the banks of Finley Creek. Created from territories of Greene, Taney and Webster counties, Christian County was formally organized as a county by an act of the Missouri Legislature on March 8, 1859 (Christian County Centennial, 1959). Ozark was selected as the county seat because of its central location and accessibility.

Trade roads and the advent of the railroads brought new settlement patterns and economic growth to Christian County in the later 1800s. The railroad utilized the area's timber reserves for tie production and industry. While Chadwick and Ozark became shipping centers for agricultural products to and from southern Missouri and northern Arkansas, Sparta became a center for shipping railroad ties and timber. Growth of the City of Billings, located in the fertile agricultural area in the western panhandle of Christian County, was also spurred by the extension of the St. Louis and San Francisco railroad through the area. The communities of Nixa and Clever developed along road/trade routes. Nixa developed at the intersection of the Wilderness Road leading south from Springfield and a road leading west (currently Missouri Highway 14) from the Ozark area. Clever developed as a trading post along the Old Wire road, a principal road west of the Mississippi River running from St. Louis to the southwest United States.

Rapid industrial growth in the Springfield area during the 1960s and 1970s provided employment opportunities within commuting distance for Christian County residents. During the 1980s, the county continued to attract new residents, many who desired to live in a more rural atmosphere but within close proximity to the amenities of the Springfield metropolitan area. The growth of the tourism and recreation economy in the Branson area since 1990 has served as a catalyst for rapid population growth and new residential and commercial development. Transportation system improvements to the Springfield-Branson corridor have also spurred the in-migration of residents who are within commuting distance of employment centers in Springfield and the Branson area. Overall, Christian county has been one of the fastest growing counties in Missouri since 2000. Northern Christian County continues to urbanize while the southern portions of the county remain relatively undeveloped, due principally to large acreages in the Busiek State Forest and the Mark Twain National Forest.

2.1.6 Occupations

Occupation information for the Christian County labor force comes from the American Community Survey 5-year estimates 2009 - 2013. Management, Business, Science, and Arts Occupations includes education and healthcare practitioner and technician occupations among others. Service Occupation includes healthcare support and protective services, such as firefighters and law enforcement in addition to food preparation and personal care services. The other occupation classifications are well defined. **Table 2.4** contains occupation statistics for the incorporated cities and the county as a whole.

Saddlebrooke and Fremont Hills have the highest percentages of management, business, science, and arts occupations while Clever and Sparta have the highest percentages of service occupations. Percentages of sales and office occupations in all communities is fairly equal ranging from 29.2% in Clever to 22.3% in Sparta. Highlandville and Sparta are well above the county percentage for natural resource, construction and maintenance occupations while Billings and Clever have a higher percentage of production, transportation, and material moving occupations than the county as a whole.

Table 2.4. Occupation Statistics, Christian County, Missouri

Place	Management, Business, Science, and Arts	Service Industry	Sales and Office	Natural Resources, Construction, and Maintenance	Production, Transportation, and Material Moving
Christian County	35.9%	16.7%	26.9%	8.7%	11.7%
Billings	24%	18.9%	29.7%	12%	15.4%
Clever	22.8%	21.2%	29.9%	1.5%	15.6%
Fremont Hills	54.2%	14%	29.2%	1.9%	0.6%
Highlandville	36.8%	18.6%	23.3%	15.1%	6.1%
Nixa	33.7%	18.4%	29.6%	8.3%	10%
Ozark	38.4%	16.7%	28.5%	5.2%	11.2%
Saddlebrooke	66.7%	2.7%	24.3%	4.5%	1.8%
Sparta	21.5%	27.7%	22.3%	16.8%	11.7%

Source: U.S. Census, 2013 American Community Survey, 5-year Estimates.

2.1.7 Agriculture

According to the USDA 2012 Agricultural Census, there were 1,177 farms covering 179,468 acres in Christian County. The average farm size was 152 acres, which was half of the average farm size in Missouri at 303 acres, with a market value of $24,272,000 of agricultural products sold. Of the total, $3,459,000 were crop, nursery, and greenhouse products and $20,813,000 were livestock, poultry, and their products. Beef cow production made up the majority farm activities with 15,440 head of cattle on 601 farms while forage crops produced 61,394 dry tons of hay and all haylage on 630 farms. In addition, 56% of principal operators reported a primary occupation of something other than farming. In 2013, there were an estimated 288 people employed in agriculture, fishing and hunting, and mining, making up 0.8% of the labor force.

2.1.8 FEMA Hazard Mitigation Assistance Grants in Planning Area

From 2006 – 2015, local governments in Christian County have been awarded $12,627,667 in Hazard Mitigation Assistance grants. Hazard Mitigation Assistance in the county has been used exclusively to fund the construction of FEMA saferooms in schools. **Table 2.5** lists information on Hazard Mitigation Assistance projects completed in the county.

Table 2.5. FEMA HMA Grants in Christian County from 1993-2015

Project Type	Sub applicant	Declaration Date	Project Total
Safe Room	Chadwick R-I Schools	04/05/2006	$817,482
Safe Room	Nixa R-II Schools	06/25/2008	$734,580
Safe Room	Clever R-V Schools	02/17/2009	$648,896
Safe Room	Nixa R-II Schools	02/17/2009	$1,563,577
Safe Room	Clever R-V Schools	08/17/2010	$1,803,752
Safe Room	Christian County	05/09/2011	$1,231,500
Safe Room	Nixa R-II Schools	05/09/2011	$3,227,880
Safe Room	Nixa R-II Schools	05/09/2011	$2,600,000
Total			**$12,627,667**

Source: Federal Emergency Management Agency

2.2 Jurisdictional Profiles and Mitigation Capabilities

This section will include individual profiles for each participating jurisdiction. It will also include a discussion of previous mitigation initiatives in the planning area. There will be a summary table indicating specific capabilities of each jurisdiction that relate to their ability to implement mitigation opportunities. The unincorporated county is profiled first, followed by the incorporated communities, the special districts, and the public school districts.

2.2.1 Unincorporated Christian County

Christian County's jurisdiction includes all unincorporated areas within the county boundaries. On January 1, 2015 Christian County became a first class county without a charter form of government. The governing body of Christian County is the County Commission. The Commission consists of a presiding Commissioner, a western Commissioner and an eastern Commissioner.

The County's elected governing body; the Board of County Commissioners directs the general administration of County Government. The Commission sets broad operating policies, enacts ordinances and establishes budgets as mandated by State law. The County enters into contracts with other public agencies to ensure the smooth flow of services including law enforcement, construction and maintenance of public roads, bridges and the operations of county offices, equipment and services. The departments of the County government include:

- Board of Commissioners
- County Assessor
- County Attorney
- County Auditor
- County Recorder
- County Collector
- County Treasurer
- County Coroner
- County Clerk
- Emergency Management
- Health Department
- Planning and Development
- Road Districts

Mitigation Initiatives/Capabilities

Staff capabilities to mitigate the impact of natural hazards include the planning and zoning administrator and the building code inspector and enforcement officer. There are two Certified Floodplain Managers in the planning and development department. Zoning regulations in the county prohibit development in SFHAs and violations are enforced under the adopted floodplain ordinance. The building inspector is responsible for the enforcement of IBC 2012 building codes.

The roles and responsibilities of the County Emergency Management Department include coordinating with local government officials and cooperating private organizations to: 1) prevent avoidable disasters and reduce the vulnerability of the residents to any disaster that may strike; 2) establish capabilities for protecting citizens from the effects of disasters; 3) respond effectively to the actual occurrence of disasters; and 4) provide for recovery in the aftermath of any emergency involving extensive damage within the county. The EMD is responsible for the development and maintenance of the Local Emergency Operations Plan.

Table 2.6 provides information about the mitigation capabilities and policies for the unincorporated county based on responses from the Data Collection Questionnaire.

Table 2.6. Christian County Mitigation Capabilities

Capabilities	Y/N Date	Comments
Plans		
Comprehensive Plan	Yes 9/2009	Utilized in land use decisions
Capital Improvement Plan	No	
Local Emergency Operations Plan	Yes 3/2014	Updated 1/2015
Local Recovery Plan	No	
Local Mitigation Plan	Yes	2011 Christian County HMP
Economic Development Plan	Yes 5/2013	
Transportation Plan	No	
Land-use Plan	Yes	Utilized in land use decisions
Watershed Plan	No	
Open Space/Recreation Plan	No	
Policies/Ordinance		
Zoning Ordinance	Yes 9/8/2010	Rev. Jan 2015
Building Code	Yes IBC 2012	
Floodplain Ordinance	Yes 3/15/1999	
Subdivision Ordinance	Yes 9/8/2010	
Tree Trimming Ordinance	No	
Nuisance Ordinance	Yes	Part of zoning regulations
Storm Water Ordinance	Yes 9/8/2010	
Drainage Ordinance	Yes	Part of Soil & Erosion Control
Site Plan Review Requirements	Yes	
Historic Preservation Ordinance	No	
Landscape Ordinance	No	
Program		
Zoning/Land Use Restrictions	Yes	
Codes Building Site/Design	Yes	
NFIP Participant	Yes	2 CFMs
(CRS) Participating Community	No	
Hazard Awareness Program	Yes	
National Weather Service (NWS) Storm Ready	Yes	
Economic Development Program	Yes	Partners w/ Ozark, Nixa, SREP
Public Education/Awareness	No	
Property Acquisition	No	
Planning/Zoning Boards	Yes	
Mutual Aid Agreements	Yes	
Studies/Reports/Maps		
Flood Insurance Maps	Yes	12/17/10
FEMA Flood Insurance Study (Detailed)	Yes	
Evacuation Route Map	No	
Critical Facilities Inventory	No	
Vulnerable Population Inventory	No	

Capabilities	Y/N Date	Comments
Land Use Map	Yes	
Staff/Department		
Building Code Official	Yes	Full
Building Inspector	Yes	Full
Mapping Specialist (GIS)	No	
Engineer	Yes	Full
Development Planner	Yes	Full
Public Works Official	No	
Emergency Management Director	Yes	Full
NFIP Floodplain Administrator	Yes	Full
Local Emergency Planning Committee	Yes	
Transportation Department	Yes	Highway and Bridge
Housing Authority	No	
Financial Resources	**Status**	
Ability to apply for CDBG grants	No	
Authority to levy taxes for a specific purpose	Yes	
Fees for water, sewer, gas, or electric services	No	
Impact fees for new development	Yes	
Ability to incur debt through GO bonds	Yes	
Ability to incur debt through special tax bonds	Yes	

Source: Data Collection Questionnaire, 2015

2.2.2 City of Billings

Billings is located in the northwest portion of the Christian County panhandle along U.S. Highway 60. The governing body of Billings includes the Mayor and Board of six (6) Alderman. Billings is the only city in the county to experience population decline since the 2000 census. At the time of the 2000 census the population in Billings was 1,091. The latest U.S. Census population estimate for Billings was 1,073 in 2014 for a slight 1.6% decrease in population since 2000. The City of Billings did not participate in the 2011 plan, as such, specific mitigation activities undertaken by the City have been limited. City departments include:

- Mayor/Board of Alderman
- City/Municipal Court Clerk
- City Treasurer
- Water and Sewer
- Animal Control
- City Maintenance
- Police Department
- Planning and Zoning Commission

According to the MCDC American Community Survey 2009 – 2013 profile report, 69.4% of housing units in Billings were constructed prior to 1980. Additionally, 21.9% of the population were over 65, median household income was $38,036, and 19.7% of the residents of Billings were living below the poverty level. Mitigation capabilities in Billings include:

- One (1) outdoor warning siren

- Mutual aid agreements with local governments/law enforcement
- One (1) part time building inspector/code official

Table 2.7 Provides information for the City of Billings mitigation capabilities based on responses to the Data Collection Questionnaire.

Table 2.7. City of Billings Mitigation Capabilities

Capabilities	Y/N Date	Comments
Plans		
Comprehensive Plan	Yes 1994	Has not been updated
Capital Improvement Plan	No	
Local Emergency Operations Plan	Yes	Represented on LEPC
Local Recovery Plan	No	
Local Mitigation Plan	No	
Economic Development Plan	Yes	
Transportation Plan	No	
Land-use Plan	Yes	1994
Watershed Plan	No	
Open Space/Recreation Plan	No	
Policies/Ordinance		
Zoning Ordinance	Yes	
Building Code	Yes IBC 2009	
Floodplain Ordinance	Yes	
Subdivision Ordinance	Yes	
Tree Trimming Ordinance	No	
Nuisance Ordinance	Yes	
Storm Water Ordinance	No	
Drainage Ordinance	No	
Site Plan Review Requirements	Yes	
Historic Preservation Ordinance	No	
Landscape Ordinance	Yes	
Program		
Zoning/Land Use Restrictions	Yes	
Codes Building Site/Design	Yes	
NFIP Participant	Yes	
(CRS) Participating Community	No	
Hazard Awareness Program	No	
National Weather Service (NWS) Storm Ready	No	
Economic Development Program	Yes	Economic Development Committee
Public Education/Awareness	No	
Property Acquisition	No	
Planning/Zoning Boards	Yes	
Mutual Aid Agreements	Yes	
Studies/Reports/Maps		
Flood Insurance Maps	Yes	12/17/10
FEMA Flood Insurance Study (Detailed)	No	
Evacuation Route Map	No	
Critical Facilities Inventory	No	
Vulnerable Population Inventory	No	
Land Use Map	Yes	
Staff/Department		
Building Code Official	Yes	Part time
Building Inspector	Yes	Part time
Mapping Specialist (GIS)	No	

Capabilities	Y/N Date	Comments
Engineer	Yes	Full
Development Planner	No	
Public Works Official	Yes	Full
Emergency Management Director	Yes	Part time
NFIP Floodplain Administrator	No	
Local Emergency Planning Committee	No	
Transportation Department	No	
Housing Authority	Yes	
Financial Resources	**Status**	
Ability to apply for CDBG grants	Yes	
Authority to levy taxes for a specific purpose	Yes	
Fees for water, sewer, gas, or electric services	Yes	Water & Sewer
Impact fees for new development	No	
Ability to incur debt through GO bonds	Yes	
Ability to incur debt through special tax bonds	Yes	

Source: Data Collection Questionnaire

2.2.3 City of Clever

Clever is located in the western panhandle of Christian County along State Highway 14. The governing body of Clever includes the Mayor and Board of four (4) Alderman. Clever has been the fastest growing city in Christian County in terms of percent change since 2000. At the time of the 2000 census the population in Clever was 1,010. The latest U.S. Census population estimate for Clever was 2,434 in 2014 representing 140% growth in population since 2000. City departments include:

- Mayor/Board of Alderman
- City/Municipal Court Clerk
- Utilities Department
- Parks Department
- Animal Control
- City Maintenance
- Police Department
- Planning and Zoning Commission

According to the MCDC American Community Survey 2009 – 2013 profile report, 46.5% of housing units in Clever were constructed in 2000 or later. Additionally, 10.1% of the population were over 65, median household income was $51,528, and 13.9% of the residents of Clever were living below the poverty level. Mitigation capabilities/activities in Clever include:

- One (1) outdoor warning siren
- Mutual aid agreements with local governments/law enforcement
- One (1) full time building inspector/code official
- Reverse 911
- Two community safe rooms in Clever schools

Table 2.8 provides information on The City of Clever mitigation capabilities based on the Data

Collection Questionnaire.

Table 2.8. City of Clever Mitigation Capabilities

Capabilities	Y/N Date	Comments
Plans		
Comprehensive Plan	Yes 4/1999	Has not been updated
Capital Improvement Plan	Yes 8/2015	
Local Emergency Operations Plan	Yes	Represented on LEPC
Local Recovery Plan	No	
Local Mitigation Plan	Yes	2011 Christian County HMP
Economic Development Plan	No	
Transportation Plan	No	
Land-use Plan	Yes	Updating now
Watershed Plan	No	
Open Space/Recreation Plan	No	
Policies/Ordinance		
Zoning Ordinance	Yes	
Building Code	Yes	BOCA 2000
Floodplain Ordinance	Yes	2010
Subdivision Ordinance	Yes	Updating Now
Tree Trimming Ordinance	No	
Nuisance Ordinance	Yes	
Storm Water Ordinance	Yes	Updating Now
Drainage Ordinance	Yes	Updating Now
Site Plan Review Requirements	Yes	
Historic Preservation Ordinance	No	
Landscape Ordinance	Yes	Updating Now
Program		
Zoning/Land Use Restrictions	Yes	
Codes Building Site/Design	Yes	
NFIP Participant	Yes	
(CRS) Participating Community	No	
Hazard Awareness Program	No	
National Weather Service (NWS) Storm Ready	No	
Economic Development Program	No	
Public Education/Awareness	No	
Property Acquisition	No	
Planning/Zoning Boards	Yes	
Mutual Aid Agreements	Yes	
Studies/Reports/Maps		
Flood Insurance Maps	Yes	12/17/10
FEMA Flood Insurance Study (Detailed)	No	
Evacuation Route Map	Yes	
Critical Facilities Inventory	Yes	
Vulnerable Population Inventory	Yes	
Land Use Map	Yes	
Staff/Department		
Building Code Official	Yes	
Building Inspector	Yes	
Mapping Specialist (GIS)	No	
Engineer	Yes	
Development Planner	No	
Public Works Official	Yes	

Capabilities	Y/N Date	Comments
Emergency Management Director	Yes	
NFIP Floodplain Administrator	No	
Local Emergency Planning Committee	Yes	
Transportation Department	No	
Housing Authority	Yes	Senior Housing
Financial Resources	**Status**	
Ability to apply for CDBG grants	Yes	
Authority to levy taxes for a specific purpose	Yes	
Fees for water, sewer, gas, or electric services	Yes	Water & Sewer
Impact fees for new development	Yes	
Ability to incur debt through GO bonds	Yes	
Ability to incur debt through special tax bonds	Yes	

Source: Data Collection Questionnaire

2.2.4 City of Fremont Hills

The City of Fremont Hills was incorporated in 1986 and is located between Nixa and Ozark along Highway CC in north central Christian County. There are three wards, with two aldermen from each ward on the City Council, a Mayor, Deputy Clerk, and Project Manager. In 2000 a Planning and Zoning Commission were appointed and a set of building codes was adapted. The City operates and maintains its own Waste Water Treatment Plant that was upgraded in 2009/2010. The population of Fremont Hills has grown 43.3% from 2000 to 2014 from 597 to 856 people. City departments include:

- Mayor/Board of Alderman
- Deputy Clerk
- Project Manager
- Planning and Zoning Board

According to the MCDC American Community Survey 2009 – 2013 profile report, 66.9% of housing units in Fremont Hills were constructed in 1990 or later. Additionally, 22.8% of the population were over 65, median household income was $98,750, and 2.9% of the residents of Fremont Hills were living below the poverty level. Mitigation capabilities/activities in Fremont Hills include:

- No (0) outdoor warning sirens
- Mutual aid agreements with local governments/law enforcement
- Full time contract building inspector/code official with the County
- Host CERT training for Residents and City Officials
- Website and e-mail to resident group

Table 2.9 provides information on The City of Clever mitigation capabilities based on the Data Collection Questionnaire.

Table 2.9. City of Fremont Hills Mitigation Capabilities

Capabilities	Y/N Date	Comments
Plans		
Comprehensive Plan	Yes 2000	
Capital Improvement Plan	No	
Local Emergency Operations Plan	Yes	Represented on LEPC
Local Recovery Plan	No	
Local Mitigation Plan	Yes	2011 Christian County HMP
Economic Development Plan	No	

Capabilities	Y/N Date	Comments
Transportation Plan	No	
Land-use Plan	Yes	
Watershed Plan	No	
Open Space/Recreation Plan	No	
Policies/Ordinance		
Zoning Ordinance	Yes	Adopted in 2000
Building Code	Yes 2006	County provides BOCA code enforcement
Floodplain Ordinance	Yes	9-16-2010
Subdivision Ordinance	Yes	Adopted in 2000
Tree Trimming Ordinance	Yes	
Nuisance Ordinance	Yes	
Storm Water Ordinance	No	
Drainage Ordinance	No	
Site Plan Review Requirements	Yes	
Historic Preservation Ordinance	No	
Landscape Ordinance	Yes	
Program		
Zoning/Land Use Restrictions	Yes	
Codes Building Site/Design	Yes	
NFIP Participant	Yes	
(CRS) Participating Community	No	
Hazard Awareness Program	No	
National Weather Service (NWS) Storm Ready	No	
Economic Development Program	No	
Public Education/Awareness	No	
Property Acquisition	Yes	P & Z Codes--annexation
Planning/Zoning Boards	Yes	
Mutual Aid Agreements	Yes	
Studies/Reports/Maps		
Flood Insurance Maps	Yes	12/17/10
FEMA Flood Insurance Study (Detailed)	Yes	County
Evacuation Route Map	Yes	
Critical Facilities Inventory	Yes	
Vulnerable Population Inventory	Yes	
Land Use Map	Yes	
Staff/Department		
Building Code Official	Yes	FT Contract With Christian County
Building Inspector	Yes	FT Contract With Christian County
Mapping Specialist (GIS)	No	
Engineer	Yes	Contract
Development Planner	No	
Public Works Official	No	
Emergency Management Director	Yes	Mayor
NFIP Floodplain Administrator	No	City Project Manager
Local Emergency Planning Committee	Yes	
Transportation Department	No	
Housing Authority	No	
Financial Resources	**Status**	
Ability to apply for CDBG grants	No	
Authority to levy taxes for a specific purpose	Yes	
Fees for water, sewer, gas, or electric services	Yes	Sewer Only
Impact fees for new development	Yes	
Ability to incur debt through GO bonds	Yes	
Ability to incur debt through special tax bonds	Yes	

Source: Data Collection Questionnaire

2.2.5 City of Nixa

Nixa is located six miles south of Springfield, Missouri, and 30 miles north of Branson, Missouri, on Highway 160, just four miles west of U.S. Hwy 65. In April of 2010, Nixa citizens voted to become a home rule charter city. The city is governed by a Mayor and six (6) City Council members. As one of the fastest growing cities in Missouri, according to the 2010 U.S. Census, Nixa's population has grown from 12,124 in 2000 to 20,570 in 2014, equating to a percent change of 69.6%. City Departments include:

- Mayor/City Council
- City Administrator
- City Clerk
- Customer Service
- Economic Development
- Finance
- Human Resources
- Municipal Court
- Parks & Recreation
- Planning and Development
- Police Department
- Public Works
- Recycling Center
- Purchasing
- Utilities

Nixa is a full-utility-service City, providing all electrical distribution, delivery of water, sanitary sewer treatment and all levels of recycling. The City purchases its electricity from Springfield City Utilities and Southwest Power Administration. All of Nixa's water is pumped from the underground Ozark aquifer. Its state of the art, 4-million gallon/day sanitary sewer treatment facility accommodates all existing and near term future demands.

- Nine (9) outdoor warning sirens
- Mutual aid agreements with local governments/law enforcement
- Full time contract building inspector/code official with the County

Table 2.10 provides information on The City of Nixa mitigation capabilities based on the Data Collection Questionnaire.

Table 2.10. City of Nixa Mitigation Capabilities

Capabilities	Y/N Date	Comments
Plans		
Comprehensive Plan	Yes 2014	
Capital Improvement Plan	Yes 2015	
Local Emergency Operations Plan	Yes 2014	Represented on LEPC
Local Recovery Plan	No	
Local Mitigation Plan	Yes	2011 Christian County HMP

Capabilities	Y/N Date	Comments
Economic Development Plan	Yes	
Transportation Plan	Yes	OTO Technical Committee
Land-use Plan	Yes	
Watershed Plan	No	
Open Space/Recreation Plan	Yes	
Policies/Ordinance		
Zoning Ordinance	Yes	
Building Code	Yes 2012	IBC
Floodplain Ordinance	Yes	9-16-2010
Subdivision Ordinance	Yes	
Tree Trimming Ordinance	Yes	3/14/2011
Nuisance Ordinance	Yes	7/2011
Storm Water Ordinance	Yes	Subdivision ordinance
Drainage Ordinance	Yes	Subdivision ordinance
Site Plan Review Requirements	Yes	
Historic Preservation Ordinance	No	
Landscape Ordinance	Yes	
Program		
Zoning/Land Use Restrictions	Yes	
Codes Building Site/Design	Yes	
NFIP Participant	Yes	
(CRS) Participating Community	No	
Hazard Awareness Program	No	
National Weather Service (NWS) Storm Ready	No	
Economic Development Program	Yes	Partners w/ County, Ozark, SREP
Public Education/Awareness	No	
Property Acquisition	Yes	
Planning/Zoning Boards	Yes	
Mutual Aid Agreements	Yes	
Studies/Reports/Maps		
Flood Insurance Maps	Yes	12/17/10
FEMA Flood Insurance Study (Detailed)	Yes	County
Evacuation Route Map	No	
Critical Facilities Inventory	No	
Vulnerable Population Inventory	No	
Land Use Map	Yes	
Staff/Department		
Building Code Official	Yes	1 Full Time
Building Inspector	Yes	2 Full Time
Mapping Specialist (GIS)	Yes	Full Time
Engineer	Yes	Contract
Development Planner	Yes	
Public Works Official	Yes	
Emergency Management Director	Yes	MOU Christian County EMD
NFIP Floodplain Administrator	Yes	City Planner
Local Emergency Planning Committee	Yes	Mayor, Appointees
Transportation Department	Yes	
Housing Authority	No	
Financial Resources	**Status**	
Ability to apply for CDBG grants	Yes	Targeted Areas
Authority to levy taxes for a specific purpose	Yes	
Fees for water, sewer, gas, or electric services	Yes	Electric, Sewer, & Water
Impact fees for new development	Yes	
Ability to incur debt through GO bonds	Yes	
Ability to incur debt through special tax bonds	Yes	

2.2.6 City of Ozark

Ozark is along U.S. Highway 65, approximately one mile south of the southern corporate limits of Springfield, Missouri in north central Christian County. Ozark is the county seat and second largest city in Christian County. Ozark is governed by a Mayor and a Board of four (4) Alderman. Ozarks population has grown 95.2% from 2000 to 2014. At the time of the 2000 census the population was 9,665 people compared to the U.S. Census population estimate for 2014 of 18,871. City Departments include:

- Mayor/Board of Alderman
- City Administrator
- Human Resources
- City Clerk
- Parks and Recreation
- Public Works
- Police Department
- Planning and Development
- Municipal Court
- Finance Department

According to the MCDC American Community Survey 2009 – 2013 profile report, 69.4% of housing units in Ozark were constructed in 1990 or later. Additionally, 12% of the population were over 65, median household income was $46,668, and 15.5% of the residents of Ozark were living below the poverty level. Mitigation capabilities/activities in Ozark include:

- Eight (8) outdoor warning sirens
- Public education programs
- Bicycle safety programs and
- Child safety seat training

Table 2.11 provides information on The City of Ozark mitigation capabilities based on the Data Collection Questionnaire.

Table 2.11. City of Ozark Mitigation Capabilities

Capabilities	Y/N Date	Comments
Plans		
Comprehensive Plan	Yes 2008	
Capital Improvement Plan	Yes	
Local Emergency Operations Plan	Yes 2014	Represented on LEPC
Local Recovery Plan	No	
Local Mitigation Plan	Yes	2011 Christian County HMP
Economic Development Plan	Yes	
Transportation Plan	Yes	OTO Technical Committee
Land-use Plan	Yes	
Watershed Plan	No	
Open Space/Recreation Plan	Yes	
Policies/Ordinance		
Zoning Ordinance	Yes	4/6/2009
Building Code	Yes 2012	IBC
Floodplain Ordinance	Yes	4/6/2009

Capabilities	Y/N Date	Comments
Subdivision Ordinance	Yes	4/6/2009
Tree Trimming Ordinance	Yes	3/21/2005
Nuisance Ordinance	Yes	
Storm Water Ordinance	Yes	Subdivision ordinance
Drainage Ordinance	Yes	Subdivision ordinance
Site Plan Review Requirements	Yes	
Historic Preservation Ordinance	Yes	
Landscape Ordinance	Yes	
Program		
Zoning/Land Use Restrictions	Yes	
Codes Building Site/Design	Yes	
NFIP Participant	Yes	
(CRS) Participating Community	No	
Hazard Awareness Program	Yes	
National Weather Service (NWS) Storm Ready	No	
Economic Development Program	Yes	Partners w/ County, Nixa, SREP
Public Education/Awareness	No	
Property Acquisition	Yes	
Planning/Zoning Boards	Yes	
Mutual Aid Agreements	Yes	
Studies/Reports/Maps		
Flood Insurance Maps	Yes	12/17/10
FEMA Flood Insurance Study (Detailed)	Yes	County
Evacuation Route Map	No	
Critical Facilities Inventory	No	
Vulnerable Population Inventory	No	
Land Use Map	Yes	
Staff/Department		
Building Code Official	Yes	1 Full Time
Building Inspector	Yes	1 Full Time
Mapping Specialist (GIS)	Yes	Full Time
Engineer	Yes	Contract
Development Planner	Yes	
Public Works Official	Yes	
Emergency Management Director	Yes	City Administrator
NFIP Floodplain Administrator	Yes	Planning and Development Appointee
Local Emergency Planning Committee	Yes	Mayor, Appointees
Transportation Department	No	Ozark Special Road District
Housing Authority	No	
Financial Resources	**Status**	
Ability to apply for CDBG grants	Yes	Targeted Areas
Authority to levy taxes for a specific purpose	Yes	
Fees for water, sewer, gas, or electric services	Yes	Sewer, & Water
Impact fees for new development	Yes	
Ability to incur debt through GO bonds	Yes	
Ability to incur debt through special tax bonds	Yes	

Source: Data Collection Questionnaire

Table 2.12 summarizes the mitigation capabilities of the county and unincorporated cities. For each capability, a "yes" or "no" indicates if the capability is in place and other relevant information, such as the most recent version of a comprehensive plan and building codes.

Table 2.12. Mitigation Capabilities Summary Table

Capabilities	Christian County	Billings	Clever	Fremont Hills	Nixa	Ozark
Planning Capabilities						
Comprehensive Plan	2009	1994	1999	2000	2014	2008
Capital Improvement Plan	No	No	Yes	No	Yes	Yes
Local Emergency Operations Plan	Yes	Yes	Yes	Yes	Yes	Yes
Local Recovery Plan	No	No	No	No	No	No
Local Mitigation Plan	Yes	No	Yes	Yes	Yes	Yes
Economic Development Plan	Yes	Yes	No	No	Yes	Yes
Transportation Plan	No	No	No	No	Yes	Yes
Land-use Plan	Yes	Yes	Yes	Yes	Yes	Yes
Watershed Plan	No	No	No	No	No	No
Open Space/Recreation Plan	No	No	No	No	Yes	Yes
Policies/Ordinance						
Zoning Ordinance	Yes	Yes	Yes	Yes	Yes	Yes
Building Code	IBC 2012	IBC 2009	BOCA 2000	BOCA 2006	IBC 2012	IBC 2012
Floodplain Ordinance	Yes	Yes	Yes	Yes	Yes	Yes
Subdivision Ordinance	Yes	Yes	Yes	Yes	Yes	Yes
Tree Trimming Ordinance	No	No	No	Yes	Yes	Yes
Nuisance Ordinance	Yes	Yes	Yes	Yes	Yes	Yes
Storm Water Ordinance	Yes	No	Yes	No	Yes	Yes
Drainage Ordinance	Yes	No	Yes	No	Yes	Yes
Site Plan Review Requirements	Yes	Yes	Yes	Yes	Yes	Yes
Historic Preservation Ordinance	No	No	No	No	No	Yes
Landscape Ordinance	No	Yes	Yes	Yes	Yes	Yes
Program						
Zoning/Land Use Restrictions	Yes	Yes	Yes	Yes	Yes	Yes
Codes Building Site/Design	Yes	Yes	Yes	Yes	Yes	Yes
NFIP Participant	Yes	Yes	Yes	Yes	Yes	Yes
(CRS) Participating Community	No	No	No	No	No	No
Hazard Awareness Program	Yes	No	No	No	No	Yes
NWS Storm Ready	Yes	No	No	No	No	Yes
Economic Development Program	Yes	Yes	No	No	Yes	Yes
Public Education/Awareness	No	No	No	No	No	No
Property Acquisition	No	No	No	Yes	Yes	Yes
Planning/Zoning Boards	Yes	Yes	Yes	Yes	Yes	Yes
Mutual Aid Agreements	Yes	Yes	Yes	Yes	Yes	Yes
Studies/Reports/Maps						
Flood Insurance Maps	Yes	Yes	Yes	Yes	Yes	Yes

Capabilities	Christian County	Billings	Clever	Fremont Hills	Nixa	Ozark
FEMA Flood Insurance Study	Yes	No	No	Yes	Yes	Yes
Evacuation Route Map	No	No	Yes	Yes	Yes	No
Critical Facilities Inventory	No	No	Yes	Yes	No	No
Vulnerable Population Inventory	No	No	Yes	Yes	No	No
Land Use Map	Yes	Yes	Yes	Yes	Yes	Yes
Staff/Department						
Building Code Official	Yes	Yes	Yes	Yes	Yes	Yes
Building Inspector	Yes	Yes	Yes	Yes	Yes	Yes
Mapping Specialist (GIS)	No	No	No	No	Yes	Yes
Engineer	Yes	Yes	Yes	Yes	Yes	Yes
Development Planner	Yes	No	No	No	Yes	Yes
Public Works Official	No	Yes	Yes	No	Yes	Yes
Emergency Management Director	Yes	Yes	Yes	Yes	Yes	Yes
NFIP Floodplain Administrator	Yes	No	No	No	Yes	Yes
Local Emergency Planning Committee	Yes	No	Yes	Yes	Yes	Yes
Transportation Department	Yes	No	No	No	Yes	No
Housing Authority	No	Yes	Yes	No	No	No
Financial Resources						
Apply for CDBG grants	No	Yes	Yes	No	Yes	Yes
Authority to levy taxes for specific purposes	Yes	Yes	Yes	Yes	Yes	Yes
Fees for water, sewer, gas, or electric services	No	Yes	Yes	Yes	Yes	Yes
Impact fees for new development	Yes	No	Yes	Yes	Yes	Yes
Incur debt through general obligation bonds	Yes	Yes	Yes	Yes	Yes	Yes
Incur debt through special tax bonds	Yes	Yes	Yes	Yes	Yes	Yes

Source: Data Collection Questionnaires, 2015

2.2.7 Billings Special Road District

The Billings Special Road District service area includes approximately 48 square miles in the western Christian County panhandle and includes the City of Billings and portions of the City of Clever. The district is responsible for maintaining county roads within its service area. The District is governed by three road commissioners elected by voters within the district. The District is funded by a combination of state motor fuel tax, assessed rural land valuation and vehicle license fees distributed to road districts by the county commission, based in part by road mileage. The Districts exposure includes:

- Two Buildings (One office/storage, one maintenance shop/storage)
- 92.4 miles of road (44 miles hot mix overlay, 48 miles chip & seal, and .4 miles gravel)
- 292 culverts, 35 box culverts, six bridges, and two low water crossings

Responsibilities of the Special Road Districts include, but are not limited to, providing for debris removal, making emergency road repairs, and coordinating restoration of utility services, especially for critical and essential facilities. They also assist with search and heavy rescue operations, survey public works damage and report information to the County EMD.

The District owns and operates snow plowing equipment for road clearing during severe winter weather events. The District also implements a road improvements program for addressing maintenance of District roads. The improvements program is considered a mechanism for incorporating hazard mitigation activities. Since 2011 the District has installed transfer switches and generators at the district shop and office. In addition, the District has replaced and increased the hydraulic capacity of culverts at six locations. The District is currently in the process of replacing damaged low water warning signs and gauges. The District has plans to continue culvert and bridge upgrades in hazard prone areas. Mitigation capabilities of the District include:

- Major road planning
- Ability to fund projects through Capital Improvements Funding
- Vegetation management program
- Snow and ice removal plan
- Representation on the LEPC
- Culvert Capacity/Threshold analysis
- Road signage with high intensity facing

2.2.8 Christian County Ambulance District

Christian County Ambulance District (CCAD) is an advanced life support property tax based Ambulance District that services all but the western portion of Christian County, Missouri. The District's service are covers 562 square miles and serves a population of 79,824. CCAD is licensed by the Missouri Bureau of Emergency Medical Services and currently contracts EMS to CoxHealth, which is a hospital-based EMS system. CCAD is very active in public education programs and contributes to the community in various forms from working with the local school districts for community education programs, partnering with local business organizations for public health issues and planning. CCAD is governed by six-elected board members for the Board of Directors and day to day operations are overseen by the District Executive Administrator. The Districts exposure includes:

- Four (4) permanent base stations
- Ten (10) Ambulances
- Miscellaneous equipment and contents

The Christian County Ambulance District is seeking to place a dual annexation measure on the April 5, 2016 election ballot in Christian and Stone counties. This election will require majority vote from current ambulance district members as well as a majority vote from the areas wishing to be annexed in the Clever Fire department response areas in Christian and northern Stone counties and the Highlandville Fire departments response areas in northern Stone county. The District has plans to construct two additional base stations. One in Ozark and another in Clever depending on the outcome of the April 2016 annexation measure.

List past or ongoing projects or programs designed to reduce disaster losses such as a levee or flood wall protecting a portion of the facility. District mitigation-related capabilities include:

- On-site warning sirens
- Weather radios
- Mutual aid agreements in place
- Ability to fund projects through Capital Improvements planning
- Community outreach programs
- Financial Resources from Impact fees for new development
- EMT training and public education/safety training

2.2.9 Ozarks Technical Community College

Ozarks Technical Community College (OTC) was founded April 3, 1990 when the residents of Springfield and thirteen surrounding public school districts voted to establish a community technical college. The OTC main campus is located in Springfield, Missouri. OTC also has satellite campuses in Christian Laclede, Pulaski, and Taney counties in Missouri. To keep pace with demands for program offerings, facility needs, and projected continued, rapid population growth, OTC purchased a 78 acre site for development of a South Campus, located north of Highway 14 and west of U.S. Highway 65 in Ozark. Now known as the Richwood Valley Campus. The Richwood Valley Campus has grown into the second largest in the OTC system. The campus consists of the Life Science and Technology Center located at 3369 W. Jackson St. in Ozark a FEMA saferoom, and a greenway trail segment. Campus exposure includes:

- Student amenities include a full-service Student Services facility, Cashier, Library, Tutoring and Learning center, Proctored and COMPASS testing and a student café.
- A 1.5-mile trail system is available for the use of our students, faculty, and staff. The general public is also welcome to use our trail system during normal hours of operation.
- Campus enrollment, faculty, and staff (1,075 people)
- A FEMA tornado shelter provides a safe environment for students and community members should severe weather threaten the area.

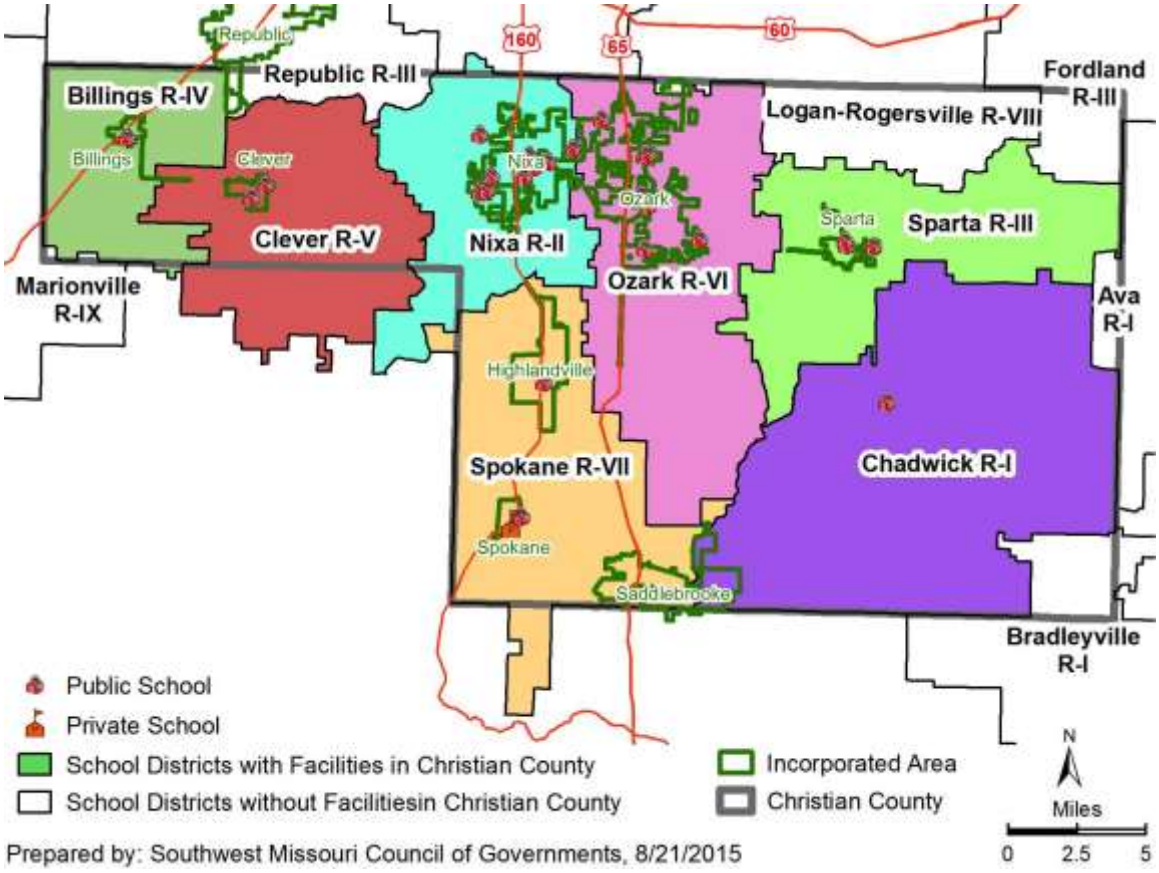
The college is governed by the OTC Board of Trustees. The Board consists six (6) trustees. The OTC Board of Trustees plans to construct an additional five classrooms at the Richwood Valley Campus. The current plan is to build the classrooms inside of the FEMA saferoom. The cost of construction is estimated to be $1,200,000. This additional asset exposure would be mitigated due to construction within the FEMA saferoom. Mitigation capabilities for OTC include:

- Master Plan
- Capital Improvement Plan
- Emergency Plan
- Weapons Policy
- Full Time Building Official (Campus President)
- Administrative Services
- Public Information Officer
- NOAA radios
- FEMA saferoom

2.2.10 Public School District Profiles and Mitigation Capabilities

This section provides general information about participating school districts in the Plan. There are seven school districts with facilities in Christian County. Other school district boundaries include areas of Christian County but do not have any facilities within the county. The Logan-Rogersville and Republic school districts participate in the Greene County Natural Hazard Mitigation Plan while the Bradleyville school district participates in the Taney County Natural Hazard Mitigation Plan. Clever, Nixa, and Spokane school district boundaries include areas of other counties but all school district facilities are located within Christian County. **Figure 2.4** is a map of school district boundaries in Christian County.

Figure 2.4. Christian County School Districts



All school districts with facilities in Christian County participated in the Plan update with the exception of Sparta R-V School District. The following profiles for each school district participating in the Plan provide information about district buildings, enrollment and mitigation capabilities.

Billings R-IV School District

All of Billings R-IV School District facilities are within the City of Billings. **Table 2.13** provides building and enrollment information.

Table 2.13. School District Buildings and Enrollment Data, Billings R-IV

Building Name	Address	Building Enrollment
Billings Sr. High	118 W. Mt. Vernon, Billings MO	191
Billings Elementary	118 W. Mt. Vernon, Billings MO	218

http://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx

Billings R-IV Schools are governed by Board of Education consisting of the Board President and six (6) Board members. The District serves over 400 students and employs approximately 60 teachers and staff. District departments include:

- Transportation
- Cafeteria Services
- Custodial Services
- Health Services
- Central Office

The District is currently in the process of applying for a hazard mitigation grant to construct a FEMA saferoom. **Table 2.14** provides responses to the Data Collection Questionnaire for school districts.

Table 2.14. Billings R-IV School District Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Elements	
Master Plan/Date	No
Capital Improvement Plan/Date	No
School Emergency Plan	Yes
Weapons Policy/Date	Yes
Personnel Resources	**Status Including Date of Document or Policy**
Full-Time Building Official	Yes
Emergency Manager	No
Grant Writer	No
Public Information Officer	Yes
Financial Resources	**Status Including Date of Document or Policy**
Capital Improvements Project Funding	Yes
Local Funds	No
General Obligation Bonds	No
Special Tax Bonds	Yes
Private Activities Donations	Yes
State and Federal Grant Funds	Yes

Capability	Status Including Date of Document or Policy
Other	
Fire Evacuation Training	Yes
Tornado Sheltering Exercises	Yes
Public Address/Emergency Alert System	Yes
NOAA Weather Radios	Yes
Tornado Shelter/Saferoom	No
Campus Police	No

Source: Data Collection Questionnaire

Chadwick R-I School District

Chadwick is an unincorporated place approximately five miles south of Sparta. Chadwick R-I facilities are located along State Highway 125 in rural eastern Christian County. The District is currently building a 5,400 foot preschool facility located east of the current school structure. **Table 2.15** provides building and enrollment information for Chadwick schools.

Table 2.15. School District and Building Enrollment Data, Chadwick R-I

Building	Address	Building Enrolment
Elementary	7090 State Highway 125	139
High School	7090 State Highway 125	73

Chadwick R-I Schools are governed by Board of Education consisting of the Board President and six (6) Board members. The District serves over 200 students and employs approximately 45 teachers and staff. District departments include:

- Administration
- Food Services
- Technology Services
- Health Services
- Transportation Services

The District has constructed two FEMA saferoom locations within existing facilities. **Table 2.16** provides mitigation capabilities for the District based on responses from the Data Collection Questionnaire for school districts.

Table 2.16. Chadwick R-I School District Mitigation Capabilities

Capability		
Planning Elements	**Y/N**	**Date of Latest Version**
Master Plan/Date	Y	8/20/2015
Capital Improvement Plan/Date	Y	8/20/2015
School Emergency Plan	Y	8/20/2015

Weapons Policy/Date	Y	8/20/2015
Personnel Resources	**Y/N**	**Department/Position**
Full-Time Building Official	Y	Principal & Superintendent K-12
Emergency Manager	Y	Principal & Superintendent K-12
Grant Writer	Y	Principal & Superintendent K-12
Public Information Officer	Y	Principal & Superintendent K-12
Financial Resources	**Accessible/Eligible to Use (Y/N)**	
Capital Improvements Project Funding	Y	
Local Funds	Y	
General Obligation Bonds	Y	
Special Tax Bonds	N	
Private Activities Donations	Y	
State and Federal Grant Funds	Y	
Other		**Status Including Date of Document or Policy**
Fire Evacuation Training	Y	
Tornado Sheltering Exercises	Y	
Public Address/Emergency Alert System	Y	
NOAA Weather Radios	Y	
Tornado Shelter/Saferoom	Y	2 saferoom locations
Campus Police	N	Christian County Sheriff

Source: Data Collection Questionnaire

Clever R-V School District

All of Clever R-IV School District facilities are within the City of Clever. **Table 2.17** provides building and enrollment information.

Table 2.17. School District and Building/Enrollment Data, Clever R-V

Building	Address	Building Enrolment
Clever Elementary/Middle School	401 Inman, Clever MO	317
Clever High School	6800 W Highway 14, Clever MO	805
Central Office	103 S. Public, Clever MO	-
Parents as Teachers/Cafeteria/Saferoom	400 Brown, Clever MO	-

Clever R-V Schools are governed by Board of Education consisting of the Board President and six (6) Board members. The District serves over 1,100 students and employs approximately 135 teachers and staff. District departments include:

- Central Office
- Food Services
- Athletic Department
- Health Services

- Transportation Services

The District has constructed two FEMA saferoom locations and a new bus barn since the 2011 Plan. **Table 2.18** provides mitigation capabilities for the District based on responses from the Data Collection Questionnaire for school districts.

Table 2.18. Clever R-V School District Mitigation Capabilities

Capability		
Planning Elements	**Y/N**	**Date of Latest Version**
Master Plan/Date	N	
Capital Improvement Plan/Date	N	
School Emergency Plan	Y	Will be completed during this school year.
Weapons Policy/Date	Y	MSBA Board Policy
Personnel Resources	**Y/N**	**Department/Position**
Full-Time Building Official	Y	Dir. Of Elementary Education/H.S. Principal
Emergency Manager	N	
Grant Writer	N	
Public Information Officer	Y	Superintendent
Financial Resources	**Accessible/Eligible to Use (Y/N)**	
Capital Improvements Project Funding	N	Unable financially
Local Funds	N	Unable financially
General Obligation Bonds	N	Unable financially
Special Tax Bonds	N	Unable financially
Private Activities Donations	N	Unable financially
State and Federal Grant Funds	N	Unable financially
Other		**Status Including Date of Document or Policy**
Fire Evacuation Training	Y	
Tornado Sheltering Exercises	Y	
Public Address/Emergency Alert System	Y	
NOAA Weather Radios	Y	
Tornado Shelter/Saferoom	Y	
Campus Police	Y	Clever PD Part Time/Available on Request

Source: Data Collection Questionnaire

Nixa R-II School District

Although the Nixa Public Schools district boundaries extend into portions of Greene and Stone Counties, all of Nixa R-II School District facilities are within the City of Nixa. **Table 2.19** provides building and enrollment information.

Table 2.19. School District Building and Enrollment, Nixa R-II

Building	Address	Building Enrolment
Nixa High School	514 South Nicholas Road	1728
Nixa Junior High	205 North Street	897
Early Learning Center	301 South Main Street	164
Espy Elementary	220 South Gregg Road	426
Century Elementary	732 North Street	435
Nicholas A. Inman Intermediate	1300 North Nicholas Road	353
Mathews Elementary	605 South Gregg Road	452
Summit Intermediate School	890 North Cheyenne Road	511
High Pointe Elementary	900 North Cheyenne Road	492
John Thomas School of Discover	312 North Market Street	482
Early Childhood Center	301 South Main Street	49

Nixa R-II Schools are governed by Board of Education consisting of the Board President and eight (8) Board members. The District serves 6,000 students and employs approximately 400 teachers and staff. District departments include:

- Business Office
- Communication
- Custodial/Maintenance
- Education Office
- Food Service
- Health Services
- Human Resources
- Special Services
- Technology
- Transportation

The District has constructed four (4) community and one (1) school based saferoom locations. **Table 2.20** provides mitigation capabilities for the District based on responses from the Data Collection Questionnaire for school districts.

Table 2.20. Nixa R-II School District Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Elements	
Master Plan/Date	Yes
Capital Improvement Plan/Date	Yes 2015
School Emergency Plan	Yes

Capability	Status Including Date of Document or Policy
Weapons Policy/Date	Yes
Personnel Resources	
Full-Time Building Official	Yes
Emergency Manager	No
Grant Writer	No
Public Information Officer	Yes
Financial Resources	**Status Including Date of Document or Policy**
Capital Improvements Project Funding	Yes
Local Funds	Yes
General Obligation Bonds	No
Special Tax Bonds	No
Private Activities Donations	No
State and Federal Grant Funds	Yes
Other	**Status Including Date of Document or Policy**
Fire Evacuation Training	Yes
Tornado Sheltering Exercises	Yes
Public Address/Emergency Alert System	Yes
NOAA Weather Radios	Yes
Tornado Shelter/Saferoom	4 Community and 1 School-Based
Campus Police	Yes

Source: Data Collection Questionnaire

Ozark R-VI School District

All of Ozark R-VI School District facilities are located within the City of Ozark. **Table 2.21** provides building and enrollment information for the school district.

Table 2.21. School District Building and Enrollment Data, Ozark R-VI

Building	Address	Building Enrolment
Ozark High School	1350 W. Bluff Drive, Ozark, MO	1599
Ozark Junior High School	1109 W Jackson, Ozark MO	893
South Elementary	1250 W South St, Ozark MO	615
Upper Elementary	3600 N Highway NN, Ozark, MO	830
West Elementary	3105 W State Highway CC, Ozark, MO	480
East Elementary	2449 E Hartley, Ozark, MO	485
North Elementary	3608 N Highway NN, Ozark, MO	582

Ozark R-VI Schools are governed by a Board of Education consisting of the Board President and six (6) Board members. The District serves 5,500 students and employs approximately 400 teachers and staff. District departments include:

- District Administration
- Health Services

- Nutritional & Food Service
- Human Resources/Payroll
- Transportation
- Business and Finance
- School Police

Voters in the district voted to approve a $20 million bond to construct saferooms in new and existing schools. All staff participate in NIMS training and certification. **Table 2.22** provides mitigation capabilities for the District based on responses from the Data Collection Questionnaire for school districts.

Table 2.22. Ozark R-VI School District Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Elements	
Master Plan/Date	Yes 2015
Capital Improvement Plan/Date	Yes Updated annually
School Emergency Plan	Yes, Crisis plan adopted by the BOE
Weapons Policy/Date	Yes
Personnel Resources	**Status Including Date of Document or Policy**
Full-Time Building Official	Yes Facilities & Grounds staff
Emergency Manager	No
Grant Writer	No
Public Information Officer	Yes, all staff are NIMS certified
Financial Resources	**Status Including Date of Document or Policy**
Capital Improvements Project Funding	Yes
Local Funds	Yes
General Obligation Bonds	No
Special Tax Bonds	No
Private Activities Donations	No
State and Federal Grant Funds	Yes
Other	**Status Including Date of Document or Policy**
Fire Evacuation Training	Yes
Tornado Sheltering Exercises	Yes
Public Address/Emergency Alert System	Yes
NOAA Weather Radios	Yes
Tornado Shelter/Saferoom	No
Campus Police	Yes

Source: Data Collection Questionnaire

Spokane R-VII School District

Spokane is an unincorporated place about five miles south of Highlandville along U.S. Highway 160 in the southwest portion of the county. **Table 2.23** provides building and enrollment information for the district.

Table 2.23. School District Building and Enrollment Data, Spokane R-VII

Building	Address	Building Enrolment
Spokane High School	1123 Spokane Road, Spokane, MO	235
Spokane Middle School	1130 Spokane Road, Spokane, MO	173
Highlandville Elementary	223 Kentling Avenue, Highlandville, MO	368

Spokane R-VII Schools are governed by a Board of Education consisting of the Board President and six (6) Board members. The District serves 775 students and employs approximately 400 teachers and staff. District departments include:

- Superintendent's Office
- Health Services
- Food Service
- Human Resources
- Transportation
- Curriculum

District administrators participate in NIMS training and certification. **Table 2.24** provides mitigation capabilities for the District based on responses from the Data Collection Questionnaire for school districts.

Table 2.24. Spokane R-VII School District Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Elements	
Master Plan/Date	Yes 2007, a new master plan will be completed in 2016
Capital Improvement Plan/Date	Yes, 2015
School Emergency Plan	Yes, 2015
Weapons Policy/Date	Yes, March 2006 MSBA
Personnel Resources	**Status Including Date of Document or Policy**
Full-Time Building Official	Yes, Elem, MS, and HS Principal
Emergency Manager	Yes, Elementary Principal
Grant Writer	As needed
Public Information Officer	Yes, Elementary Principal
Financial Resources	**Status Including Date of Document or Policy**
Capital Improvements Project Funding	Yes
Local Funds	Yes
General Obligation Bonds	Yes, pending voter approval
Special Tax Bonds	Yes, pending voter approval

Capability	Status Including Date of Document or Policy
Private Activities Donations	Yes
State and Federal Grant Funds	Yes
Other	**Status Including Date of Document or Policy**
Fire Evacuation Training	Yes
Tornado Sheltering Exercises	Yes
Public Address/Emergency Alert System	Yes
NOAA Weather Radios	Yes
Tornado Shelter/Saferoom	No
Campus Police	Highlandville PD, Christian County Sheriff's Office

Source: Data Collection Questionnaire

Table 2.25 Provides a summary of mitigation capabilities for school districts participating in the Plan.

Table 2.25. Summary of Mitigation Capabilities-School Districts

Capability	Billings R-IV	Chadwick R-I	Clever R-V	Nixa R-II	Ozark R-VI	Spokane R-VII
Planning Elements						
Master Plan	No	Yes	No	Yes	Yes	Yes
Capital Improvement Plan	No	Yes	No	Yes	Yes	Yes
School Emergency Plan	Yes	Yes	Yes	Yes	Yes	Yes
Weapons Policy	Yes	Yes	Yes	Yes	Yes	Yes
Personnel Resources						
Full-Time Building Official (Principal)	Yes	Yes	Yes	Yes	Yes	Yes
Emergency Manager	No	Yes	No	No	No	Yes
Grant Writer	No	Yes	No	No	No	Yes
Public Information Officer	Yes	Yes	Yes	Yes	Yes	Yes
Financial Resources						
Capital Improvements Project Funding	Yes	Yes	No	Yes	Yes	Yes
Local Funds	Yes	Yes	No	Yes	Yes	Yes
General Obligation Bonds	No	Yes	No	No	No	Yes
Special Tax Bonds	No	No	No	No	No	Yes
Private Activities/Donations	Yes	Yes	No	No	No	Yes
State And Federal Funds/Grants	Yes	Yes	No	Yes	Yes	Yes
Other						
Fire Evacuation Training	Yes	Yes	Yes	Yes	Yes	Yes
Tornado Sheltering Exercises	Yes	Yes	Yes	Yes	Yes	Yes
Public Address/Emergency Alert System	Yes	Yes	Yes	Yes	Yes	Yes
NOAA Weather Radios	Yes	Yes	Yes	Yes	Yes	Yes
FEMA Saferoom	No	Yes	Yes	Yes	No	No
Campus Police	No	No	Yes	Yes	Yes	Yes

Data Collection Questionnaires, 2015

3 RISK ASSESSMENT

44 CFR Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

The goal of the risk assessment is to estimate the potential loss in Christian County, Missouri, including loss of life, personal injury, property damage, and economic loss, from a hazard event. The risk assessment process allows communities and school/special districts in Christian County to better understand their potential risk to the identified hazards. It will provide a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

This plan is an update of the previous Christian County Hazard Mitigation Plan adopted in May of 2011. According to the U.S. Census Bureau July 1, 2014 population estimate, the population of Christian County grew to 82,101 from 77,422 at the time of the 2010 decennial census. The population has increased by approximately 4,680 people since the Christian County Hazard Mitigation Plan was adopted in 2011. According to building permit data from the U.S. Census Bureau, 1,508 single family residences and 55 multi-family structures with 112 units have been added to the building stock from 2010 to 2014. The reported construction cost of these new structures was $323,848,885.

Since the adoption of the 2011 Plan Christian County has become a first class county in Missouri. According to Missouri Revised statutes (MORS 48.020), “All counties having an assessed valuation of nine hundred million dollars and over shall automatically be in the first classification after that county has maintained such valuation for the time period...”

Christian County has been one of the fastest growing counties in Missouri in terms of population percent change for the past decade. Although growth has occurred at a fast pace, it has been well regulated by local codes and ordinances. Most of the increase in population and structures in Christian County has occurred in the cities of Ozark, Nixa, and Clever. Growth has also occurred in unincorporated parts of the county in the vicinity of Ozark and Nixa along the U.S. 65 and U.S. 160 Highway corridors in the north-central portion of the county. The added population and structures since the 2011 Plan increases assets at risk to natural hazard risks in areas within the county, however, the capabilities of local governments to manage growth in these areas mitigates the some of the risk from natural hazards. This chapter is divided into four main parts:

- **Section 3.1 Hazard Identification** identifies the hazards that threaten the planning area and provides a factual basis for elimination of hazards from further consideration;

- **Section 3.2 Assets at Risk** provides the planning area’s total exposure to natural hazards, considering critical facilities and other community assets at risk;

- **Section 3.3 Future Land Use and Development** discusses areas of planned future development;

- **Section 3.4 Hazard Profiles and Vulnerability Analysis** provides more detailed information about the hazards impacting the planning area. For each hazard, there are three sections: 1) Hazard Profile provides a general description and discusses the threat to the planning area, the geographic location at risk, potential severity/magnitude/extent, previous occurrences of hazard events, probability of future occurrence, risk summary by jurisdiction, impact of future development on the risk; 2) Vulnerability Assessment further defines and quantifies populations, buildings, critical facilities, and other community/school or special district assets at risk to natural hazards; and 3) Problem Statement briefly summarizes the problem and develops possible solutions.

3.1 Hazard Identification

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

The Plan profiles all natural hazards that can affect Christian County. The natural hazards that can affect the county have been identified in the 2011 Christian County Plan and the 2013 Missouri State Plan. Natural hazards are naturally occurring climatological, hydrological or geologic events that have a negative effect on people and the built environment. Natural hazards identified in the 2011 Christian County Plan included:

- Tornado
- Severe Thunderstorm
- Riverine and Flash Flood
- Severe Winter Weather
- Drought
- Heatwave
- Earthquake
- Dam Failure
- Wildfire, and
- Sinkholes

No new natural hazards have been identified since the adoption of the previous plan. The 2013 Missouri State Plan combines severe cold from severe winter weather hazard and heatwave into an extreme temperature hazard. The Plan will follow the 2013 Missouri State Plan and incorporate this change. The 2013 Missouri State Plan also addresses human-caused, and technological hazards, however, these will not be included in this plan update.

3.1.1 Review of Existing Mitigation Plans

The MPC reviewed the hazards identified in the previously approved plan, as well as the hazards identified in the state plan the April 29, 2015 meeting. The hazards identified in the 2011 Webster county Plan are identified in the 2013 Missouri State Plan. The State Plan also includes levee failure as well as structural and urban fire in addition to wildfire. Human-caused and technological hazards identified in the State Plan include:

- CBRNE Attack
- Civil Disorder
- Cyber Disruption
- Hazardous Materials
- Mass Transportation Accidents
- Nuclear Power Plants
- Public Health Emergencies/Environmental Issues
- Special Events
- Terrorism
- Utility Interruptions and System Failures

In Missouri, local plans customarily include only natural hazards, as only natural hazards are required by federal regulations to be included. The MPC was informed that they may decide to include technological hazards and human-caused threats in the plan, although this is not required by federal regulations. The MPC determined to include only natural hazards. The MPC agreed that human-caused and technological hazards are addressed in a Regional Homeland Security Oversight Committee (RHSOC) Threat and Hazard Identification Risk Assessment (THIRA) and that including only natural hazards would meet the needs of local entities participating in the plan update.

Levee failure was omitted due to the fact that the National Levee Database, maintained by U.S.A.C.E, shows no federal levees located in the Christian County and planning committee research revealed no records of levees within Christian County. Although it is likely that levees exist, such as low-head agricultural levees, no records indicate that that a breach or overtopping of these levees would impact property other than that of the levee owner. Damage to residential structures is unlikely. Therefore, these hazards are not included in this risk assessment for Christian County. Landslides occur in all 50 states; however, this hazard is not likely to have much of a notable impact on Christian County due to soil profile, geology, and climate factors. In addition, the risk of coastal storms, hurricanes, tsunamis, avalanche, and volcanic activity does not exist in Christian County due to the county's location in the central United States.

3.1.2 Review Disaster Declaration History

Between May 5, 2002 and May 9, 2015 Christian County has experienced severe storms, tornadoes, flooding, severe winter storms, and a hurricane evacuation. All hazard events triggered federal disaster declaration. Federal and/or state declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster is so severe that both the local and state governments' capacities are exceeded; a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

FEMA also issues emergency declarations, which are more limited in scope and do not include the long-term federal recovery programs of major disaster declarations. Determinations for declaration type are based on scale and type of damages and institutions or industrial sectors affected. The Robert T. Stafford Disaster Relief and Emergency Assistance Act, (PL 100-707) requires that all requests for a declaration by the President must be made by the governor of the affected state. State and federal officials conduct a Preliminary Damage Assessment (PDA) to show that the disaster is of such severity and magnitude that effective response is beyond state and local capabilities. Based on the governor's request, the president may declare that a major disaster or emergency exists, thus activating federal programs to assist in the response and recovery effort. Not all programs are activate for every disaster. Some declarations will provide only individual assistance or public assistance, while others provide both. FEMA also issues emergency declarations, which are more limited in scope and do not include the long-term federal recovery programs of major disaster declarations. Determinations for declaration type are based on scale and type of damages and institutions or industrial sectors affected.
(https://www.fema.gov/declaration-process)

Since 1990, Christian County has experience 13 hazard events that triggered federal disaster declarations. The most recent occurred during the Plan update when rivers and streams in the county reached historic flood levels. Flooding was included in 10 out of 13 events that triggered a FEMA disaster declaration. Seven declarations also included tornados. Four of these declarations triggered both individual and public assistance. Table 3.1 lists the federal FEMA disaster declarations that included the Christian County from 1990 to present.

Table 3.1. FEMA Disaster Declarations that included Christian County, Missouri, 1990-Present

Disaster Number	Description	Date Declared	Type of Assistance
4238	Severe Storms, Flooding, Straight Line Winds, Tornados	08/07/2015	Public Assistance
1980	Severe Storms, Tornados, and Flooding	05/09/2011	Public Assistance
1847	Severe Storms, Tornados, and Flooding	06/19/2009	Individual Assistance
1809	Severe Storms, Tornados, and Flooding	11/13/2008	Public Assistance
1773	Severe Storms and Flooding	06/25/2008	Public Assistance
1749	Severe Storms and Flooding	03/19/2008	Individual & Public Assistance
1748	Severe Winter Storms and Flooding	03/12/2008	Public Assistance
3281	Severe Winter Storms	12/12/2007	Public Assistance
1676	Severe Winter Storms and Flooding	01/15/2007	Public Assistance
1631	Severe Storms, Tornados, and Flooding	03/16/2006	Individual & Public Assistance
3232	Hurricane Katrina Evacuation	09/10/2005	Public Assistance (Category B)
1463	Severe Storms, Tornados, and Flooding	05/06/2003	Individual & Public Assistance
1412	Severe Storm & Tornados	05/06/2002	Individual & Public Assistance

Source: Federal Emergency Management Agency http://www.fema.gov/disasters

3.1.3 Research Additional Sources

A variety of sources were researched for data on natural hazards. Primary sources included FEMA, SEMA, National Climate Data Center (NCDC) and National Oceanic and Atmospheric Administration (NOAA). The U.S. Geological Survey (USGS) and the Center for Earthquake Research and Information (CERI) were major sources for earthquake information. The Missouri Department of Natural Resources (MDNR) Dam Safety Division provided information concerning dams and the Missouri Department of Conservation (MDC). Other information sources included county officials; existing city, county, regional and state plans; and information from local officials. The additional sources of data on locations and past impacts of hazards in Christian County include:

- Missouri Hazard Mitigation Plans (2010 and 2013);
- Christian County Multi-Jurisdictional Natural Hazard Mitigation Plan (2011);
- Federal Emergency Management Agency (FEMA);
- Missouri Department of Natural Resources (MDNR);
- National Drought Mitigation Center Drought Reporter;
- US Department of Agriculture's (USDA) Risk Management Agency Crop Insurance

Statistics;

- Data Collection Questionnaires completed by each jurisdiction
- State of Missouri GIS data
- Environmental Protection Agency
- Flood Insurance Administration
- Hazards US (HAZUS)
- Missouri Department of Transportation
- Missouri Division of Fire Marshal Safety
- Missouri Public Service Commission
- Missouri Spatial Data Information System (MSDIS)
- National Fire Incident Reporting System (NFIRS)
- National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC);
- Pipeline and Hazardous Materials Safety Administration
- Christian County and local Comprehensive Plans to the extent available
- County Emergency Management
- County Flood Insurance Rate Map, FEMA
- Flood Insurance Study, FEMA
- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- U.S. Army Corps of Engineers
- U.S. Department of Transportation
- United States Geological Survey (USGS)
- Various articles and publications available on the internet (you should state that you will give citations to the sources in the body of the plan)

The only centralized source of data for many of the weather-related hazards is the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC). Although it is usually the best and most current source, there are limitations to the data which should be noted. The NCDC documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and disruption of commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. Some information appearing in the NCDC may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, law enforcement and/or other government agencies, private companies, individuals, etc. An effort is made to use the best available information but because of time and resource constraints, information from these sources may be unverified by the NWS. Those using information from NCDC should be cautious as the NWS does not guarantee the accuracy or validity of the information.

The NCDC damage amounts are estimates received from a variety of sources, including those listed above in the Data Sources section. For damage amounts, the NWS makes a best guess using all available data at the time of the publication. Property and crop damage figures should be considered as a broad estimate. Damages reported are in dollar values as they existed at the time of the storm event. They do not represent current dollar values.

- The database currently contains data from January 1950 to August 2015, as entered by the NWS. Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. The following timelines show the different time spans for each period of unique data collection and processing procedures;

- Tornado: From 1950 through 1954, only tornado events were recorded;

- Tornado, Thunderstorm Wind and Hail: From 1955 through 1992, only tornado, thunderstorm wind and hail events were keyed from the paper publications into digital data. From 1993 to 1995, only tornado, thunderstorm wind and hail events have been extracted from the Unformatted Text Files;

- All Event Types (48 from Directive 10-1605): From 1996 to present, 48 event types are recorded as defined in NWS Directive 10-1605

It should be noted that injuries and deaths caused by a storm event are reported on an area-wide basis. When reviewing a table resulting from an NCDC search by county, the death or injury listed in connection with that county search did not necessarily occur in that county.

3.1.4 Hazards Identified

The natural hazards that can possibly or have affected the planning area are profiled in alphabetical order. All hazards do not affect every jurisdiction participating in the Plan. Table 3.2 provides a summary of the jurisdictions that may be affected by each hazard. An “x” in the table indicates that jurisdictions are affected by the hazard, and a "-" indicates the hazard is not applicable to that jurisdiction.

Table 3.2. Hazards Identified for Each Jurisdiction

Jurisdiction	Dam Failure	Drought	Earthquake	Extreme Temperature	Wildfires	Flooding (River and Flash)	Land Subsidence/Sinkholes	Severe Winter Weather	Thunderstorm/Lightning/Hail/ High Wind	Tornado
Christian County	x	x	x	x	x	x	x	x	x	x
Billings	-	x	x	x	-	x	x	x	x	x
Clever	-	x	x	x	-	x	x	x	x	x
Fremont Hills	-	x	x	x	-	x	x	x	x	x
Nixa	-	x	x	x	x	x	x	x	x	x
Ozark	-	x	x	x	x	x	x	x	x	x
School Districts										
Billings R-IV	-	-	x	x	-	x	x	x	x	x
Chadwick R-I	-	-	x	x	x			x	x	x
Clever R-V	-	-	x	x	-	x	x	x	x	x
Nixa R-II	-	-	x	x	-	x	x	x	x	x
Ozark R-VI	-	-	x	x	-	x	x	x	x	x
Spokane R-VII	-	-	x	x	x		x	x	x	x
Other Special Districts										
Billings Special Road	-	-	x	x	-	x	x	x	x	x
Christian Co. Ambulance	-	-	x	-	-	-	x	-	x	x
Ozarks Technical College	-	-	x	-	-	-	x	x	x	x

3.1.5 Multi-Jurisdictional Risk Assessment

The risk assessment assesses each participating jurisdiction's vulnerability to each hazard that can affect the planning area. Many of the hazards identified in the risk assessment have the same probability of occurrence throughout the planning area. The hazards that vary across the planning area in terms of risk include dam failure, flash flood, grass or wildland fire, river flood, flash flood, and sinkholes/land subsidence. These differences are detailed in each hazard profile under geographic location and vulnerability.

Christian County is fairly uniform in terms of climate, however, topography and building construction characteristics vary within the county. Christian County has experienced rapid growth in population and development from 2000 to the present. Most of this growth has occurred in the north central portion of the county and western panhandle due to its proximity to the Springfield metropolitan area. As these areas have urbanized the capability to manage growth has increased as well. Mitigation capabilities of each jurisdiction are profiled in section 2.2.

The urbanized areas within the planning area, which have more assets at a greater density, have greater vulnerability to weather-related hazards, however, the vulnerability to future development can be mitigated through updated building codes and code enforcement as well as land use planning. These capabilities and resources to mitigate the impact of natural hazards vary across jurisdictions in the planning area. These differences will be discussed in greater detail in the vulnerability sections of each hazard.

3.2 Assets at Risk

This section assesses the planning area population, structures, critical facilities and infrastructure, and other important assets that may be at risk to hazards. The inventory of assets for each jurisdiction were derived from parcel data from the Christian County Assessor, the Christian County Structures dataset downloaded from MSDIS, local jurisdiction data collection questionnaires, and HAZUS MH 2.2.

3.2.1 Total Exposure of Population and Structures

Table 3.3 shows the total population, building count, estimated value of buildings, estimated value of contents and estimated total exposure to parcels for the unincorporated Christian County and each incorporated city. For multi-county communities, the population and building data may include data on assets located outside the planning area. **Table 3.4** that follows provides the building value exposures for the Christian County and each city in the planning area broken down by usage type. Finally, **Table 3.5** provides the building count total for the Christian County and each city in the planning area broken out by building usage types (residential, commercial/industrial, and agricultural).

Table 3.3. Maximum Population and Building Exposure by Jurisdiction-Local Gov't

Jurisdiction	2014 Population	Building Count	Building Exposure	Contents Exposure	Total Exposure
Unincorporated County	35,345	16,723	$1,659,471,600	$901,219,000	$2,560,690,600
Billings	1,073	436	$35,323,600	$23,168,200	$58,491,800
Clever	2,434	1,008	$103,201,800	$100,768,600	$203,970,400
Fremont Hills	856	367	$88,635,633	$43,662,050	$132,297,683
Nixa	20,570	7,301	$969,592,653	$519,084,622	$1,488,677,275
Ozark	18,871	6,011	$903,317,120	$513,946,118	$1,417,263,238
Total	**79,149**	**31,846**	**$3,759,542,406**	**$2,101,848,590**	**$5,861,390,996**

Sources: Population, 2014 U.S. Census population estimates; Contents Exposure derived by applying multiplier to Building Exposure based on HAZUS MH 2.1 standard contents multipliers per usage type as follows: Residential (50%), Commercial (100%), Agricultural (100%). For purposes of these calculations, local government asset contents were derived from values reported via data collection questionnaires.

Table 3.4. Building Values/Exposure by Usage Type

Jurisdiction	Residential	Commercial/ Industrial	Agricultural	Total
Unincorporated County	$1,516,505,200	$111,419,600	$26,156,800	$1,654,081,600
Billings	$24,310,800	$6,991,600	$65,200	$31,367,600
Clever	$75,838,300	$9,197,100	$66,400	$85,101,800
Fremont Hills	$83,853,900	$1,775,100	$0	$85,629,000
Nixa	$792,994,500	$119,871,000	$90,800	$912,956,300
Ozark	$633,760,200	$194,053,100	$252,500	$828,065,800
Total	**$3,225,136,200**	**$448,390,200**	**$27,167,600**	**$3,700,694,000**

Source: Christian County Assessor Parcel Data, 8/25/2015

Table 3.5. Building Counts by Usage Type

Jurisdiction	Residential Counts	Commercial/ Industrial Counts	Agricultural Counts	Total
Unincorporated County	12,662	509	3,546	16,717
Billings	431	55	13	499
Clever	948	48	5	1,001
Fremont Hills	361	3	0	364
Nixa	6,938	292	16	7,246
Ozark	5,471	452	35	5,958
Total	**27,930**	**1,462**	**3,695**	**33,087**

Source: Christian County Assessor Parcel Data, 8/25/2015

The number of enrolled students at the participating public school districts is provided in **Table 3.6** below. Additional information includes the number of buildings, building values (building exposure) and contents value (contents exposure). These numbers will represent the total enrollment for the public school districts regardless of the county in which students reside. No school district participating in the plan has buildings or facilities located outside of the county. Ozarks Technical College main campus is located in Springfield, Missouri. The community college maintains several satellite campuses in several counties throughout southwest Missouri. Only facilities located at the Richwood Valley location in Christian County are included in the population and building exposure inventory. Enrollment information is not applicable to the Billings Special Road District and the Christian County Ambulance District.

Table 3.6. Population and Building Exposure by Jurisdiction-Public School Districts and Other Special Districts

Public School District	Enrollment	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
Billings R-IV	409	2	$14,158,067	$2,693,479	$16,851,546
Chadwick R-I	212	1	$9,771,364	$830,138	$10,601,502
Clever R-V	1,122	7	$38,337,795	$4,560,045	$42,897,840
Nixa Public Schools	5,989	11	$142,991,720	$28,256,044	$171,247,764
Ozark R-VI	5,484	14	$181,989,461	$35,962,237	$217,951,698
Spokane R-VII	776	3	$27,749,567	$10,609,475	$38,359,042
Billings Special Road	-	2	$160,000	$662,825	$822,825
CC Ambulance Dist.	-	4	$1,800,000	$1,980,000	$3,780,000
OTC-Richwood Valley	1,031	2	$13,500,000	$6,785,000	$20,289,674

Source: http://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx., Data Collection Questionnaires from School Districts.

3.2.2 Critical and Essential Facilities and Infrastructure

This section will include information from the Data Collection Questionnaire and other sources concerning the vulnerability of participating jurisdictions' critical, essential, high potential loss, and transportation/lifeline facilities to identified hazards. Definitions of each of these types of facilities are provided below.

- Critical Facility: Those facilities essential in providing utility or direction either during the response to an emergency or during the recovery operation
- Essential Facility: Those facilities that if damaged, would have devastating impacts on disaster response and/or recovery
- High Potential Loss Facilities: Those facilities that would have a high loss or impact on the community
- Transportation and lifeline facilities: Those facilities and infrastructure critical to transportation, communications, and necessary utilities

Table 3.7 includes a summary of the inventory of critical and essential facilities and infrastructure in the planning area. The list was compiled from the Data Collection Questionnaire as well as the following sources:

- HAZUS 2.2
- Christian County Assessor Parcel Data
- Christian County GIS Structures Data (MSDIS)

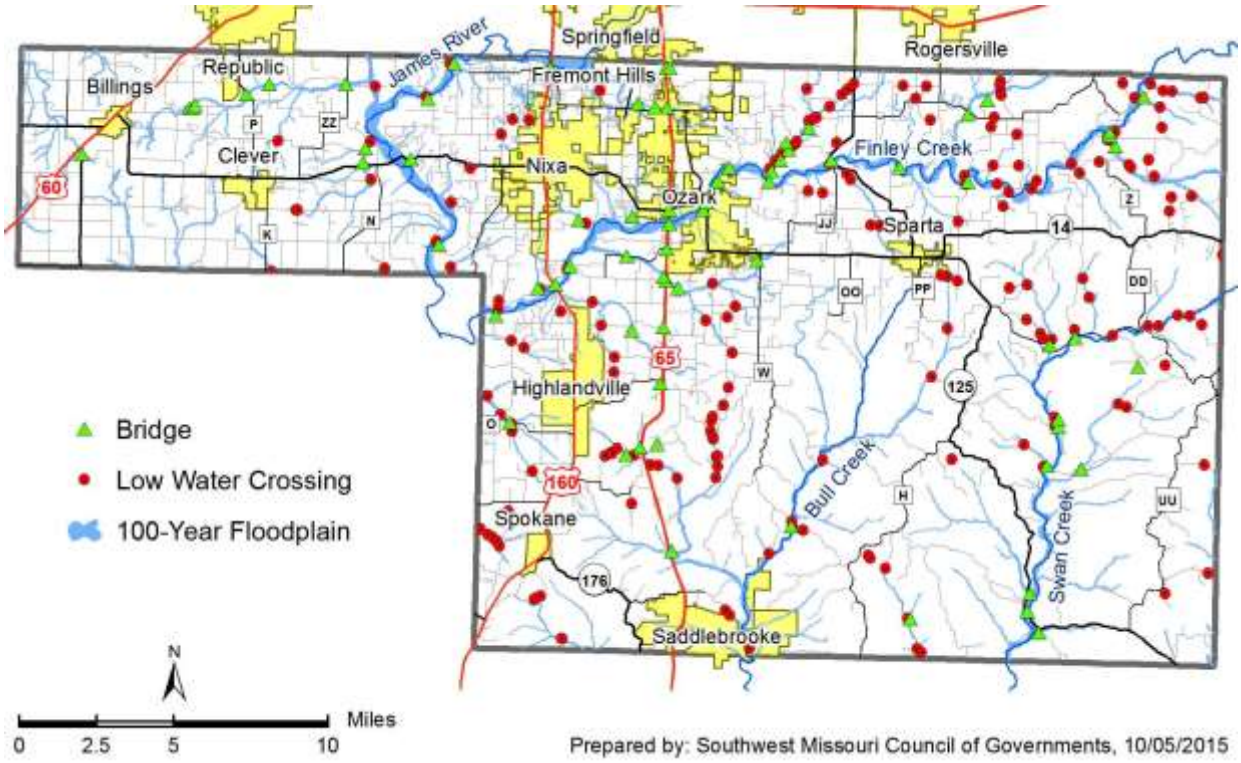
Table 3.7. Inventory of Critical/Essential Facilities and Infrastructure by Jurisdiction

Jurisdiction	Airport Facility	Childcare Facility	Communications Tower	Electric Power Facility	Emergency Operations	Fire Service	Government	Highway Bridge	Health Care	Military	Natural Gas Facility	Nursing Homes	Police Station	Potable Water Facility	Rail	Sanitary Pump Stations	School Facilities	Wastewater Facility	Total
Billings	0	0	1	0	0	1	1	0	0	0	0	0	1	2	Y	1	3	1	12
Clever	0	2	2	0	0	1	2	0	0	0	0	0	0	2	N	2	4	1	16
Fremont Hills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	1	0	2	3
Highlandville	0	1	0	0	0	0	2	0	0	0	1	0	0	2	N	1	1	1	7
Nixa	0	4	1	4	0	2	9	0	4	1	0	6	1	9	N	15	8	1	65
Ozark	0	8	3	2	3	2	7	9	2	0	1	8	2	15	N	16	7	2	97
Sparta	0	1	1	0	0	1	1	0	2	0	0	0	0	1	N	1	3	1	13
Saddlebrooke	0	0	1	0	0	1	0	0	0	0	0	0	0	0	N	0	0	0	2
Unincorporated	4	4	33	10	0	9	7	71	0	7	9	0	0	0	Y	0	9	0	163
Totals	**4**	**25**	**42**	**16**	**3**	**18**	**8**	**80**	**8**	**8**	**10**	**14**	**4**	**31**	**-**	**37**	**34**	**8**	**378**

Source: Data Collection Questionnaires; HAZUS, Christian County Assessor, Christian County Structure Data.

Figure 3.1 is a map that shows the locations of bridges in the planning area included in the National Bridge Inventory data set. This data was extracted from FEMA HAZUS MH 2.2 software which reflects conditions from 2010. The HAZUS data contains a "scour index", which is a number indicating the vulnerability of a bridge to scour during a flood. Bridges with a scour index between 1 and 3 are considered "scour critical", or a bridge with a foundation determined to be unstable for the observed or evaluated scour condition. According to this information, there are no scour critical bridges identified in the planning area. Included on the map are local low water crossing locations within the county.

Figure 3.1. Christian County Highway Bridges and Low Water Crossings



Source: HAZUS, Christian County Emergency Management

3.2.3 Other Assets

Assessing the vulnerability of the planning area to disaster also requires data on the natural, historic, cultural, and economic assets of the area. This information is important for many reasons.

- These types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- Knowing about these resources in advance allows for consideration immediately following a hazard event, which is when the potential for damages is higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- The presence of natural resources can reduce the impacts of future natural hazards, such as wetlands and riparian habitats which help absorb floodwaters.
- Losses to economic assets like these (e.g., major employers or primary economic sectors) could have severe impacts on a community and its ability to recover from disaster.

Threatened and Endangered Species: **Table 3.8** shows Federally Threatened, Endangered, Proposed and Candidate Species in Christian County.

Table 3.8. Threatened and Endangered Species in Christian County

Common Name	Scientific Name	Status
Gray Bat	Myotis Grisescens	Endangered
Indiana Bat	Myotis Sodalis	Endangered
Northern Long-eared Bat	Myotis Septentrionalis	Threatened
Missouri Bladderpod	Physaria Filformis	Threatened
Running Buffalo Clover	Trifolium Stolonifereum	Endangered
Virginia Sneezeweed	Helenium Virginicum	Threatened

Source: U.S. Fish and Wildlife Service, http://www.fws.gov/midwest/Endangered/lists/missouri-cty.html; see also http://ecos.fws.gov/ipac/

Natural Resources: The Missouri Department of Conservation (MDC) provides a database of lands the MDC owns, leases, or manages for public use. **Table 3.9** to provide the names and locations of parks and conservation areas in the planning area.

Table 3.9. Parks in Christian County

Area Name	Address	City
Busiek SF and WA	Highlandville, MO 65669	Christian
Delaware Town Access	Nixa, MO 65714	Christian
Ozark (Jim Turner Public Fishing	907 Riverside Rd Ozark, MO	Christian
Shelvin Rock Access	Clever, MO 65631	Christian

Source: Missouri Department of Conservation

Park Name	Address	City
McMauley Park	701 N Taylor Way	Nixa
Rotary Park	Intersections of Fort St and Tower	Nixa
The Gardens at Woodfield	Truman Blvd., near McLean Ct.	Nixa
Finley River Park	601 N. 3rd Street	Ozark
Ozark Disc Golf Course	499 E. Parkview	Ozark
Billings City Park	101 E. Howard	Billings

Source: Christian County and community websites.

Historic Resources: The National Register of Historic Places is the official list of registered cultural resources worthy of preservation. It was authorized under the National Historic Preservation Act of 1966 as part of a national program. Properties listed in the National Register include districts, sites, buildings, structures and objects that are significant in American history, architecture, archeology, engineering, and culture. The purpose of the program is to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. Properties in Christian county listed in the National Register of Historic Places are listed in **Table 3.10**.

Table 3.10. Christian County Properties on the National Register of Historic Places

Property	Address	City	Date Listed
Ozark Courthouse Square Historic		Ozark	12-17-2008
Prehistoric Rock Shelter & Caves	N/A	N/A	10-23-1991
Wilson's Creek National Battlefield	1 ¾ A miles south of	N/A	-

Source: Missouri Department of natural Resources – Missouri National Register Listings by County

Economic Resources: **Table 3.11** shows major non-government employers in the planning area.

Table 3.11. Major Non-Government Employers in Christian County

Employer Name	Main Locations	Product or Service	Employees
Silver Star Families Of America	Clever	E-Commerce	3000
Diversified Plastics Corp	Nixa	Plastic Products	350
Walmart Supercenter	Nixa	Retail	350
Walmart Supercenter	Ozark	Retail	350
Bass Pro Shops	Nixa	Sporting Goods Retail	210
Lambert Cafe	Ozark	Food Service	200
Southwest Materials	Ozark	Concrete Ready-Mixed	150
Lowe's Home Improvement	Ozark	Retail	140
Mc Donald's	Ozark	Food Service	120
Third Street Sportswear Mfg	Ozark	Clothing (Mfrs)	120
Tracker Marine	Ozark	Trailer/Boat (Mfrs)	112
Ozark Riverview Manor	Ozark	Nursing Home	110
Riverview Residential Place	Ozark	Nursing Home	110
A-M Home Inspection	Nixa	Real Estate Inspection	100
Murfin's Market	Ozark	Grocery Store	100
Springfield Marine Co	Nixa	Furniture & Fixtures (Mfrs)	100
Concurrent Manufacturing Sltns	Ozark	Circuit Board (Mfrs)	95
Price Cutter	Nixa	Grocery Store	80
Doctors Hospital Of Nixa	Nixa	Healthcare	75
Christian Residential Care	Nixa	Nursing Home	70
Snyder Equipment Co	Nixa	Railroad Equipment (Mfrs)	70
Walmart Neighborhood Market	Clever	Grocery Store	70

Source: ReferenceUSA®, US Business Database. Accessed via Springfield-Greene County Library 9/4/2015

3.3 Future Land Use and Development

Table 3.12 providing the population growth statistics for all cities in Christian County as well as the unincorporated part of Christian County based on the 2000 census and 2014 U.S. Census population estimates.

Table 3.12. County Population Growth, 2000-2014

Jurisdiction	Total Population 2014	Total population 2000	2000-2014 # Change	2000-2014 % Change
Christian County	82,101	54,285	27,806	51.2%
Unincorporated	35,345	27,792	7,533	27.1%
Billings	1,073	1,091	-18	-1.6%
Clever	2,434	1,010	1,424	141%
Fremont Hills	856	597	259	43.3%
Nixa	20,570	12,124	8,446	69.6%
Ozark	18,871	9,665	9,206	95.2%

Source: U.S. Bureau of the Census, Decennial Census 2000; U.S. Census Bureau 2014 Population Estimates

Population growth or decline is generally accompanied by increases or decreases in the number of housing units. Increases in population growth add to the built environment and increase risk and exposure to hazard events. **Table 3.13** provides the change in numbers of housing units in the county as a whole and incorporated communities from 2000 to 2013. The totals for 2013 were taken from the American Community Survey 2009 – 2013 five year estimates. It should be noted that is a margin of error associated with these values.

Table 3.13. Change in Housing Units, 2000-2013

Jurisdiction	Housing Units 2013*	Housing Units 2000	2000-2013 # Change	2000-2013 % change
Christian County	31,812	21,827	9,749	44.66
Unincorporated	13,722	11,014	2,708	19.7
Billings	500	492	8	1.6
Clever	824	420	404	49
Fremont Hills	302	230	72	31.3
Nixa	7,856	4,962	2,894	58.3
Ozark	7,279	3,853	3,458	89.9

Source: U.S. Bureau of the Census 2000. *2009 – 2013 American Community Survey; data based on sampling and accompanied by a margin of error.

Christian County continues to be one of the fastest growing counties in Missouri since 2000. Most of this growth is being fueled added capacity to major transportation routes connecting the county to the Springfield Metropolitan Area. Future development in the county is expected continue in the north central portion of the county in relative proximity to U.S. Highway 65 and U.S. Highway 160. **Figures 3.2** and **3.3** are population density maps depicting census block population at the time of the 1990 and 2010 census, respectively. Each dot on the maps represent 100 people and are symbolized as small groups of people.

Figure 3.2. Christian County Dot Density by Census Block, 1990

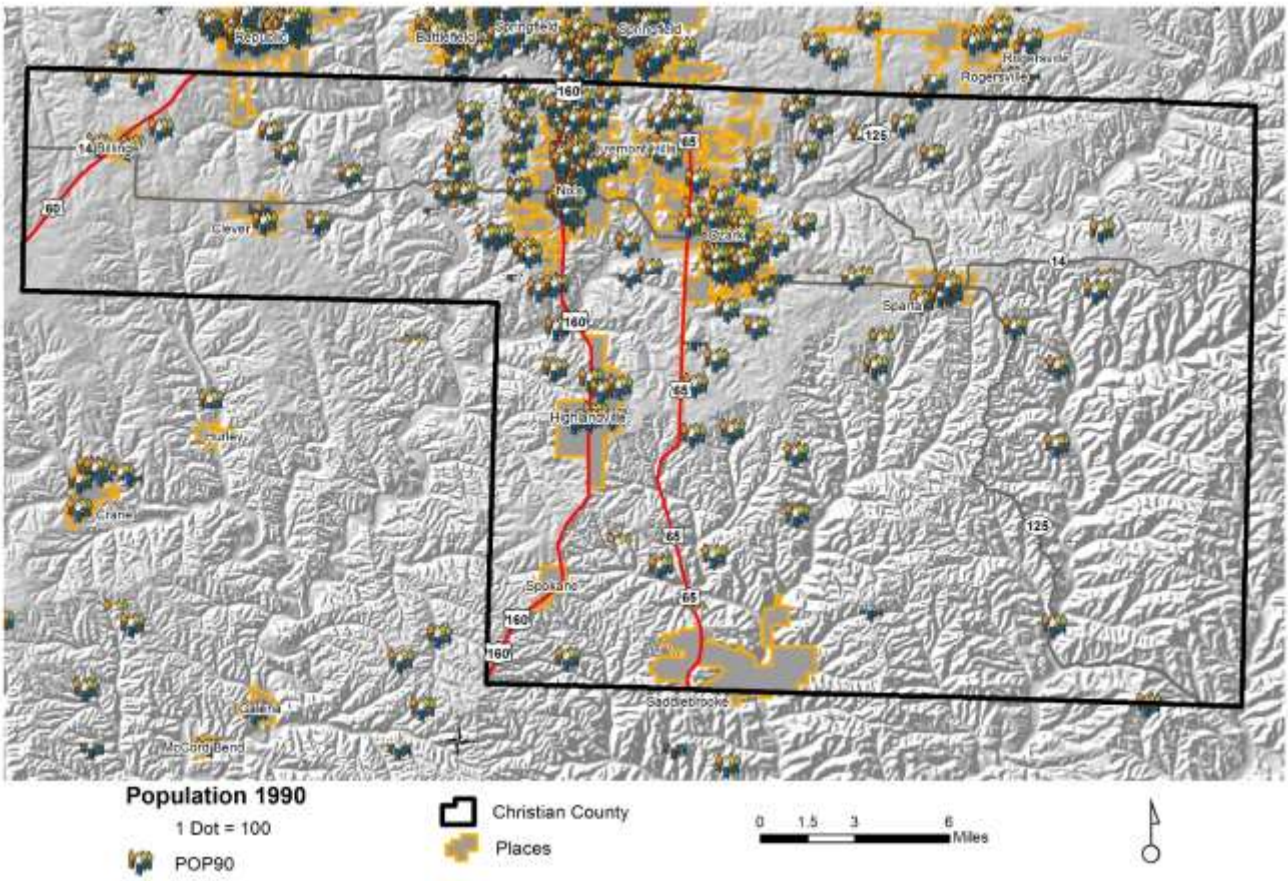
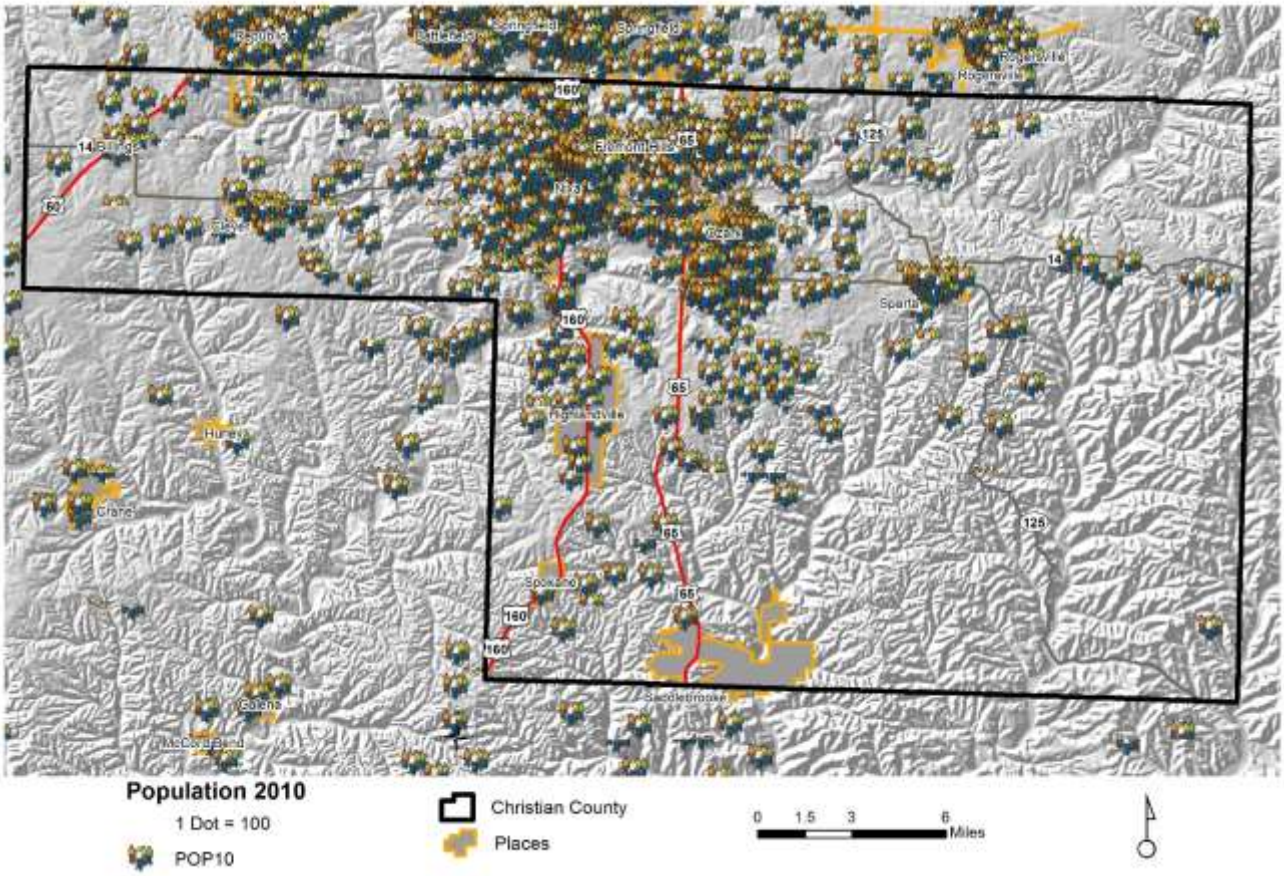


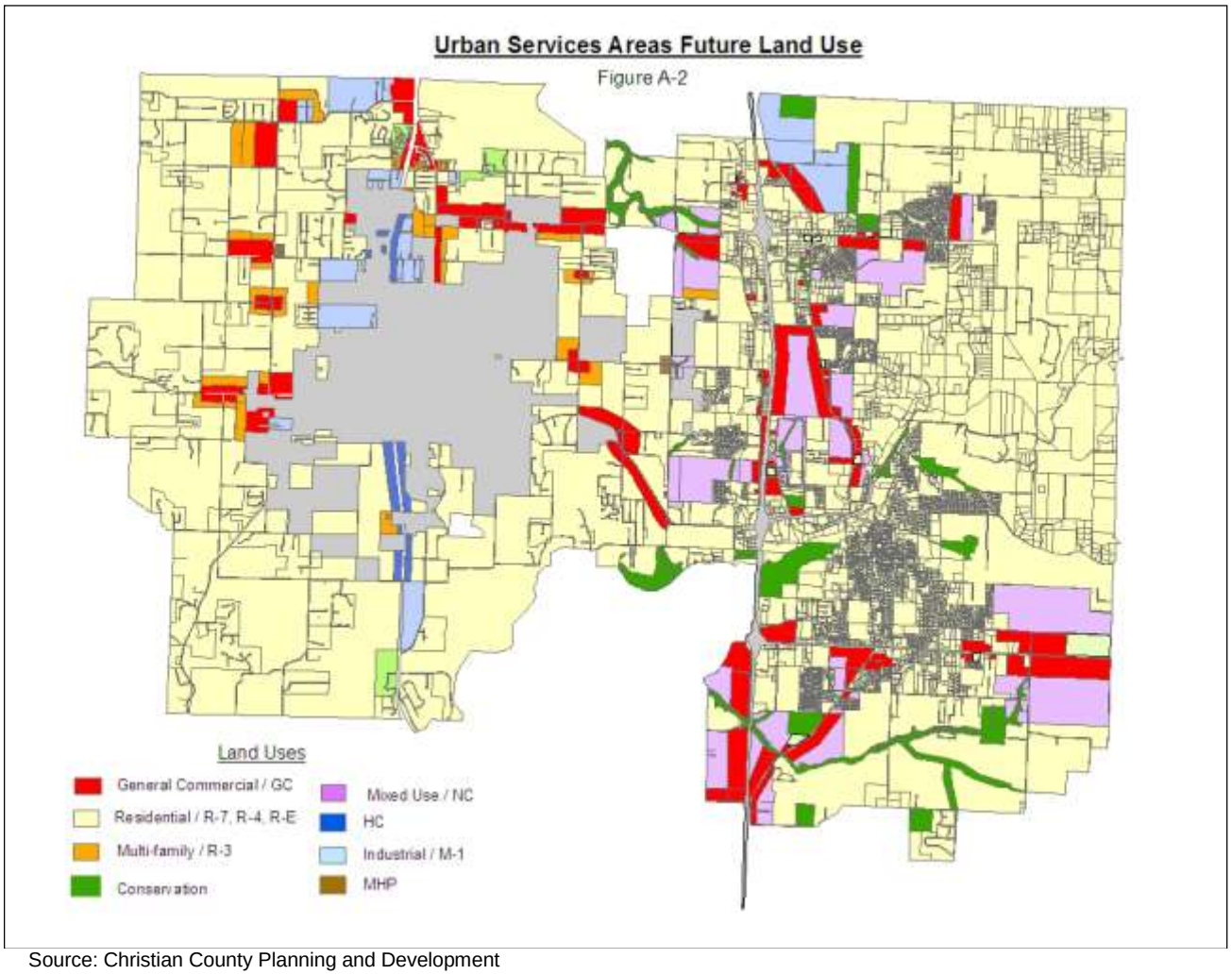
Figure 3.3. Christian County Dot Density by Census Block, 2010



The figures indicate the rapid growth pattern experienced in Christian County over the period from 1990 to 2000. Population growth is continuing north central portion of the county and along major transportation routes in the county. The unincorporated areas in the county have experienced population growth at a rate of 51.2% adding 27,806 people from 2000 to 2014. Continued transportation improvements such as lane additions between Springfield and Nixa and Ozark along U.S. Highway 160 and U.S. Highway 65 will reduce the travel time in these areas to employment opportunities in the Springfield metro area extending development further south of these cities along these transportation corridors in the central part of the county. This pattern of growth in the county will likely continue over the next few decades.

Land use in the county is primarily low density residential and agricultural. Development is unlikely to reach the southeast portion of the county which is primarily Mark Twain National Forest Land. The cities of Nixa and Ozark constitute the major urban areas within the county. Future land use in these areas are in both these cities is expected to occur within the urban service areas depicted in **Figure 3.4**.

Figure 3.4. Nixa and Ozark Urban Service Area Future Land-Use



Source: Christian County Planning and Development

The City of Billings

The City of Billings currently has no comprehensive plan, however, a land use plan exists but has not been updated since 1994. Billings has experienced a 1.6% decline in population from 2000 to 2014. Significant development is not anticipated to occur within the next five years. The City has annexed the right of way to the south and east along Highway 14 towards the City of Clever. The City anticipates annexing development along Highway 14 as it occurs.

The City of Clever

The City of Clever has not updated its comprehensive plan since 1999 and is currently in the process of updating its land use plan. The City has been growing rapidly since 2000 growing at a rate of 141% through 2014 adding an additional 1,424 people during this period. In addition, 404 new housing units from 2000 to 2013. Clever has not annexed rights of way but expects continued commercial development along Highway 14 in the city boundaries. Growth is anticipated to continue through the next five years.

The City of Fremont Hills

The City of Fremont Hills was built around Fremont Hills Golf Course and Country Club. Fremont Hills is increasingly becoming land locked by the cities of Nixa and Ozark, however, the community has grown at a rate of 43.3% from 2000 to 2014 adding an additional 259 people to its population and 72 new housing units from 2000 to 2013. The City has a planning and zoning commission but has not updated its comprehensive plan since 2003. The City has Annexed 5 acre residential tract of land. No commercial or industrial development is expected but expects 5 to 10 additional housing units to be constructed over the next five years.

The City of Nixa

The City of Nixa updated its comprehensive plan in 2014 and an updated land use plan. The City has a planning and zoning commission and a planning and development office that reviews site plans and enforces subdivision regulations and codes. The City has grown at a rate of 69.6% from 2000 to 2014 adding an additional 8,446 people to its population. In addition, 2,894 housing units have been constructed from 2000 to 2013. The City has not annexed rights of way along major transportation routes but annexes large subdivisions as they are planned and constructed adjacent to the city limits as development occurs.

The City of Ozark

The City of Ozark has not updated its comprehensive plan since 2008. The future land use map defines development occurring in tiered phases in the areas outside of its city limits. The City has planning and zoning and collaborates with the County and Nixa on planned future growth. A planning and development department reviews site plans and enforces subdivision regulations and codes. The City has grown at a rate of 95.2% from 2000 to 2014 adding an additional 9,206 people to its population. In addition, 3,458 housing units have been constructed from 2000 to 2013. The City has annexed right of way along Highway 65 from the Greene County line to Highway EE five miles south of the city limits. The City also annexes large subdivisions as they are planned and constructed adjacent to the city limits as development occurs.

School District's Future Development

Billings R-IV School District enrollment has declined 5% from 2012 to 2015. A tax levy was approved by voters in the district in April 2015 to construct a FEMA saferoom in the high school. The District has submitted a Notice of Interest (NOI) to SEMA to apply for HMGP funding for saferoom construction.

Chadwick R-I School District enrollment has increased 3.5% in the past three years. An estimate for enrollment in the next five years 250 to 275 students K-12. The District is currently constructing an early childhood education facility, partially funded through a CDBG grant, on the school campus. The new building is replacing three mobile trailers.

Clever R-V School District enrollment is projected to increase by 2% - 5% over the next five years. In the last five years the district has constructed a new high school, two FEMA saferooms, and a new bus barn. Construction of new facilities is not currently planned over the next five years.

Ozark R-VI School District enrollment is expected to increase 1% - 2% annually over the next five years. A $20,000,000 bond to build FEMA saferooms in the District was approved by voters in the District in April of 2015. The District has submitted an NOI to SEMA for HMGP funding to add

saferooms to existing facilities. Construction of a new elementary school facility is planned in the next five years.

Nixa R-II School District enrollment is anticipated to increase by 3% - 5% over the next five years. In the past five years the District has constructed two additional saferooms in school facilities. Although additional facilities are not currently planned for the next five years, the District anticipates renovating and improving existing facilities in the next five years through annual capital improvement planning.

Spokane R-VII School District enrollment is anticipated to increase by approximately 5% over the next five years. The District has renovated an addition of the middle school to house its preschool formally housed in a temporary structure. The District has also and renovated existing facilities with buzz in doors and protective filming. The District has submitted an NOI to SEMA to construct a FEMA saferoom at the Highlandville or Spokane campus.

Special District's Future Development

Billings Special Road District has plans to replace culverts at several low water crossings over the next five years.

Christian County Ambulance District is seeking to place a dual annexation measure on the April 5, 2016 election ballot in Christian and Stone counties. This election will require majority vote from current ambulance district members as well as a majority vote from the areas wishing to be annexed in the Clever Fire department response areas in Christian and northern Stone counties and the Highlandville Fire departments response areas in northern Stone county. If the measure is approved, a new EMS station will be constructed in the western panhandle of the county. The District also has plans to construct an additional EMS station in northern Ozark.

OTC Richwood Valley Campus enrollment at the campus is expected to increase by 5% over the next five years. An additional five classrooms are planned on being constructed within the existing FEMA saferoom facility at a cost of $1,200,000.

3.4 Hazard Profiles, Vulnerability, and Problem Statements

Each hazard identified in Section **3.1.4** will be alphabetically analyzed individually in a hazard profile. The profile will consist of a general hazard description, location, severity/magnitude/extent, previous events, future probability, a discussion of risk variations between jurisdictions, and how anticipated development could impact risk. At the end of each hazard profile will be a vulnerability assessment, followed by a summary problem statement.

Hazard Profiles

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

The level of information presented in the profiles will vary by hazard based on the information available. With each update of this plan, new information will be incorporated to provide better evaluation and prioritization of the hazards that affect the planning area. Detailed profiles for each of the identified hazards include information categorized as follows:

Hazard Description: This section consists of a general description of the hazard and the types of impacts it may have on a community or school/special district.

Geographic Location: This section describes the geographic location of the hazard in the planning area. Where available, use maps to indicate the specific locations of the planning area that are vulnerable to the subject hazard. For some hazards, the entire planning area is at risk.

Severity/Magnitude/Extent: This includes information about the severity, magnitude, and extent of a hazard. For some hazards, this is accomplished with description of a value on an established scientific scale or measurement system, such as an EF2 tornado on the Enhanced Fujita Scale. Severity, magnitude, and extent can also include the speed of onset and the duration of hazard events. Describing the severity/magnitude/extent of a hazard is not the same as describing its potential impacts on a community. Severity/magnitude/extent defines the characteristics of the hazard regardless of the people and property it affects.

Previous Occurrences: This section includes available information on historic incidents and their impacts. Historic event records form a solid basis for probability calculations. Tables are a good way to convey this data. Include events for the previous 20 years if available for hazards that are random in occurrence, such as tornadoes. Hazard events that occur more than once annually can include data for the previous 10 years. Use judgment for retrieval of enough data on which to base a solid probability calculation. Some hazard events occur many times annually, and retrieving data for all events can become cumbersome. When this is the case, searches can be limited by criteria such as severity (for example, an NCDC search for hail could be limited to events with hail sizes of 2.0” and above).

Probability of Future Occurrence: The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability was determined by dividing the number of recorded events by the number of years and multiplying by 100. This gives the percent chance of the event

happening in any given year. For events occurring more than once annually, the probability will be reported 100% in any given year, with a statement of the average number of events annually.

Vulnerability Assessments

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

Requirement §201.6(c)(2)(ii)(A) :The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Requirement §201.6(c)(2)(ii)(B) :[The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(ii): (As of October 1, 2008) [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged in floods.

Following the hazard profile for each hazard will be the vulnerability assessment. The vulnerability assessment further defines and quantifies populations, buildings, critical facilities, and other community assets at risk to damages from natural hazards. The vulnerability assessments will be based on the best available county-level data, which is in the Missouri Hazard Mitigation Plan (2013) and Assessor's parcel data. The county-level assessments in the State Plan were based on the following sources:

- Statewide GIS data sets compiled by state and federal agencies; and
- FEMA's HAZUS-MH loss estimation software.

The vulnerability assessments in the Christian County plan will also be based on:

- Written descriptions of assets and risks provided by participating jurisdictions;
- Existing plans and reports;
- MPC meetings
- NOAA/NCDC Storm event database

The Vulnerability Overview provided for each hazard consists of:

Potential Losses to Existing Development: Includes the types and numbers, of buildings, critical facilities.

Future Development: This section will include information on anticipated future development in the county, and how that would impact hazard risk in the planning area.

Hazard Summary by Jurisdiction: For hazard risks that vary by jurisdiction, this section will provide an overview of the variation and the factual basis for that variation. For example, a community that has adopted more recent building codes and constructed saferooms would be less vulnerable to the impact of tornados.

Problem Statements

Each hazard analysis must conclude with a brief summary of the problems created by the hazard in the planning area, and possible ways to resolve those problems.

3.4.1 Dam Failure

Hazard Profile

Hazard Description

A dam failure is characterized by an uncontrolled release of water from behind a dam. A dam is generally defined as an artificial barrier usually constructed across a stream channel to impound water. Flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation and poor construction can all cause a dam to fail. When a dam failure occurs, an enormous amount of water is suddenly released, destroying infrastructure and flooding the area downstream of the dam. Dams can fail for many reasons. The most common are as follows:

- **Overtopping** - inadequate spillway design, debris blockage of spillways or settlement of the dam crest
- **Piping** - internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam
- **Erosion** - inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection
- **Structural Failure** - caused by an earthquake, slope instability or faulty construction.

According to the State Plan, Missouri had some 5,423 recorded dams in 2013, the largest number of man-made dams of any state in the country. Missouri's topography allows lakes to be built easily and inexpensively, which accounts for the high number of dams. Despite the large number of dams, there are only 682 (about 13 percent) state regulated dams, with an additional 66 federally regulated dams. Federal dams in Missouri are primarily regulated by two federal agencies; the U.S. Army Corps of Engineers (USACE), and the U.S. Department of Agriculture Forest Service. The remaining 4,495 dams are unregulated.

Dams that fall under state regulation are non-federally regulated dams that are more than 35 feet in height. Most nonfederal dams are privately owned structures built either for agricultural, water supply or recreational use. The Department of Natural Resources (MDNR) Water Resources Center maintains the Dam and Reservoir Safety Program in Missouri. The program ensures that dams over 35 feet in height are safely constructed, operated, and maintained pursuant to Chapter 236 of Revised Statutes of Missouri.

The Department of Natural Resources provides information about regulated and unregulated dams in Missouri. The information includes details of the dam dimensions, date of construction, approximate reservoir volume, contributing drainage basin area and hazard classification. In addition, USACE maintains the National Inventory of Dams (NID). The information in the NID database matches the list from the MDNR website with some additional details for dams in Christian County. Although both agencies provide a hazard classification for dams, the dam classification systems differ.

The Missouri Dam and Reservoir Safety Council Rules and Regulations uses three classes of downstream environmental zone used when considering permits. The downstream environment zone is the area below the dam that would become inundated should the dam fail. Inundation is defined as water two feet or more over the submerged ground outside of the stream channel. These classes are based on the number of structures and types of development contained within the inundation area as presented in **Table 3.14**. The downstream environment zone classification is also used to prescribe the frequency of inspection.

Table 3.14. MDNR Dam Hazard Classification Definitions

Hazard Class	Definition
Class I	The area downstream from the dam that would be affected by inundation contains ten (10) or more permanent dwellings or any public building. Inspection of these dams must occur every two years
Class II	The area downstream from the dam that would be affected by inundation contains one to nine permanent dwelling, or one (1) or more campgrounds with permanent water, sewer and electrical services or one (1) or more industrial buildings. Inspection of these dams must occur once every three years.
Class III	The area downstream from the dam that would be affected by inundation does not contain any of the structures identified for Class I or Class II dams. Inspection of these dams must occur once every five years

Source: Missouri Department of Natural Resources, http://dnr.mo.gov/env/wrc/docs/rules_reg_94.pdf

Dams in the NID are classified according to hazard potential, an indicator of the consequences of dam failure. A dam's hazard potential classification, presented in **Table 3.15**, does not indicate its condition. Dams assigned the high hazard potential classification are those where failure will potentially result in loss of human life. Significant hazard potential are those dams where failure results in no probable loss of human life but can cause economic loss. Dams assigned the low hazard potential classification are those where failure or results in no probable loss of human life and low economic or environmental losses. Losses are principally limited to the owner's property.

Table 3.15. NID Dam Hazard Classification Definitions

Hazard Class	Definition
Low Hazard	Failure results in only minimal property damage.
Significant Hazard	Failure could possibly result in the loss of life and appreciable property damage.
High Hazard	If the dam were to fail, lives would be lost and extensive property damage could result.

Source: USACE, National Inventory of Dams

There is not a direct correlation between the State Hazard classification and the NID classifications. However, most dams that are in the State's Classes I and II are considered NID High Hazard Dams.

Geographic Location

There are five dams recorded in Christian County in both the MDNR and NID databases. The Galindo Family Dam was permitted in 2014 increasing the number of dams from four at the time of

the 2011 Plan. The Galindo Family Dam and Liar's Lake Dam are the only two state regulated dams in the county with dam heights of 48 and 39 feet, respectively. These dams are rated as high hazard dams in the NID and Class II dams by MDNR. The remaining three dams are rated as low hazard dams in the NID and Class III dams by MDNR. All dams in the county are located in unincorporated rural areas. There are no federally owned and operated dams in the county.

Pertinent information on dams in Christian County is presented in **Table 3.16.** The table indicates if there is an Emergency Action Plan (EAP) in place, height, last inspection date, nearest downstream city, "as the crow flies" distance to the nearest downstream city and normal storage of water impounded by the dam in acre feet. An acre foot is defined as the volume of one acre of surface area to the depth of one foot.

Table 3.16. High Hazard Dams in Christian County

Dam Name	Emergency Action Plan (EAP)	Dam Height (Ft)	Normal Storage (Acre-Ft)	Last Inspection Date	River	Nearest Downstream City	Distance To Nearest City (Miles)	Dam Owner
Liars Lake Dam	N	39	420	11//27/12	Elkhorn Creek	Forsyth	21	Bruce Winship
Paul's Lake Dam	NR	25	40	N/A	Finley Creek	Ozark	15	Fred Paul
Stoneshire Lake #2 Dam	NR	25	67	N/A	Camp Creek	Saddlebrooke	6	Private
Sugar Camp Creek Dam	NR	34	691	N/A	Swan Creek	Forsyth	22	Bruce Winship
Galindo Family Dam	N/A	48	0	4/24/14	W. Fork Bull Creek	Saddlebrooke	6	Galindo Family

Sources: Missouri Department of Natural Resources and National Inventory of Dams.

Figure 3.5 provides the locations of NID high hazard dams located in the planning area. **Figure 3.6** is a map of the inundation area for Liar's Lake Dam in the eastern rural part of the county. Although the newly constructed Galindo Family Dam is over 35 feet in height and a state regulated high hazard dam, no inundation area map for the dam has been produced by DNR. This dam lies above the northeast portion of the Village of Saddlebrooke. All dam locations are in rural parts of the county and no population concentrations are anticipated to be at risk.

Upstream Dams Outside the Planning Area

The Springfield Lake Dam in southern Greene County on the James River would impact areas north of Nixa and along the James River in rural parts of the county. **Figure 3.7** is a map of the dam breech inundation zone for the Springfield Lake Dam.

Figure 3.5. Christian County High Hazard Potential Dams

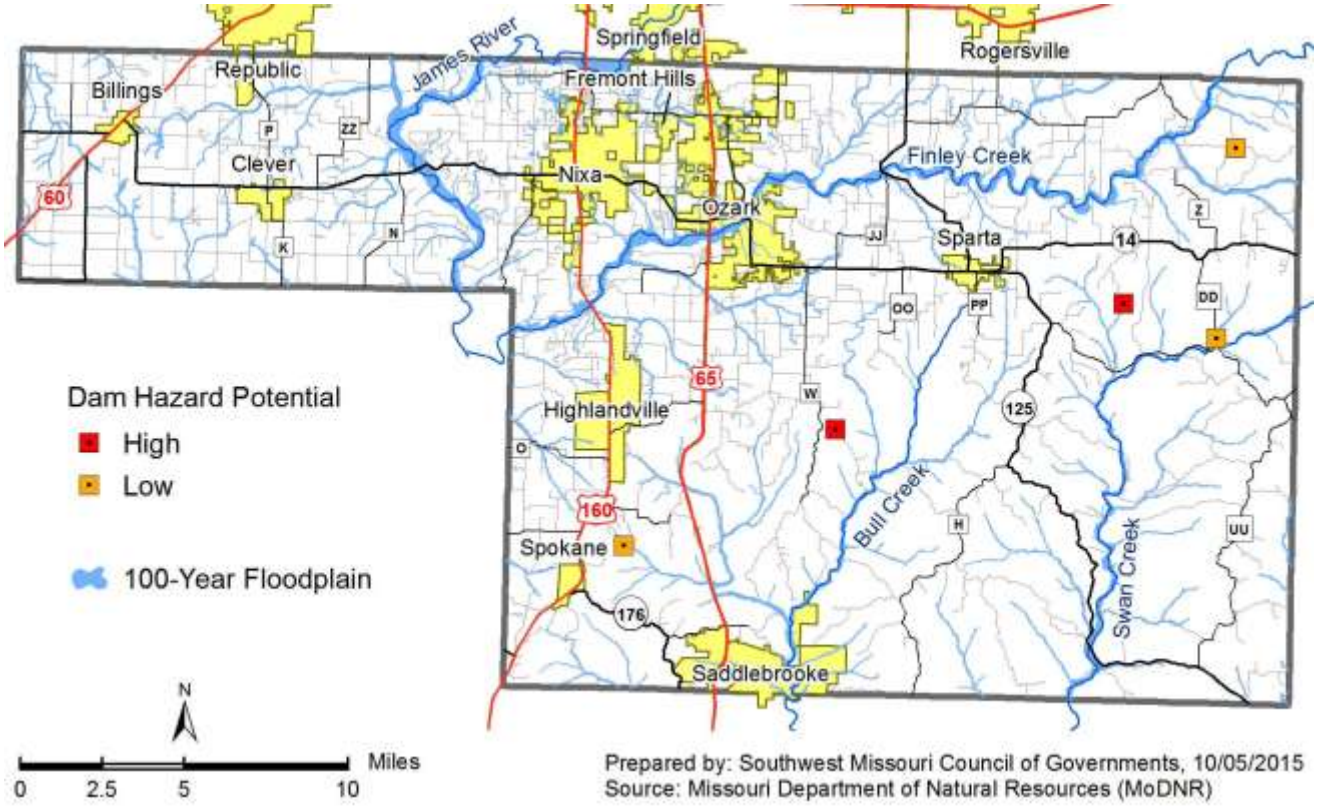
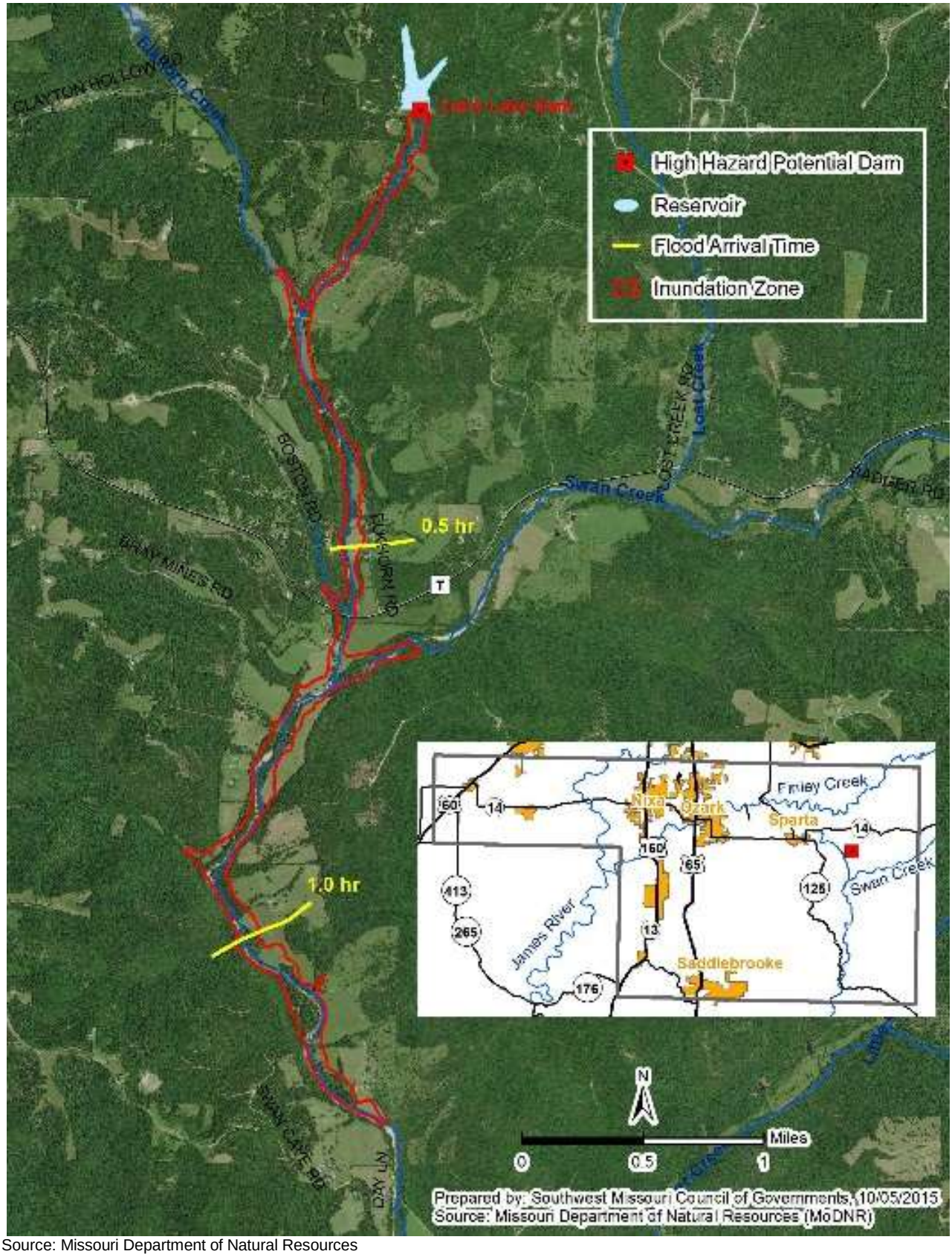
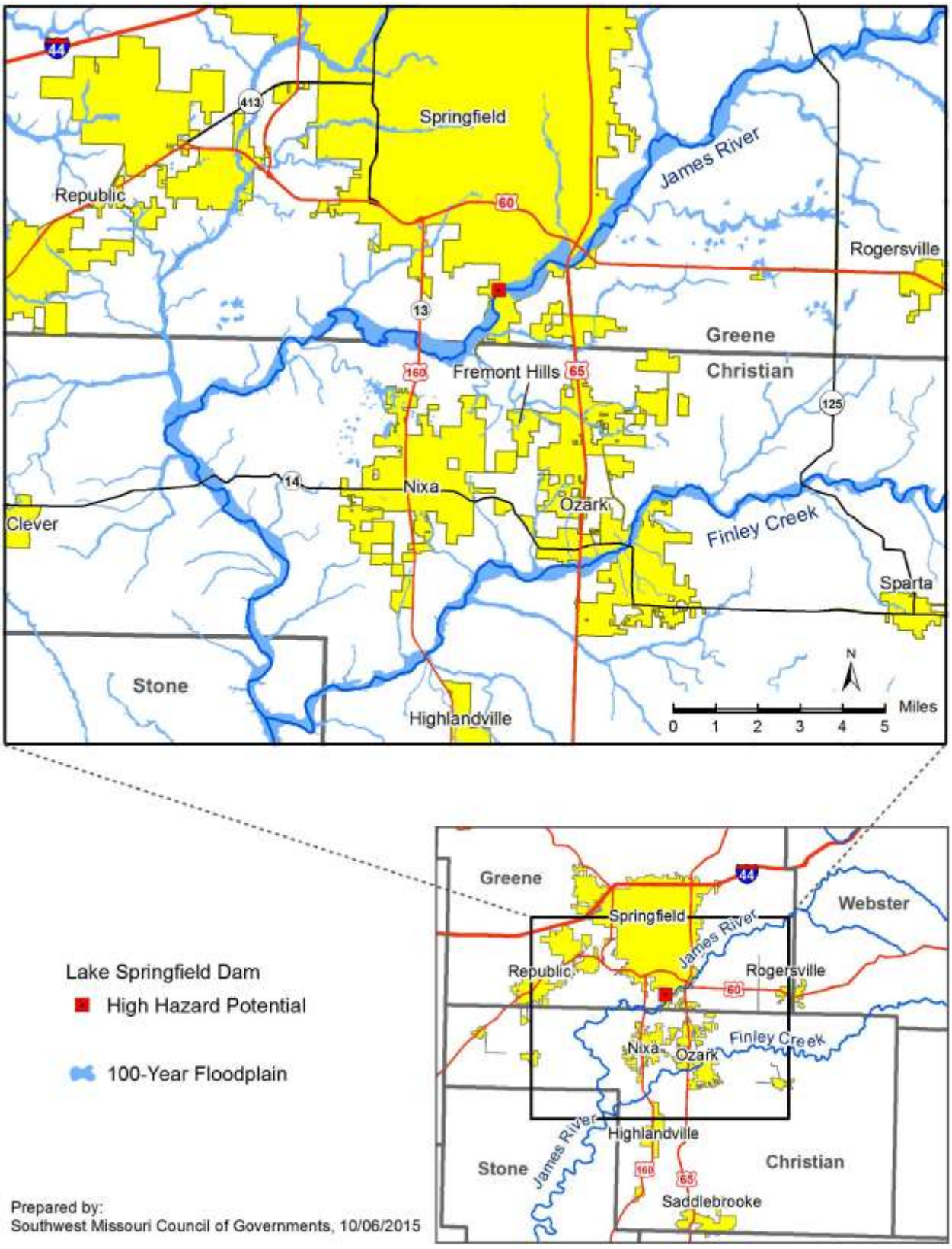


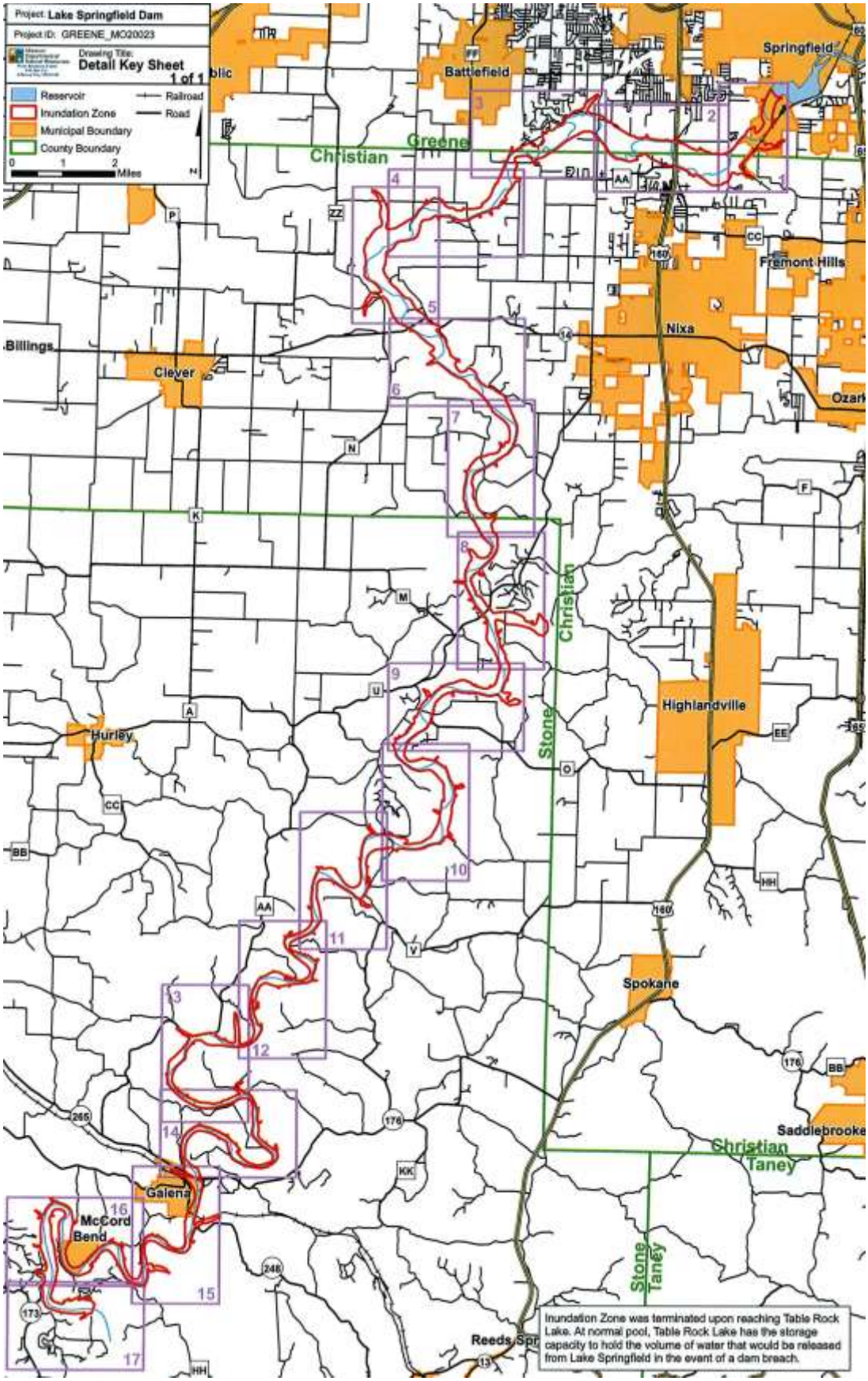
Figure 3.6. Liars Lake Dam Location in Christian County and Areas Impacted in the Event of Breach.



Source: Missouri Department of Natural Resources

Figure 3.7. Upstream Dams Outside Christian County





Source: U.S. Army Corps of Engineers, Missouri Department of Natural Resources

Severity/Magnitude/Extent

It can be stated that the severity/magnitude of dam failure would be similar in some cases to the impacts associated with flood events (see the flood hazard vulnerability analysis and discussion). Based on the hazard class definitions, failure of any of the High Hazard/Class I dams could result in a serious threat of loss of human life, serious damage to residential, industrial or commercial areas, public utilities, public buildings, or major transportation facilities. Catastrophic failure of any high hazard dams has the potential to result in greater destruction due to the potential speed of onset and greater depth, extent, and velocity of flooding. For this reason, dam failures could flood areas outside of mapped flood hazards.

Actual dam failure can result not only in loss of life, but also considerable loss of capital investment, loss of income, and property damage. Loss of the reservoir itself can cause hardship for those dependent on it for their livelihood or water supply.

Previous Occurrences

There is no record of a dam failure within the county. For the 26-year period from 1975 to 2001 for which dam failure statistics are available, 17 dam failures were recorded. This does not include the Taum Sauk failure in 2005 or the Moon Valley Lake Dam failure in 2008 since the comprehensive data collected by Stanford University was not updated past 2001. According to this data, the annual probability calculates to a 65% probability in any given year for at least one dam failure event somewhere in the State of Missouri. However, with over 5,000 dams in the State, this translates to an overall low probability per dam structure.

Probability of Future Occurrence

There is no record of dam failure in Christian County. According to information from the 2013 State Plan, Missouri's percentage of high hazard dams in the DNR inventory puts the State at about the national average for that category. However, if development occurs downstream of dams the percentage of high hazard dams will increase. Additionally, the probability of dam failure increases as many of the smaller and privately owned dams continue to deteriorate without the benefit of further regulation or improvements. Regular inspection and maintenance schedules for dams greatly reduces the probability of dam failure.

Vulnerability

Vulnerability Overview

Vulnerability to dam failure in Christian County is limited to structures and critical infrastructure located in dam inundation zones. All dams are located in unincorporated parts of the county. The Springfield Lake Dam is upstream of the County on the James River and the mapped inundation zone for dam failure only includes unincorporated parts of the county along the James River. Currently only two state regulated dams with heights of 35 or greater. Both of these dams are rated High Hazard/Class II dams. Of these two, only the Liar's Lake Dam inundation area has been mapped by DNR. It should be noted that there 3 unregulated dams in Christian County that do not meet the 35-foot dam height requirement to fall under state regulation. These three dams are Class III dams according to the NID. According to this classification there are no structures or

infrastructure in the downstream. Although failure potential certainly exists for these non-regulated dams, it is very difficult to attempt to analyze vulnerability due to data limitations. It can be assumed that there are up to nine (9) permanent structures, campgrounds, or utilities in the downstream environments of the two Class II dams. The Springfield Lake Dam is a federally regulated Class I structure.

Potential Losses to Existing Development: (including types and numbers, of buildings, critical facilities, etc.)

Potential losses were estimated for dam failure at Liar's Lake Dam were calculated by overlaying 2014 GIS structure data on the inundation zone layer provided by DNR. The results indicated that two agricultural structures were in the inundation zone. These two structure points were overlaid on the Assessor's parcel data to determine the value of these structures. The appraised value of these structures was $8,900.

This same method was used to estimate potential losses due to a dam failure at the Springfield Lake Dam. The results of potential loss by building type for unincorporated parts of the county, which is the only jurisdiction that would be affected are listed below:

- 18 Residential structures valued at $3,094,700
- 9 Commercial structures valued at $2,210,800
- 9 Agricultural buildings valued at $85,800

It is not possible to estimate losses at the Galindo Family Dam without a dam inundation area analysis from DNR. However according to the NID dam class criteria there are potentially up to nine (9) permanent dwellings in the downstream environment from this dam. Using the average value per structure for unincorporated areas of the county of $119,768, the potential exposure to dam failure at the Galindo Family Dam is $1,077,913.

Impact of Future Development

It is possible that future development will occur in the downstream environment of dams within the county, however no major development is expected. Christian County is a participant of the NFIP and can regulate development within SFHAs that overlap with dam inundation zones. Prohibiting development in the floodplain will somewhat mitigate potential damages to future development.

Hazard Summary by Jurisdiction

Christian County is the only jurisdiction in the county vulnerable to dam failure. There are no mapped inundation areas or potential inundation areas within cities. No school district facilities or special district facilities are located within inundation areas or downstream environments from existing dams.

Problem Statement

There are two dams in the county with a high hazard potential. Both of these dams of these dams are state regulated, however, only the Liar's Lake Dam has a mapped dam inundation zone or has an emergency action plan in place. Neither DNR nor Christian County have the regulatory

authority to regulate the Springfield Lake Dam, however, this dam is federally regulated. Although the probability of dam failure in the county is very low the potential for damage remains.

Residents near a Class I or Class II hazard dams should become familiar with the dam's emergency action plans, if available. Emergency plans written for dams include procedures for notification and coordination with local law enforcement and other governmental agencies, information on the potential inundation area, plans for warning and evacuation, and procedures for making emergency repairs.

3.4.2 Drought

Hazard Profile

Hazard Description

Drought is generally defined as a condition of moisture levels significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. A drought period can last for months, years, or even decades. There are four types of drought conditions relevant to Missouri, according to the 2013 State Plan, which are as follows.

Meteorological - drought is defined in terms of the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

Hydrological - drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts also are out of phase with impacts in other economic sectors.

Agricultural - drought focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, etc. Plant demand for water depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

Socioeconomic - drought refers to when physical water shortage begins to affect people.

Geographic Location

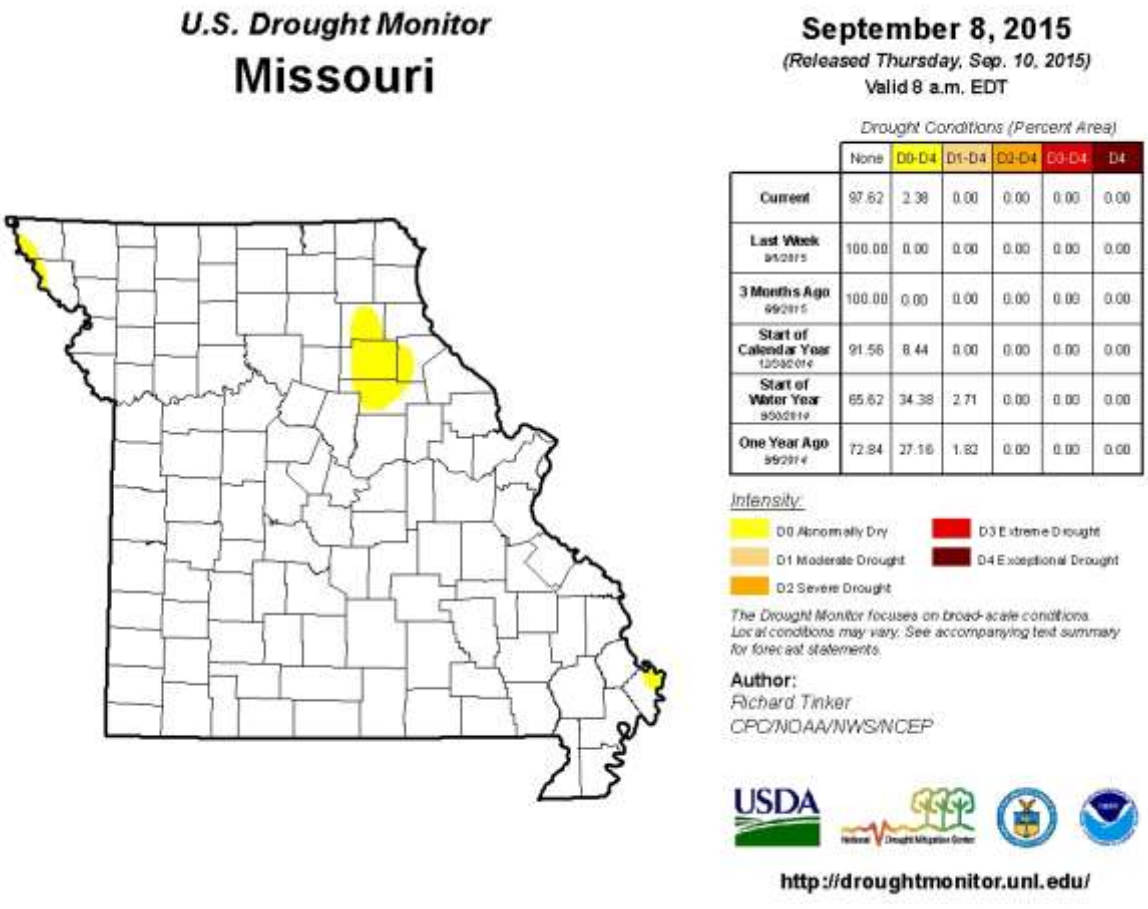
Droughts are regional climatic events that can impact large areas and multiple counties. The entire county is at risk to the impacts of drought. However, drought most directly impacts the agricultural sector, so areas within the county where there is extensive agricultural land use can experience significant impacts. Although areas in the western panhandle of the county are rated by the USDA Soil Survey as prime farmland, the majority of agricultural activity in the county is low-intensity livestock production. The lower density of low intensity livestock production in the county limits areas of extensive agricultural land use in the county. All incorporated communities in the county rely on wells for water supply. The impact of drought on deeper public wells would not be significant unless the drought was of such severity to reduce groundwater levels.

Severity/Magnitude/Extent

The National Drought Monitor Center at the University of Nebraska at Lincoln summarizes the potential severity of drought. Drought can create economic impacts on agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and disease to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn place both human and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Finally, while drought is rarely a direct cause of death, the associated heat, dust and stress can all contribute to increased mortality.

Figure 3.8 is a recent map from the U.S. Drought Monitor and an example of the size of the geographic area that could be in drought at any given moment in time. The map is only a snapshot of conditions at a given time and indicates the severity of drought conditions.

Figure 3.8. U.S. Drought Monitor Map of Missouri on 9/8/2015



Source: U.S. Drought Monitor, http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?MO

The most commonly used indicator of drought and drought severity is the Palmer Drought Severity Index (PDSI), jointly published by the NOAA and the United States Department of Agriculture. The Palmer Drought Indices measure dryness based on recent precipitation and temperature. The indices are based on a "supply-and-demand model" of soil moisture. Calculation of supply is relatively straightforward, using temperature and the amount of moisture in the soil. However demand is more complicated as it depends on a variety of factors, such as evapotranspiration and recharge rates. These rates are harder to calculate. Palmer tried to overcome these difficulties by developing an algorithm that approximated these rates, and based the algorithm on the most readily available data — precipitation and temperature.

The Palmer Index has proven most effective in identifying long-term drought of more than several months. However, the Palmer Index has been less effective in determining conditions over a matter of weeks. It uses a "0" as normal, and drought is shown in terms of negative numbers; for example, negative 2 is moderate drought, negative 3 is severe drought, and negative 4 is extreme drought. Palmer's algorithm also is used to describe wet spells, using corresponding positive numbers.

According to the MDNR Missouri Drought Plan revised in 2002, Missouri's Drought Response System is divided into four phases based on Palmer index values:

- **Phase I: Advisory Phase**—Requires a drought monitoring and assessment system to provide enough lead time for state and local planners to take appropriate action;

- **Phase II: Drought Alert**—When the PDSI reads -1.0 to -2.0, and stream flows, reservoir levels, and groundwater levels are below normal over a several month period, or when the Drought Assessment Committee (DAC) determines that Phase II conditions exist based on other drought determination methods;

- **Phase III: Conservation Phase**—When the PDSI reads -2.0 to -4.0, and stream flows, reservoir levels, and groundwater levels continue to decline, along with forecasts indicating an extended period of below-normal precipitation, or when the DAC determines that Phase III conditions exist based on other drought determination models;

- **Phase IV: Drought Emergency**—When the PDSI is lower than -4.0, or when the DAC determines that Phase IV conditions exist based on other drought determination methods.

Palmer also developed a formula for standardizing drought calculations for each individual location based on the variability of precipitation and temperature at that location. The Palmer index can therefore be applied to any site for which sufficient precipitation and temperature data is available.

The USDA's Risk Management Agency provides insured crop loss payments in the county as a result of drought from 1948 to the present. From 2010 through 2014, these records indicate that there were $832,898 in crop insurance payments during this time in Christian County. Over half of those losses, or $461,080 were paid in 2012. There were no reported crop loss payments from 2009 through 1998 recorded in the county. The 2013 State Plan states that from 1998 through 2012 there were $754,685 in insured crop loss payments with annualized losses of $50,312. It is difficult to reconcile this information as information presented in the 2013 State Plan indicates there is data missing in the Risk Management Agency data available online.

Previous Occurrences

The NCDC storm events database includes 17 drought events occurring in Christian County from 1996 through 2014. Many of these were multiple reports from persistent drought events that lasted several months. The NCDC reports indicate that there were five distinct drought periods during an 18 year timeframe. **Table 3.17** provides a summary of these events.

Table 3.17. Previous Drought Occurrences 1996 - 2015

Drought Year	Duration	Property Damage	Crop Damage
1999	July - October	$0	$20,000
2000	August -September	$0	$0
2006	January - April	$0	$0
2011	July - November	$0	$5,000
2012/2013	June - January	$0	$1,370,000

The impact of these events are described in the NCDC storm event narratives:

- **1999** - Stock ponds in many areas dried up forcing farmers to either pump or transport water for livestock, a few shallower wells reportedly ran dry, Many ranchers sold cattle and other livestock due to the lack of an adequate water supply

- **2000** - These conditions allowed for the continuation of short-term dryness, lower yields of soybeans, and above normal fire danger. Soybean yields were reduced from normally 26-31 bushels per acre, to 20 bushels per acre

- **2006** - All-time record dry conditions for the month of February, analyzed as a severe drought according to the United States Drought Monitor

- **2011** – The USDA Service center in Christian County indicated that crop losses were as high as 75 percent, many farmers and ranchers reported having to feed hay as pastures became dry and farm stock ponds dried up

- **2012** - The USDA Service center in Christian County indicated that crop losses were 75 percent of the spring planting many farmers and ranchers reported having to feed hay as pastures stopped growing and became dry through the month which added to operation costs, monetary crop loss figures are estimates using information from the National Agricultural Statistics database

Probability of Future Occurrence

Although it would be best to use at least a 20-year period from which to draw data on drought events in order to obtain a more accurate estimate of probability, only an 18-year record period is available from the NCDC. Over the 18-year record period, Christian County was in a drought for 20 months. There are a total of 216 months in the record period. The calculated risk percent from the number of months of drought and the total number of months in the record period equates to the annual average percentage of **9.25%** probability of drought occurrence in the county. Although

drought is not predictable, long-range outlooks and predicted impacts of climate change could indicate an increased chance of drought persistence and severity.

Vulnerability

Vulnerability Overview

The agriculture sector is particularly vulnerable to drought. Periods of dry weather can reduce stock ponds and force the early sale of livestock. Crop production can be disrupted and vegetative diseases can spread reducing yields. Cities that operate water wells can experience water shortages during persistent drought periods like the six month drought period in 2012/2013. Those that rely on private wells are likely be impacted by reductions in the groundwater supply.

Potential Losses to Existing Development

The 2013 State Plan states that from 1998 through 2012 there were $754,685 in insured crop loss payments with annualized losses of $50,312. There are no anticipated structural losses, loss of life, or injuries associated with this hazard.

Impact of Future Development

Increases in acreage planted with crops would add to exposure to drought-related agricultural losses. In addition, increases in population result in increased demand for treated water, adding additional strain on water supply systems.

Impact of Climate Change

A new analysis, performed for the Natural Resources Defense Council, examined the effects of climate change on water supply and demand in the contiguous United States. The study found that more than 1,100 counties will face higher risks of water shortages by mid-century as a result of climate change. Two of the principal reasons for the projected water constraints are shifts in precipitation and potential evapotranspiration (PET). Climate models project decreases in precipitation in many regions of the U.S., including areas that may currently be described as experiencing water shortages of some degree.

The Natural Resources Defense Council developed a new water supply sustainability index. The risk to water sustainability is based on the following criteria:

- Projected water demand as a share of available precipitation
- Groundwater use as a share of projected available precipitation
- Susceptibility to drought
- Projected increase in freshwater withdrawals
- Projected increase in summer water deficit

The risk to water sustainability for counties meeting two of the criteria are classified as “moderate,” while those meeting three of the criteria are classified as “high,” and those meeting four or more are classified as “extreme.” Counties meeting less than two criteria are considered to have low risk to water sustainability. According to the Natural Resources Defense Council, without climate

change the water sustainability index for Christian County is moderate. With climate change, the water supply sustainability index increases to high (NRDC).

Hazard Summary by Jurisdiction

Although the probability of drought is the same for the entire county, farming and livestock enterprises in the unincorporated parts of the county would feel the greatest impact. These impacts are mitigated somewhat by the purchase of crop insurance. The communities of Billings and Clever have two source wells for potable water and would be impacted during water shortages and reductions in groundwater due to their reliance on limited source wells for public water supply during persistent drought periods. Fremont Hills does provide water to its residents. Although Nixa and Ozark have numerous potable water wells, the City of Ozark reported that groundwater supplies reached a critical stage during the drought of 2012/2013. School and special districts would be the least impacted by drought, however, those districts in communities with single source wells may experience water shortages prior to those in larger communities.

Problem Statement

Although drought most likely will not cause structural damage, the impact is greatest on the agriculture sector and if persistent enough, could cause reductions in groundwater and water shortages in communities that provide potable water services. Potential solutions to mitigate the impact of drought would be for communities to develop an ordinance to restrict the use of public water resources for non-essential usage, such as landscaping, washing cars, filling swimming pools, etc. during extreme drought periods. School and special districts can also implement water conservation measures at all district facilities.

3.4.3 Earthquakes

Hazard Profile

Hazard Description

An earthquake is a sudden motion or trembling that is caused by a release of energy accumulated within or along the edge of the earth's tectonic plates. Earthquakes occur primarily along fault zones and tears in the earth's crust. Along these faults and tears in the crust, stresses can build until one side of the fault slips, generating compressive and shear energy that produces the shaking and damage to the built environment. Heaviest damage generally occurs nearest the earthquake epicenter, which is that point on the earth's surface directly above the point of fault movement. The composition of geologic materials between these points is a major factor in transmitting the energy to buildings and other structures on the earth's surface.

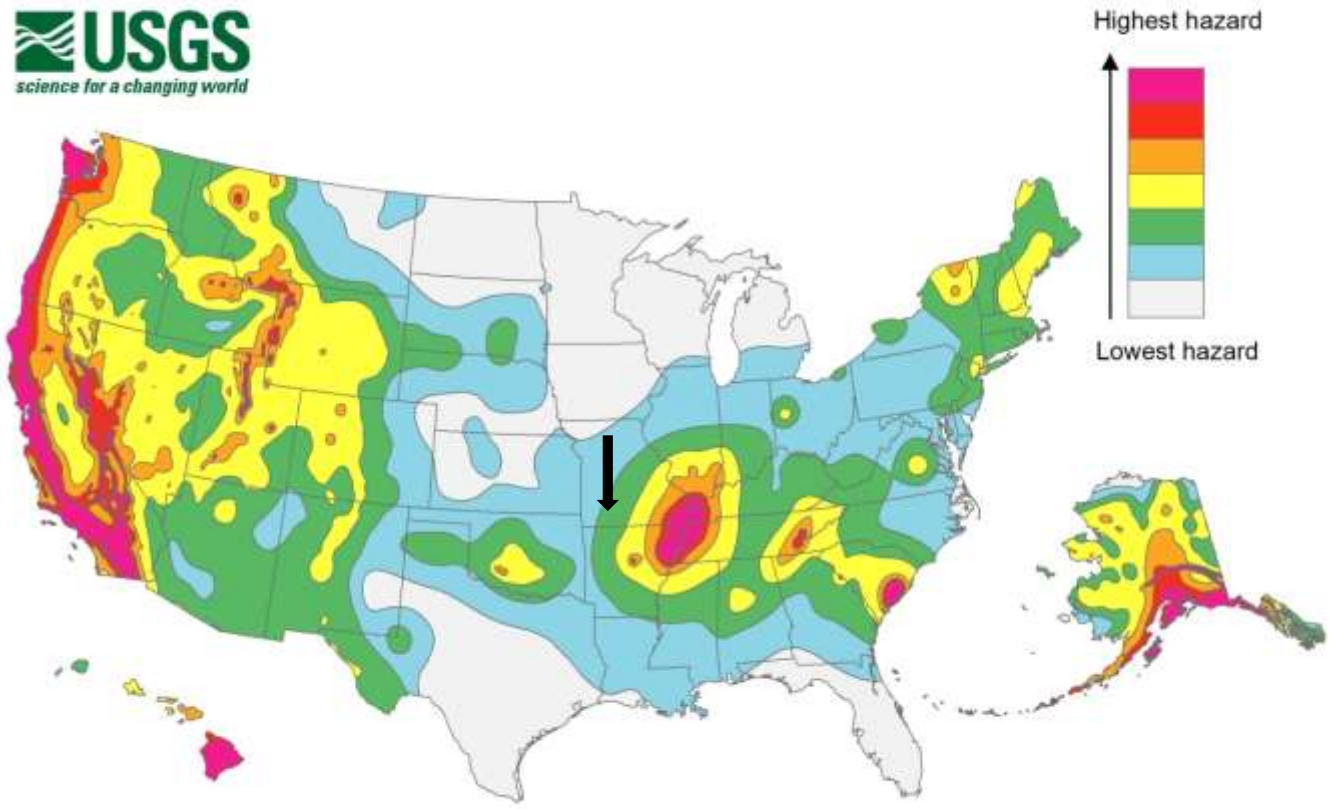
The subterranean faults were formed many millions of years ago on or near the surface of the earth. Subsequent to that time, these ancient faults subsided, while the areas adjacent were pushed up. As this fault zone (also known as a rift) lowered, sediments filled in the lower areas. Under pressure, the sediments hardened into limestones, sandstones, and shales – thus burying the rifts. The pressures on the North American plate and the movements along the San Andreas Fault by the Pacific plate have reactivated the buried rift(s) in the Mississippi embayment. This rift system is called the Reelfoot Rift and underlies the New Madrid Seismic Zone (Braile et al., 1986).

Geographic Location

The greatest hazard from earthquakes in Christian County comes from the New Madrid Seismic Zone situated in the boot heel area of southeast Missouri. The potential of high magnitude earthquakes occurring along the New Madrid fault presents risk that does not vary across the planning area. The Nemaha uplift in central Kansas is also prone to seismic activity, however, the center of the Humbolt fault zone near the Nemeha Uplift is approximately 180 to 220 mile west of Christian County and produces lower magnitude seismic events.

The 2014 USGS National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. The updated maps represent an assessment of the best available science in earthquake hazards and incorporate new findings on earthquake ground shaking, faults, seismicity, and geodesy. The USGS National Seismic Hazard Mapping Project developed these maps by incorporating information on potential earthquakes and associated ground shaking obtained from interaction in science and engineering workshops involving hundreds of participants, review by several science organizations and State surveys, and advice from expert panels and a Steering Committee. **Figure 3.9** is a USGS map illustrating seismicity in the United States. A black arrow showing the location of Christian County has been inserted on the map.

Figure 3.9. United States Seismic Hazard Map



Source: United States Geological Survey at http://earthquake.usgs.gov/hazards/products/conterminous/2014/HazardMap2014_lg.jpg

Severity/Magnitude/Extent

The extent or severity of earthquakes is generally measured in two ways: 1) the Richter Magnitude Scale is a measure of earthquake magnitude; and 2) the Modified Mercalli Intensity Scale is a measure of earthquake severity. The two scales are defined a follows.

Richter Magnitude Scale

The Richter Magnitude Scale was developed in 1935 as a device to compare the size of earthquakes. The magnitude of an earthquake is measured using a logarithm of the maximum extent of waves recorded by seismographs. Adjustments are made to reflect the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. For example, comparing a 5.3 and a 6.3 earthquake shows that the 6.3 quake is ten times bigger in magnitude. Each whole number increase in magnitude represents a tenfold increase in measured amplitude because of the logarithm. Each whole number step in the magnitude scale represents a release of approximately 31 times more energy.

Modified Mercalli Intensity Scale

The intensity of an earthquake is measured by the effect of the earthquake on the earth's surface. The intensity scale is based on the responses to the quake, such as people awakening, movement of furniture, damage to chimneys, etc. The intensity scale currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 and is composed of 12 increasing levels of intensity. They range from imperceptible shaking to catastrophic destruction, and each of the twelve levels is denoted by a Roman numeral. The scale does not have a mathematical basis, but is based on observed effects. Its use gives the laymen a more meaningful idea of the severity. **Table 3.18** provides the impact by levels of intensity on the Mercalli scale.

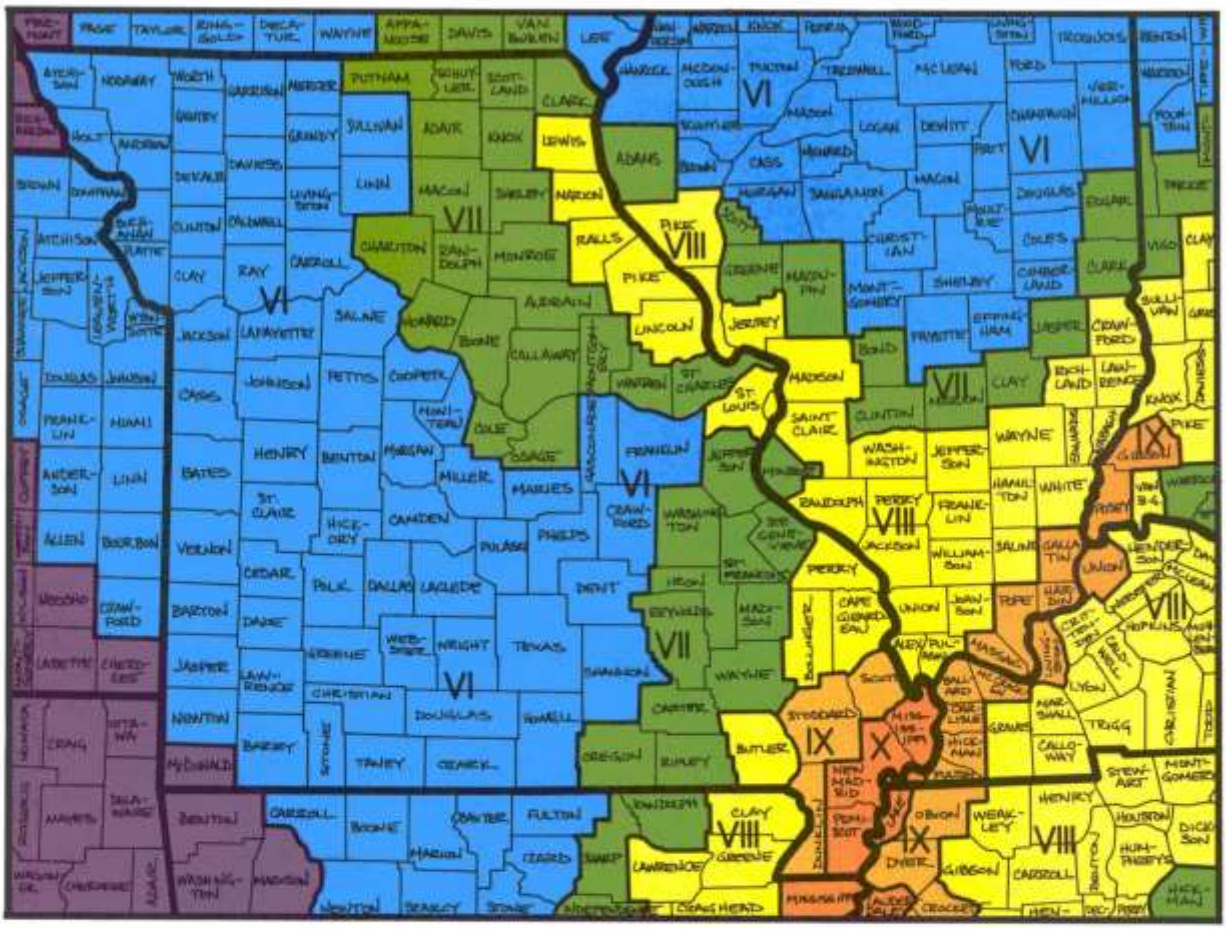
Table 3.18. Modified Mercalli Intensity Scale

Intensity Level	Description
I	People do not feel any movement.
II	A few people might notice movement.
III	Many people indoors feel movement; Hanging objects swing.
IV	Most people indoors feel movement; Dishes, windows, and doors rattle; Walls, frames and structures creak; Liquids in open vessels are slightly disturbed; Parked cars rocked.
V	Almost everyone feels movement. Most people are awakened; Doors swing open or closed; Dishes are broken: Pictures on the wall move: Windows crack in some cases; Small objects move or are turned over: Liquids might spill out of open containers.
VI	Everyone feels movement; Poorly built buildings are damaged slightly; Considerable quantities of dishes, glassware and windows are broken; People have trouble walking; Pictures fall off walls; Objects fall from shelves; Plaster in walls might crack; Some furniture is overturned; Small bells in churches, chapels, and schools ring.
VII	People have difficulty standing; Considerable damage in poorly built or badly designed buildings, adobe houses, old walls, and spires; Damage is slight to moderate in well-built buildings; Numerous windows are broken; Weak chimneys break at rooflines; Cornices from towers and high buildings fall; Loose bricks fall from buildings; Heavy furniture is overturned and damaged; Some sand and gravel stream banks cave in.
VIII	Drivers have trouble steering; Poorly built structures suffer severe damage; Ordinary substantial buildings partially collapse; Damage slight in structures especially built to withstand earthquakes; Tree branches break; Houses not bolted down may shift on foundations; Tall structures such as towers and might chimneys twist and fall; Temporary or permanent changes in springs and wells; Sand and mud is ejected.
IX	Most buildings suffer damage; Houses not bolted down move off their foundations; Some underground pipes are broken; The ground cracks conspicuously; Reservoirs suffer damage.
X	Well-built wooden structures destroyed; most masonry and frame structures destroyed, including foundations; Rails bent; Dams seriously damaged; Cracks open in pavement.
XI	Few, if any masonry structures remain standing; Large well-built bridges destroyed; Rails bent greatly; Buried pipelines are rendered completely useless. Water mixed with sand and mud ejected in large amounts.
XII	Damage total, nearly all works of construction damaged greatly or destroyed; Objects thrown into the air; Large amounts of rock may move; The ground moves in waves or ripples.

Source: http://sema.dps.mo.gov/docs/EQ_Map.pdf

Figure 3.10 shows the highest projected Modified Mercalli intensities by county from a potential magnitude 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid Seismic Zone. The secondary maps in Figure 3.6 on show the same regional intensities for 6.7 and 8.6 earthquake, respectively. Christian County is located in zone VI from a potential magnitude 7.6 earthquake along the New Madrid fault.

Figure 3.10. Impact Zones for Earthquake Along the New Madrid Fault

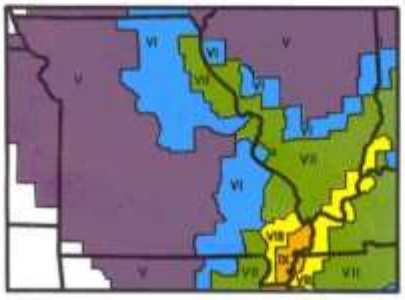


This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

6.7

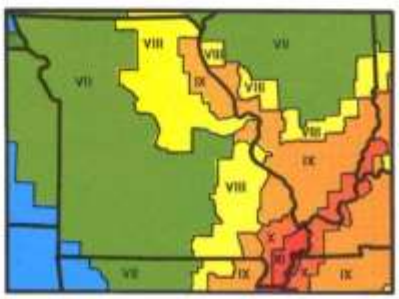
7.6

8.6



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 6.7 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 8.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.



Source: SEMA, http://sema.dps.mo.gov/docs/EQ_Map.pdf

Previous Occurrences

There is no historical record of an earthquake occurrence within Christian County. The southeastern portion of Missouri is most susceptible to earthquakes because it overlies the New Madrid Seismic Zone. Earthquake hazards in the western part of the State also exist because of the historical earthquakes in eastern Kansas and Nebraska. No area of Missouri is immune from the danger of earthquakes. Minor, but potentially damaging, earthquakes can occur anywhere in the state (SEMA, 2013).

Probability of Future Occurrence

Without a historical record for earthquakes in Christian County it is not possible to calculate a precise probability of earthquake occurrence. The Center for Earthquake Research and Information (CERI) at the University of Memphis has computed conditional probabilities of a magnitude 6.0 earthquake in the New Madrid seismic zone. According to a fact sheet prepared by SEMA in 2003, the probability for a magnitude 6.0 to 7.5 or greater earthquake along the New Madrid Fault is 25 to 40 percent over the next 50 years. . At the 25% level, the likelihood of an earthquake happening in a given year is 1.0%. At the 40% level, the likelihood of an earthquake happening in a given year is 1.6%. The previous map in **Figure 3.10** indicates the potential severity for Christian County of a 6.7, 7.6, and 8.6 magnitude earthquake anywhere along the New Madrid fault.

Vulnerability

Vulnerability Overview

Ground shaking is the most damaging effect from earthquakes. Ground shaking will impact all structures and critical infrastructure such as roads and electrical transmission systems. Although Webster county has experience a 3.3 magnitude earthquake there were no documented damages associated with this low magnitude event. The greatest earthquake risk to Christian County is the New Madrid fault in the bootheel region of Missouri. A 7.6 magnitude earthquake would result in poorly built buildings damaged slightly; considerable quantities of dishes, glassware and windows are broken; people having trouble walking; pictures falling off walls; objects falling from shelves; plaster in walls cracking; and furniture overturned. Damage to structures will occur but will vary on the quality of construction. In addition, some underground utilities may be damaged. Some injuries may occur but fatalities are unlikely.

Potential Losses to Existing Development

Potential losses to existing development include the total exposure for all communities listed in 3.3 and 3.5 in the Assets at Risk section of this chapter. The total exposure of each jurisdiction was used to estimate losses due to a 7.6 earthquake along the New Madrid. A damage factor of 0.5% was applied to each jurisdictions total building and contents based on the expected impact for Zone VI on the modified Mercalli scale. **Table 3.19** depicts the estimated losses in each jurisdiction based on total exposure and a 0.5% damage factor.

Table 3.19. Estimated Potential Earthquake Losses

Jurisdiction	Potential Earthquake Losses
Christian County	$12,803,453
City of Billings	$292,459
City of Clever	$1,019,852
City of Fremont Hills	$661,488
City of Nixa	$7,443,386
City of Ozark	$7,086,316
Billings R-IV	$84,258
Chadwick R-I	$53,008
Clever R-V	$214,489
Nixa R-II	$856,239
Ozark R-VI	$1,089,758
Spokane R-II	$191,795
Billings Special Road	$4,114
Christian County Ambulance District	$18,900
OTC Richwood Valley Campus	$101,448

Impact of Future Development

Future development is not expected to increase the risk other than contributing to the overall exposure of what could become damaged as a result of an event.

Hazard Summary by Jurisdiction

Earthquake intensity is not likely to vary greatly throughout the planning area, the risk of occurrence is be the same throughout. However, damages will differ where there are variations in the planning area based on percentage of structures built prior to 1939. For example, if one community has a higher percentage of residences built prior to 1939 than the other participants, that community is likely to experience higher damages. Table **3.20** with the number and percentage of housing units built in 1939 or earlier.

Table 3.20. Percent of Housing Units Built in 1939 or Earlier

Jurisdiction	Built 1939 or earlier #	Built 1939 or earlier %
Christian County	1,668	5.2
Billings	94	18.8
Clever	59	7.2
Fremont Hills	0	0
Nixa	101	1.3
Ozark	114	1.6

Source: Missouri Census Data Center. (2015). ACS Profiles.

School Districts with facilities constructed prior to 1939 could suffer more damages than newer facilities, however, the majority of school facilities in the district have been constructed after 1939 and are considered well-built structures and therefore, less vulnerable to potential ground shaking. All districts in the county have renovated or plan on renovating and improving campus facilities over the past five years or within the next five years. Billings Special Road District could experience structural damages to low water crossings and bridges resulting from ground shaking during an earthquake. In addition, Christian County Ambulance District facilities and OTC Richwood Valley Campus facilities have all been constructed after 2000.

Problem Statement

Based on likely damage from a 7.6 magnitude earthquake along the New Madrid fault, Older poorly built structures will suffer slight damage. Only the City of Billings has a percentage of housing units built in 1939 or earlier greater than 10% at 18.8% and would likely feel the impact of an earthquake in terms of percentage of housing units affected. Potential damages to future development can be mitigated by adopting and enforcing IBC 2012 building codes. Only the communities of Billings, Clever, and Fremont Hills have earlier versions of building codes. Updating and enforcing building codes in Billings, Clever, and Fremont Hills would mitigate the impact on future development from an earthquake event.

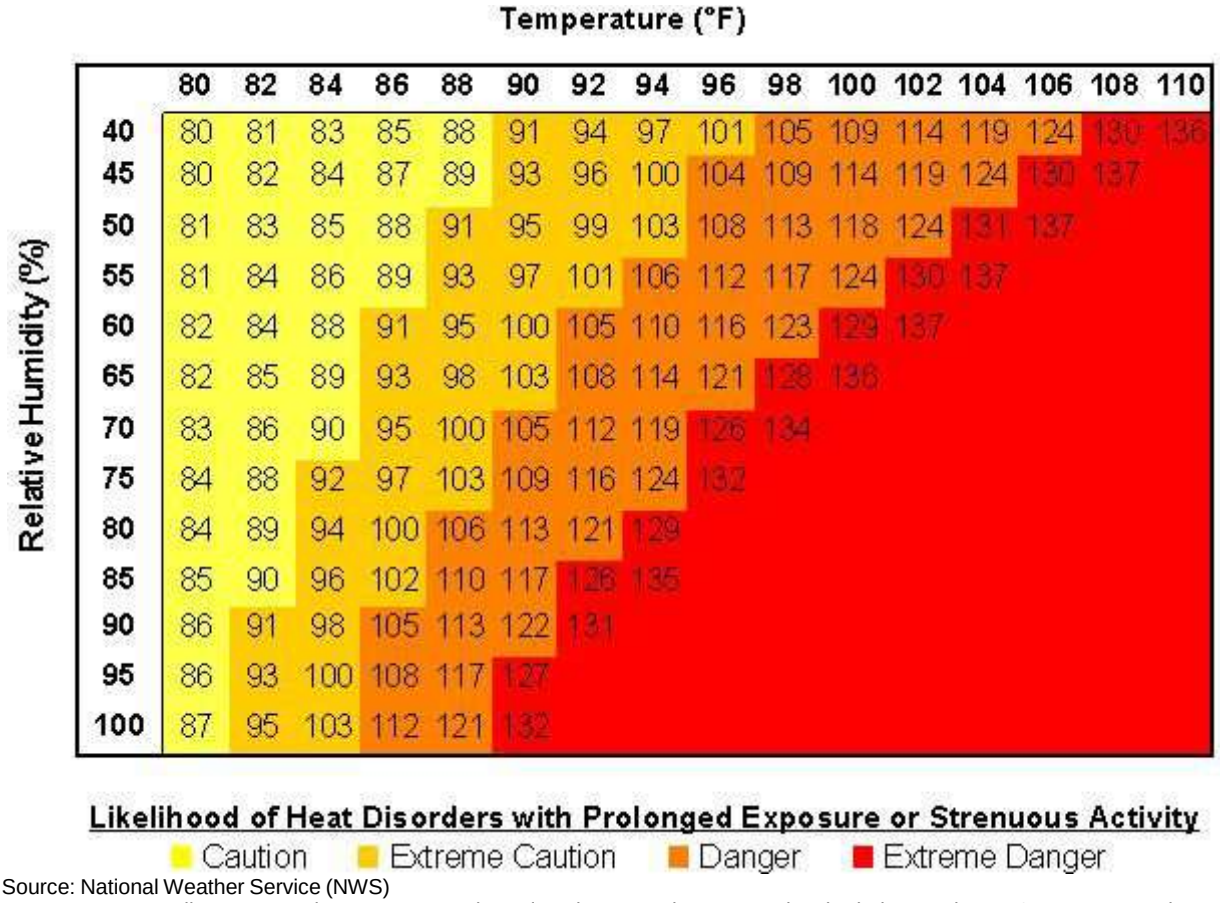
3.4.4 Extreme Heat

Hazard Profile

Hazard Description

Extreme temperature events, both hot and cold, can impact human health and mortality, natural ecosystems, agriculture and other economic sectors. The remainder of this section profiles extreme heat. Extreme cold events are profiled in combination with Winter Storm in **Section 3.4.10.** According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Ambient air temperature is one component of heat conditions, with relative humidity being the other. The relationship of these factors creates what is known as the apparent temperature. The Heat Index chart shown in **Figure 3.11** uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

Figure 3.11. Heat Index (HI) Chart



Source: National Weather Service (NWS)
Note: Exposure to direct sun can increase Heat Index values by as much as 15°F. The shaded zone above 105°F corresponds to a HI that may cause increasingly severe heat disorders with continued exposure and/or physical activity.

Geographic Location

Extreme temperatures are an area-wide hazard event, the risk of extreme heat or cold does not vary within the county.

Severity/Magnitude/Extent

Extreme heat can cause stress to crops and animals. According to USDA Risk Management Agency, losses to insurable crops during the 4-year time period from 2010 to 2014 were $0 due to extreme heat in Christian County. Extreme heat can also strain electricity delivery infrastructure overloaded during peak use of air conditioning during extreme heat events. Another type of infrastructure damage from extreme heat is road damage. When asphalt is exposed to prolonged extreme heat, it can cause buckling of asphalt-paved roads, driveways, and parking lots.

From 1988-2011, there were 3,496 fatalities in the U.S. attributed to summer heat. This translates to an annual national average of 146 deaths. During the same period, __ deaths were recorded in the planning area, according to NCDC data. The National Weather Service stated that among natural hazards, no other natural disaster—not lightning, hurricanes, tornadoes, floods, or earthquakes—causes more deaths.

Those at greatest risk for heat-related illness include infants and children up to five years of age, people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. However, even young and healthy individuals are susceptible if they participate in strenuous physical activities during hot weather. In agricultural areas, the exposure of farm workers, as well as livestock, to extreme temperatures is a major concern.

Table 3.21 lists typical symptoms and health impacts due to exposure to extreme heat.

Table 3.21. Typical Health Impacts of Extreme Heat

Heat Index (HI)	Disorder
80-90° F (HI)	Fatigue possible with prolonged exposure and/or physical activity
90-105° F (HI)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity
105-130° F (HI)	Heatstroke/sunstroke highly likely with continued exposure

Source: National Weather Service Heat Index Program, www.weather.gov/os/heat/index.shtml

The National Weather Service has an alert system in place (advisories or warnings) when the Heat Index is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. A common guideline for issuing excessive heat alerts is when for two or more consecutive days : (1) when the maximum daytime Heat Index is expected to equal or exceed 105 degrees Fahrenheit (°F); and the night time minimum Heat Index is 80°F or above. A heat advisory is issued when temperatures reach 105 degrees and a warning is issued at 115 degrees.

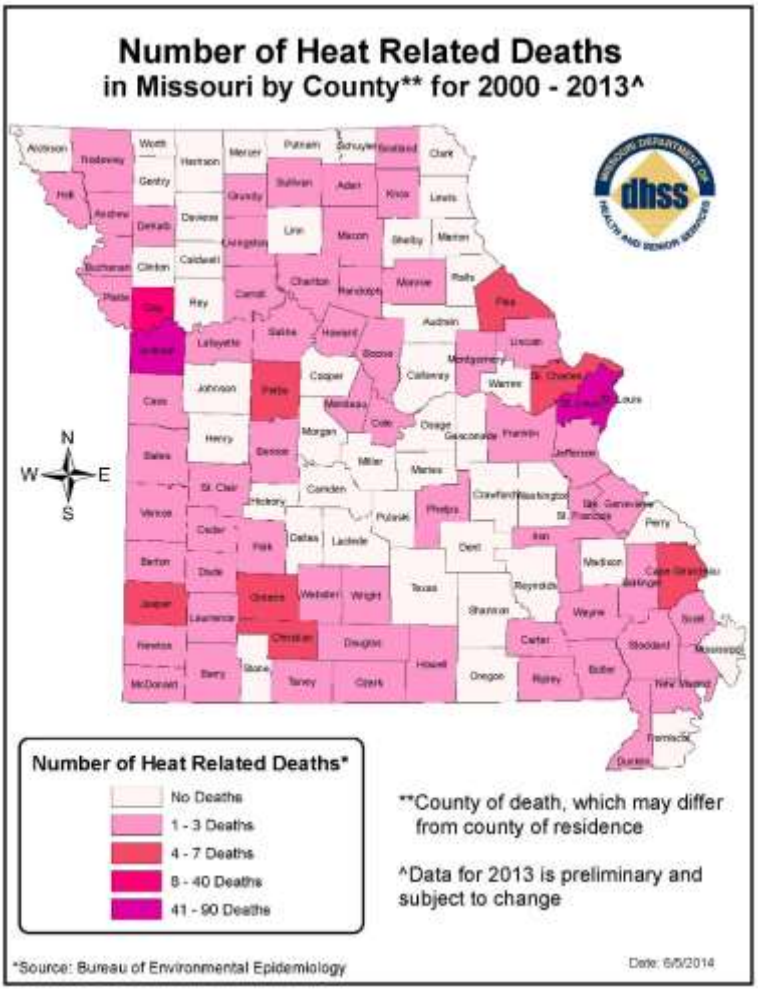
Previous Occurrences

There are nine (9) recorded extreme heat events in the National Climatic Data Center (NCDC) database from 1996 to 2015 for Webster County. There was one death and no injuries or property and crop damage associated with these events in the NCDC data for Christian County. The event narratives describe fatalities that occurred during regional multi-county heat events for other nearby counties. Extreme heat events in Christian County were recorded in consecutive months in four separate years from 1996 to 2015. The months for each year are summarized as follows:

- **1999** – July & August
- **2000** – August & September
- **2001** – July & August
- **2012** – June, July & August

Figure 3.12 is a map created by The Missouri Department of Health and Senior Services (DHSS) for heat related fatalities by county. The map indicates that there have been between four (4) and seven (7) heat related fatalities in Christian County from 2000 to 2013.

Figure 3.12. Heat Related Deaths in Missouri 2000 - 2013



Probability of Future Occurrence

The probability that an extreme heat event will occur in Christian County in any given year is 20% or once every four years. This equates to dividing four (4) years with an event period by the total number of years in the record period from 1996 to 2015 (20) and multiplying by 100. The events recorded in the NCDC database describe prolonged periods were temperatures rose above at least 90° for at least 12 consecutive days. Heat advisories and warnings are issued for shorter periods of extreme heat nearly every year and may not meet the threshold for consecutive days in the NCDC database. It is possible that the heat related fatalities reported by DHSS occurred during a shorter period of extreme heat and would not be recorded in the NCDC database. This data limitation indicates that extreme heat events could be underreported in the NCDC.

Vulnerability

Vulnerability Overview

High humidity, which often accompanies heat in Missouri, can make the effects of heat even more harmful. While heat-related illness and death can occur from exposure to intense heat in just one afternoon, heat stress on the body has a cumulative effect. Consequently, the persistence of a heat wave increases the threat to public health. The people most at risk are children under five years of age and adults over the age of 65 as well as people who work outdoors. The agriculture sector can also suffer crop loss during periods of extreme heat. Extreme heat may also cause buckling of roads.

Potential Losses to Existing Development

Based on information in the 2013 Plan and DHSS, four to seven heat related deaths may occur within Christian County over the next 13 years.

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Impact of Future Development

Population growth can result in increases in the age-groups that are most vulnerable to extreme heat. Population growth also increases the strain on electricity infrastructure, as more electricity is needed to accommodate the growing population. Christian County, Nixa, and Ozarks have the largest populations under five years of age and over 65. Unincorporated parts of the county, Clever, Nixa, and Ozark are expected to experience high growth over the next decade.

Hazard Summary by Jurisdiction

Those at greatest risk for heat-related illness and deaths include children up to five years of age, people 65 years of age and older, people who are overweight, and people who are ill or on certain medications. To determine jurisdictions within the planning area with populations more vulnerable to extreme heat, demographic data was obtained from the 2013 American Community Survey on population percentages in each jurisdiction comprised of those under age 5 and over age 65. Data was not available for overweight individuals and those on medications vulnerable to extreme heat. **Table 3.22** below summarizes vulnerable populations in the participating jurisdictions. Note that school and special districts are not included in the table because students and those working for the special districts are not customarily in these age groups. Note that school and special districts are

not included in the table because students and those working for the special districts are not customarily in these age groups.

Table 3.22. County Population Under Age 5 and Over Age 65, 2013

Jurisdiction	Population Under 5 yrs	Population 65 yrs and over
Christian County	5,660	10,131
Billings	38	199
Clever	238	213
Fremont Hills	32	159
Nixa	1,428	2,290
Ozark	1,559	2,163

Source: MCDC, 2015. ACS 2009 – 2013 Five Year Estimates

Problem Statement

Older and younger segments of the population are more vulnerable to the impact of extreme heat. In addition people living below the poverty level may be more vulnerable during periods of extreme heat due to a lack of air conditioning or utilities in their homes. Institutionalized populations such as those living in nursing homes become more vulnerable to extreme heat due to power outages. This problem has been mitigated due to the installation of emergency generators at these facilities.

The Christian County EMA maintains a list of heating and cooling centers throughout the county. These locations are promoted on the County's website. Partnering with local community organizations to continue to donate fans and offer weatherization programs would mitigate the impact on vulnerable populations in the county. Summarize the risks presented in the preceding extreme heat analysis. Include a brief discussion of possible solutions, which could be brought forward into the strategy section in later analysis.

3.4.5 Wildfire

Hazard Profile

Hazard Description

The fire incident types for wildfires include: 1) natural vegetation fire, 2) outside rubbish fire, 3) special outside fire, and 4) cultivated vegetation, crop fire.

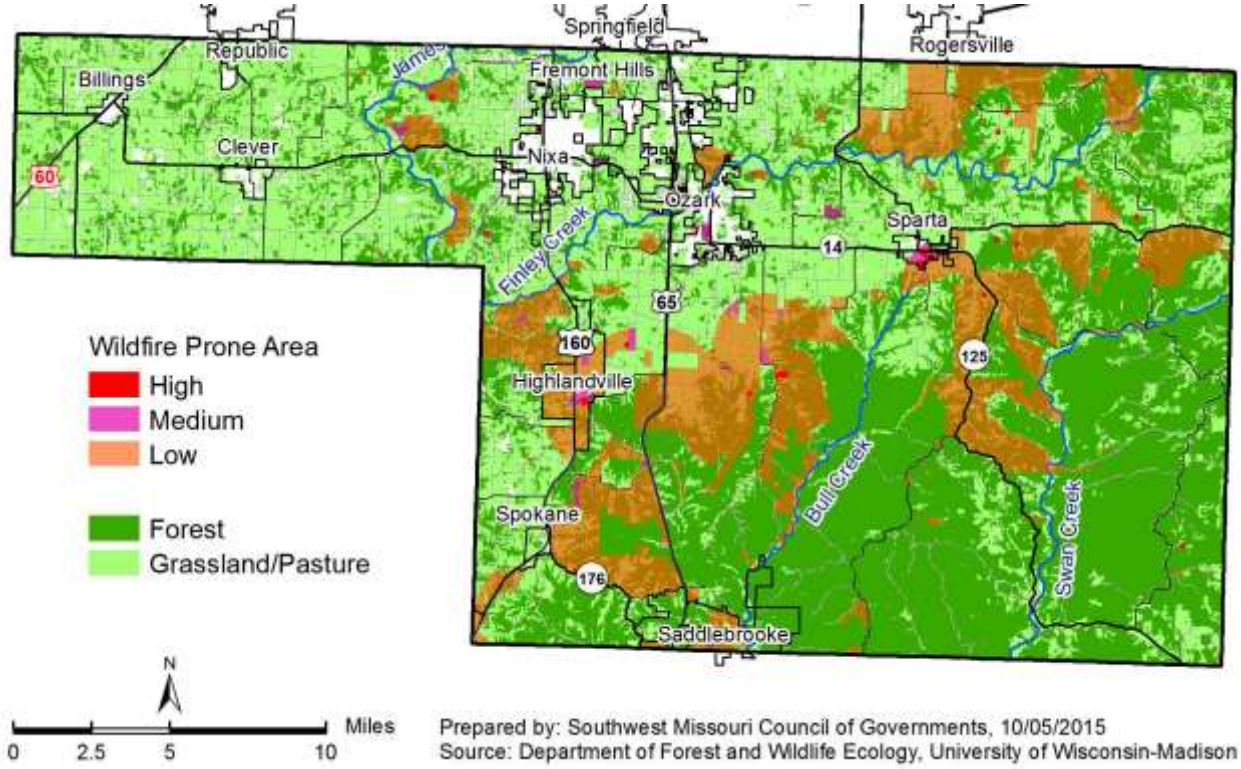
The Forestry Division of the Missouri Department of Conservation (MDC) is responsible for protecting privately owned and state-owned forests and grasslands from wildfires. To accomplish this task, eight forestry regions have been established in Missouri for fire suppression. The Forestry Division works closely with volunteer fire departments and federal partners to assist with fire suppression activities. Currently, more than 900 rural fire departments in Missouri have mutual aid agreements with the Forestry Division to obtain assistance in wildfire protection if needed.

Most of Missouri fires occur during the spring season between February and May. The length and severity of wildland fires depend largely on weather conditions. Spring in Missouri is usually characterized by low humidity and high winds. These conditions result in higher fire danger. In addition, due to the recent lack of moisture throughout many areas of the state, conditions are likely to increase the risk of wildfires. Drought conditions can also hamper firefighting efforts, as decreasing water supplies may not prove adequate for firefighting. It is common for rural residents burn their garden spots, brush piles, and other areas in the spring. Some landowners also believe it is necessary to burn their forests in the spring to promote grass growth, kill ticks, and reduce brush. Therefore, spring months are the most dangerous for wildfires. The second most critical period of the year is fall. Depending on the weather conditions, a sizeable number of fires may occur between mid-October and late November.

Geographic Location

Absent demographic information indicating otherwise, the risk of structural fire probably does not vary widely across the planning area. However, damages due to wildfires would be higher in communities with more wildland–urban interface (WUI) areas. The term refers to the zone of transition between unoccupied land and human development and needs to be defined in the plan. Within the WUI, there are two specific areas identified: 1) Interface and 2) Intermix. The interface areas are those areas that abut wildland vegetation and the Intermix areas are those areas that intermingle with wildland areas. **Figure 3.13** shows WUI areas in Christian County. Areas of medium interface/intermix are present in the communities of Ozark and Fremont Hills. Most of the WUI areas in the unincorporated part of the county are considered low interface/intermix, however, there are smaller areas that are medium and high interface/intermix.

Figure 3.13. Christian County Wildland Urban Intermix, Interface



Severity/Magnitude/Extent

Wildfires damage the environment, killing some plants and occasionally animals. Firefighters have been injured or killed, and structures can be damaged or destroyed. The loss of plants can heighten the risk of soil erosion and landslides. Although Missouri wildfires are not the size and intensity of those in the Western United States, they could impact recreation and tourism in and near the fires.

Wildland fires in Missouri have been mostly a result of human activity rather than lightning or some other natural event. Wildfires in Missouri are usually surface fires, burning the dead leaves on the ground or dried grasses. They do sometimes “torch” or “crown” out in certain dense evergreen stands like eastern red cedar and shortleaf pine. However, Missouri does not have the extensive stands of evergreens found in the western US that fuel the large fire storms seen on television news stories.

While very unusual, crown fires can and do occur in Missouri native hardwood forests during prolonged periods of drought combined with extreme heat, low relative humidity, and high wind. Tornadoes, high winds, wet snow and ice storms in recent years have placed a large amount of woody material on the forest floor that causes wildfires to burn hotter and longer. These conditions also make it more difficult for fire fighters suppress fires safely. See ***http://www.firewisemissouri.org/wildfire-in-missouri.html***

Often wildfires in Missouri go unnoticed by the general public because the sensational fire behavior that captures the attention of television viewers is rare in the state. Yet, from the standpoint of destroying homes and other property, Missouri wildfires can be quite destructive.

Previous Occurrences

According to MDC Wildfire Data, there have been 316 wildfires reported in Christian County from 2005 to September of 2015. A total of 9,708 acres were burned as a result of these reported wildfires. In addition, two residences, 14 outbuildings, and two commercial structures were destroyed with another seven residences and one outbuilding damaged. The 333 structures threatened included 223 residences, 107 outbuildings, and three commercial structures. **Table 3.23** contains MDC wildfire statistics by year.

Table 3.23. Christian County Wildfires 2005 – 2015

Year	Number of Wildfires	Buildings Destroyed	Buildings Damaged	Buildings Threatened	Acres Burned
2005	15	0	0	15	73
2006	27	0	0	33	212
2007	1	1	1	2	2
2008	7	0	0	10	41
2009	22	3	0	14	454
2010	15	0	0	15	113.5
2011	45	1	1	42	399.25
2012	87	12	5	162	7,471
2013	4	0	0	8	26
2014	65	2	1	29	651.75
2015*	28	0	0	3	264.25
Total	**316**	**19**	**8**	**333**	**9,707.75**

Source: Missouri Department of Conservation, http://mdc4.mdc.mo.gov/applications/FireReporting/Report.aspx
*Through September 24, 2015

There are no records from school districts and special districts about previous wildfire events and the damages resulting from them. However, Chadwick R-I reported that in 2012 a large wildfire came within two miles of District facilities.

Probability of Future Occurrence

There is a 100% probability of wildfire occurrence in Christian County in any given year. Based on the last ten years of fire reporting statistics from the MDC, There have been an average of 31.6 reported wildfires in Christian County per year. Nearly two buildings per year have been destroyed and every year approximately one building is damaged. Another 33 structures are threatened per year with an average of 970 acres burned annually.

Vulnerability

Vulnerability Overview

Wildfires occur throughout wooded and open vegetation areas of Missouri They can occur any time of the year, but mostly occur during long, dry hot spells. Any small fire, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness or negligence. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Structures and people in WUI areas in the county and cities are more vulnerable to the impact of wildfires due to the level of fuel mixed with structures.

Potential Losses to Existing Development

Discuss known historical losses to estimate future losses. If data is available, determine average annual losses. If data is not available, include information on where data was sought, and the fact that no information was available.

Impact of Future Development

It is anticipated that there will be future development in WUI areas throughout unincorporated areas of the county. Future growth in WUI areas of the county will increase the risk and exposure to wildfires. It is expected that WUI development in cities will be mitigated by development regulations reducing the risk to wildfire hazard.

Hazard Summary by Jurisdiction

Table 3.24 summarizes the structure exposure for Christian County and cities. The structure counts and values were derived by overlaying Christian County Assessor parcels with the WUI census block data. The exposure amount indicates the dollar amount of assets at risk and the variability of vulnerability from place to place.

Table 3.24. Wildfire Structure Exposure by Jurisdiction

Jurisdiction	Residential	Commercial	Agriculture	Exposure ($)
Webster County	3,216	62	824	$389,830,300
Billings	-	-	-	$0
Clever	-	-	-	$0
Fremont Hills	-	-	-	$0
Nixa	2	-	-	$234,500
Ozark	41	11	1	$2,720,500

All of the Chadwick R-I facilities and Spokane R-VII middle school are within the low density WUI areas. The Spokane R-VII Highlandville elementary is in a medium density WUI area. Risk of wildfire for these school facilities is mitigated by fire breaks created by roads, parking lots, and landscaping. The Highlandville elementary school is located in an urban area and unlikely to be affected by wildfires. No other school facilities are in hazard prone areas. Billings Special Road District, Christian County Ambulance District, and OTC Richwood Valley Campus have no facilities located in hazard prone areas.

Problem Statement

Wildfire occurrence is frequent within Christian County. These events can destroy, damage, and threaten structures in hazard prone areas. Populations and structures in WUI areas of the county have an increased risk to wildfires due to the level of fuel mixed with structures. Table 3.23 indicates that the participating jurisdictions of Christian County, Nixa and Ozark have some risk of wildfire. Cities that have adopted landscape ordinances can include fire safe landscape design requirements in these areas. The Chadwick and Spokane school districts have facilities located in WUI areas and have a slightly elevated risk of wildfire due to the proximate amount of fuel present.

The unincorporated part of the county has the highest risk and exposure to wildfires. The County Planning and Development department can promote fire resistant construction materials and landscape design techniques to mitigate the risk to wildfire in future development. Information about these materials and techniques are included in the MDC publication, Living with Wildfire. Including this information to education and awareness programs for the public may potentially mitigate wildfire damage in the county.

3.4.6 Flooding (Flash and River)

Profile

Hazard Description

A flood is partial or complete inundation of normally dry land areas. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. There are several types of riverine floods, including headwater, backwater, interior drainage, and flash flooding. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt or ice melt. The areas adjacent to rivers and stream banks that carry excess floodwater during rapid runoff are called floodplains. A floodplain is defined as the lowland and relatively flat area adjoining a river or stream. The terms “base flood” and “100- year flood” refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year. Floodplains are part of a larger entity called a basin, which is defined as all the land drained by a river and its branches.

A flash flood occurs when water levels rise at an extremely fast rate as a result of intense rainfall over a brief period, sometimes combined with rapid snowmelt, ice jam release, frozen ground, saturated soil, or impermeable surfaces. Flash flooding can happen in Special Flood Hazard Areas (SFHAs) as delineated by the National Flood Insurance Program (NFIP), and can also happen in areas not associated with floodplains.

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow.

Most flash flooding is caused by slow-moving thunderstorms or thunderstorms repeatedly moving over the same area. Flash flooding is a dangerous form of flooding which can reach full peak in only a few minutes. Rapid onset allows little or no time for protective measures. Flash flood waters move at very fast speeds and can move boulders, tear out trees, scour channels, destroy buildings, and obliterate bridges. Flash flooding can result in higher loss of life, both human and animal, than slower developing river and stream flooding.

In certain areas, aging storm sewer systems were not designed to carry the capacity currently needed to handle the increased storm runoff. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. This combined with rainfall trends and rainfall extremes all demonstrate the high probability, yet generally unpredictable nature of flash flooding in the planning area.

Although flash floods are somewhat unpredictable, there are factors that can point to the likelihood of flash floods occurring. Weather surveillance radar is being used to improve monitoring capabilities of intense rainfall. This, along with knowledge of the watershed characteristics, modeling techniques, monitoring, and advanced warning systems has increased the warning time for flash floods.

Geographic Location

Riverine flooding is most likely to occur in Special Flood Hazard Areas (SFHAs) where the 100-year floodplain has been mapped. Areas along the Finley and James Rivers, specifically, the city of Ozark and Nixa and developed parts of the unincorporated county experience the greatest impact of riverine flooding. According to NCDC storm event data from 1996 through September of 2015. There were 15 flood events recorded in the county during this period. These events are typically regional in nature and affect rivers, streams, and tributaries across a wide area. **Figures 3.14** through **3.18** are mapped SFHAs for communities and unincorporated areas in Christian County.

Figure 3.14. Christian County SFHAs with Critical Facilities

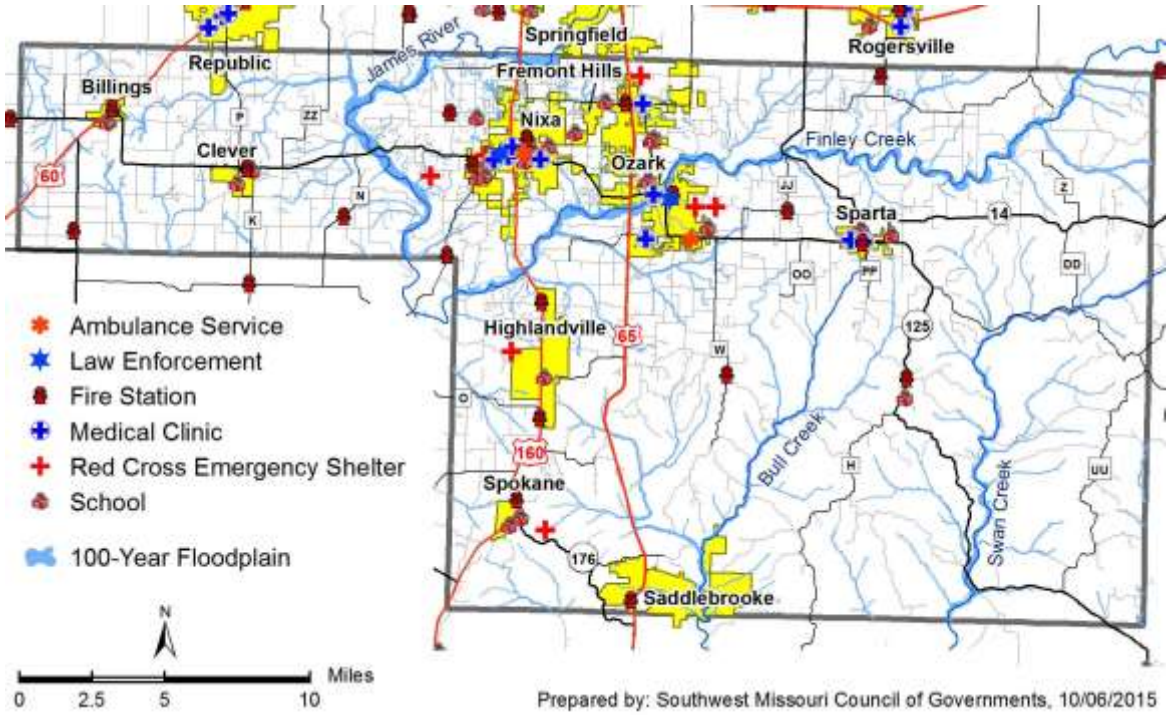


Figure 3.15. City of Billings SFHAs with Critical Facilities

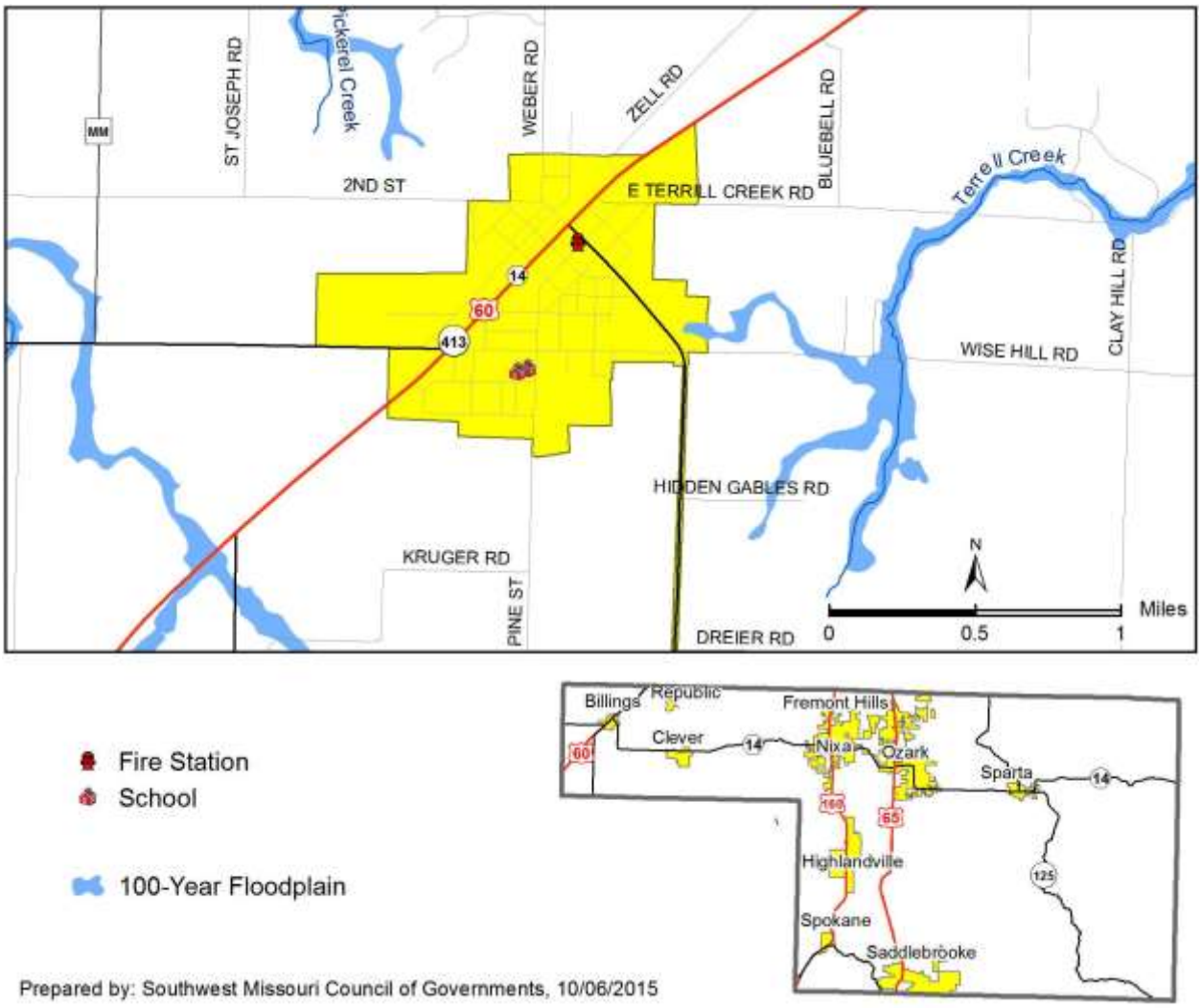
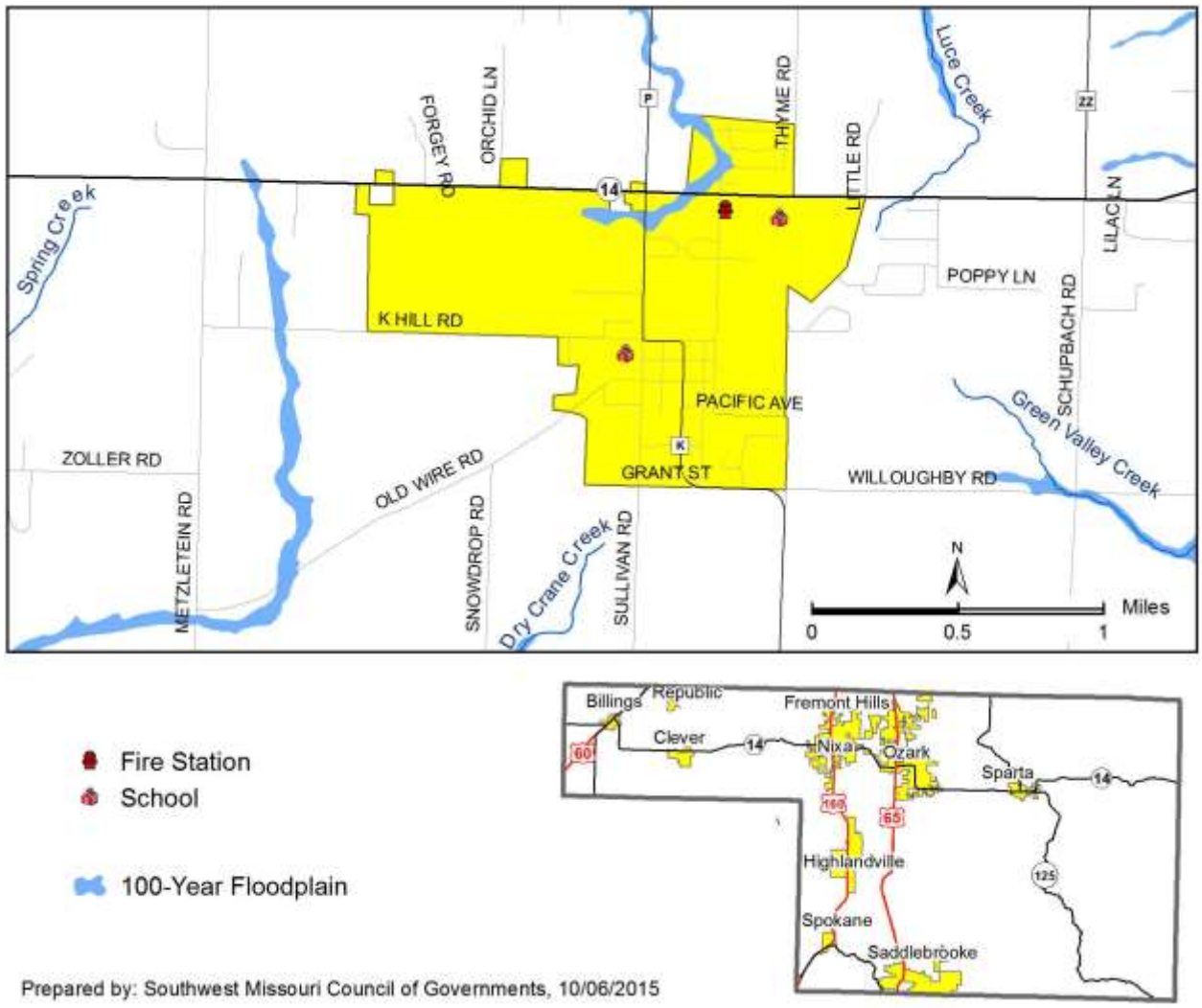


Figure 3.16. City of Clever SFHAs with Critical Facilities



Prepared by: Southwest Missouri Council of Governments, 10/06/2015

Figure 3.17. City of Nixa SFHAs Map with Critical Facilities

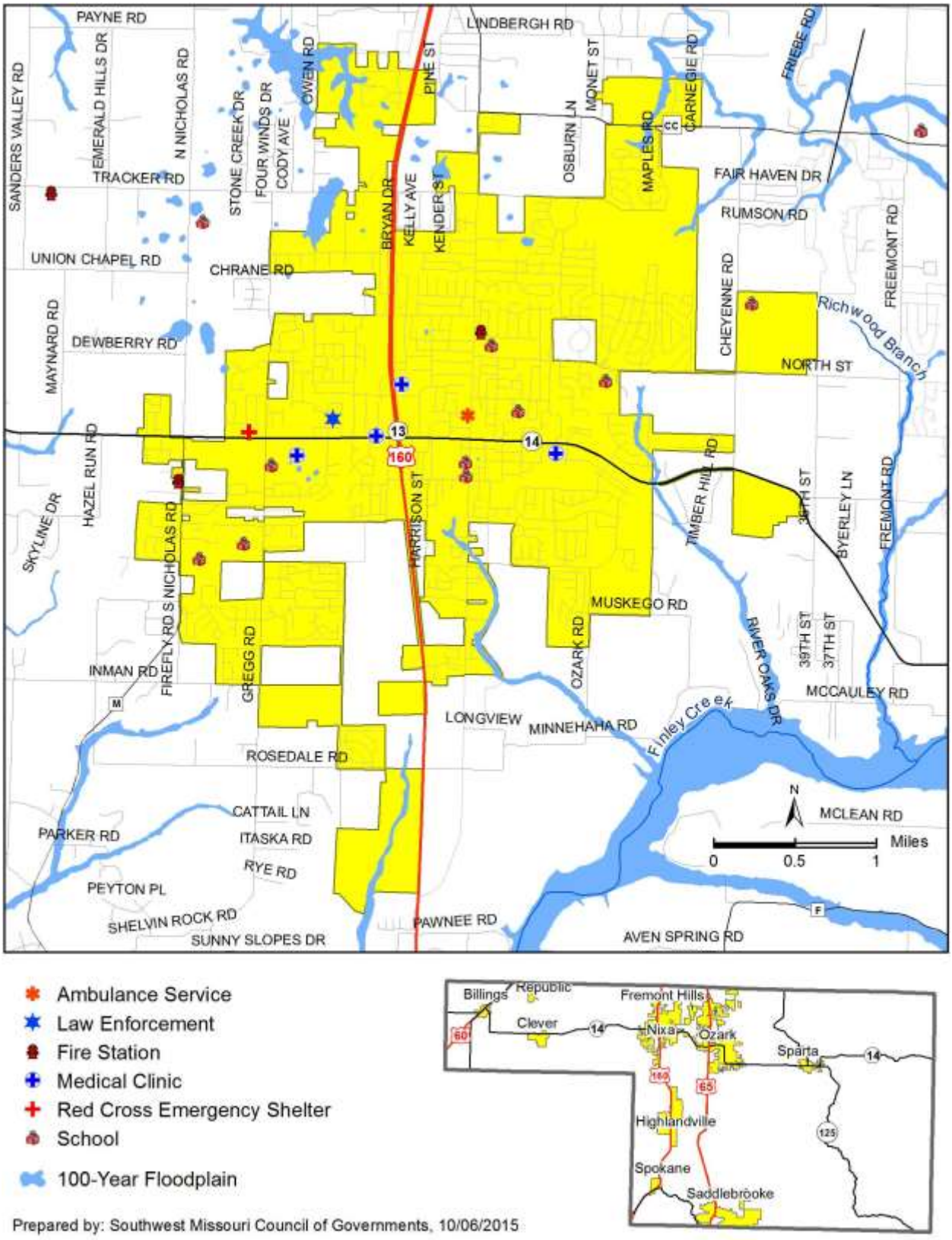
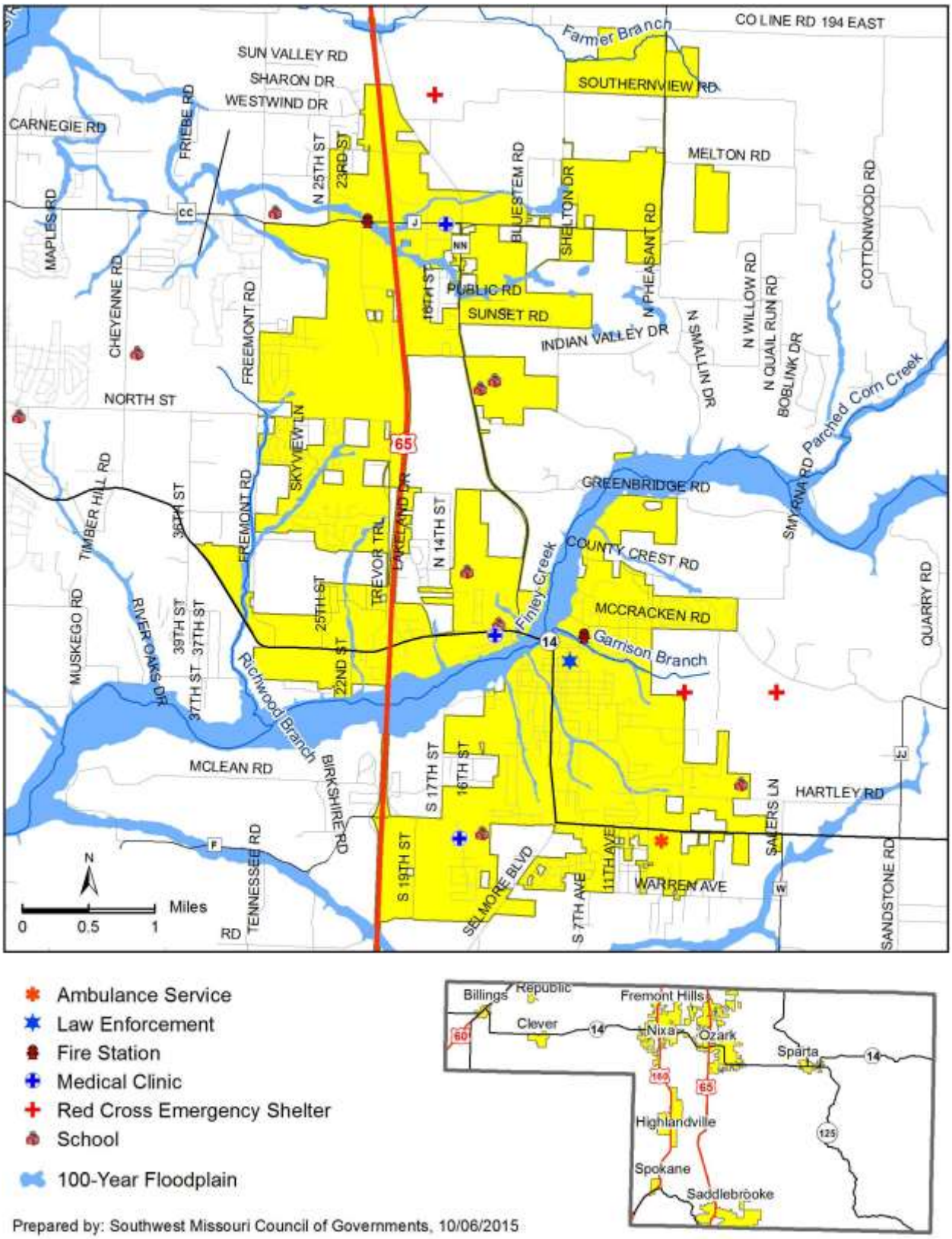


Figure 3.18. City of Ozark SFHAs with Critical Facilities



Prepared by: Southwest Missouri Council of Governments, 10/06/2015

Flash flooding events pose the most pervasive hazard of the two flood types in the county due to permeability of soils, slopes, increasing urban development and extensive network of streams and rivers. Sustained rainfall or downpours at the rate of one inch per hour have caused street flooding in incorporated areas and made a significant number of low water crossings impassible. In the instances of low water crossings, flash flooding occurs in the floodplain while low-lying areas in all jurisdictions are susceptible to flash floods outside the 100-year floodplain. They also occur in areas without adequate drainage to carry away the amount of water that falls during intense rainfall events. A review of the NCDC storm event database determined which jurisdictions are most prone to flash flooding from 1996 to August, 2015 are listed in **Table 3.25**.

Table 3.25. Christian County NCDC Flash Flood Events by Location, 1996-2015

Location	# of Events
Unincorporated County	**28**
- East portion, numerous low water crossings (2/26/1998), (7/5/2001)	
- Western Portion (5/4/1999) & (6/20/2000)	
-Countywide/Unspecified (5/24/2000), (7/12/2000), (2/24/2001), (1/12/2005), (3/31/2008), (4/10/2008), (4/25/2011)	
- Southern Portion (6/29/2001)	
- Northern Portion (5/17/2002), (1/8/2008)	
- Riverdale Road, Bull Creek, Finley River bridge near Riverside Inn (1/5/2005)	
- Rural northwest (6/10/2005)	
- Linden along Finley River, water rescue near Sparta (6/12/2007)	
- Hwys MM & CC (6/30/2007)	
- Center Road & Bull Creek (6/13/2008), (6/23/2008), (6/28/2008)	
- Old Prospect Road between Hwy W and Elk Valley Road (7/30/2008)	
- Riverdale Road 5 mi. west of Ozark (9/14/2008)	
- Water rescue at Farm Road 186 & 99 along Terrell Creek, road closures Rtes U & OO (10/8/2009)	
- Hog Creek Rd & Crab Tree Rd (10/9/2009)	
- Smyrna Rd closure north of Green Bridge Rd (9/1/2010)	
- Willoughby Rd ½ mi. west of Hwy N (5/30/2013)	
- Sections of Hwy 14 between Sparta and Douglas County (6/1/2013)	
- Hwy U at several locations, water rescue on Peck Rd & Pedelo Creek (8/5/2013)	
Billings	**3**
-Terrell Road & Beal Road (2/16/2008), (6/13/2008), (6/23/2008), (10/8/2009)	
Clever	**4**
- Street and residence flooding (7/28/2000)	
- Highway K near Clever (11/18/2003)	
- Hwy K & Hwy P (2/16/2008)	
- Jasmine Rd & Hwy K (4/24/2011)	
Fremont Hills	**1**
-Fremont Rd between Hwy CC & 14 (6/19/2015)	
Highlandville	**5**
- Hwy O & Hwy V along Tory Creek (8/6/2006)	
- Sections of Hwy O along Tory Creek (6/8/2007), (6/28,2008), (6/18/2015)	
- Water rescue near Highlandville (4/25/2011)	
Nixa	**11**
-Tracker Road west of Hwy 160 (3/19/1998), (9/6/2007), (7/30/2013)	
-Tracker Road & Eagle Crest (7/24/2004)	
-Street flooding (6/11/2007), (9/17/2014)	
-James River unspecified (3/17/2008)	
-Nicholas Road & Hwy AA (6/13/2008)	
-Hwy AA near US 160 (6/23/2008)	
-Hwy 14 & Mt. Vernon Rd (9/2/2010)	
-Hwy CC & US 160 (6/15/2013)	

Location	# of Events
Ozark	**11**
- Localized road flooding over most of the county (9/26/1996)	
- Unspecified location, street flooding and low lying areas (6/17/1997), (12/27/2008)	
- Unspecified location, street flooding (6/26/1997)	
- Unspecified location, street flooding (7/9/1997)	
- Street flooding 1 mi. north of Ozark (6/30/2003)	
- Finley River (2/16/2008), (3/17/2008), (9/14/2008)	
- Hwys J & NN (5/16/2010)	
- Finley River Bridge on Business 14 (9/2/2010)	
Sparta	**3**
- Braden Rd Closure (9/1/2010)	
- Hwy 125 closure (8/4/2013), (8/5/2013)	

Source: National Climatic Data Center

The NCDC storm event data lists flash flood events according to the nearest community or place. Most of these events cover larger areas than the smaller geographic areas reported in the data. Some specific locations are listed within the narratives for flash flood events. Where specific roads and locations are listed they are provided in the table. Although some events may not be inside the corporate limits of the community identified in the narrative, they are in such proximity that the community named would be the most affected by impassible roads. It is safe to assume that numerous low water crossings by heavy rains that exacerbate flash flooding across the county. In addition, multiple records are related to the same event and vice versa.

Severity/Magnitude/Extent

Flooding presents a danger to life and property, often resulting in injuries, and in some cases, fatalities. Floodwaters themselves can interact with hazardous materials. Hazardous materials stored in large containers could break loose or puncture as a result of flood activity. Examples are bulk propane tanks. When this happens, evacuation of citizens is necessary.

Public health concerns may result from flooding, requiring disease and injury surveillance. Community sanitation to evaluate flood-affected food supplies may also be necessary. Private water and sewage sanitation could be impacted, and vector control (for mosquitoes and other entomology concerns) may be necessary.

When roads and bridges are inundated by water, damage can occur as the water scours materials around bridge abutments and gravel roads. Floodwaters can also cause erosion undermining road beds. These damages can cause costly repairs for state, county, and city road and bridge maintenance departments. Flooding at low water crossings is extremely hazardous to public safety. Motorists can easily be swept from the roadway when they attempt to cross flooded roads resulting in water rescues, loss of property, and fatalities, all of which have occurred within Christian County.

National Flood Insurance Program (NFIP) Participation

Table 3.26 provides details on NFIP participation for the communities in the planning area. **Table 3.27** contains the number of policies in force, amount of insurance in force, number of closed losses, and total payments for each jurisdiction, where applicable. The time period represented by the data for closed losses is from January 1, 1978 through June 30, 2015.

Table 3.26. NFIP Participation in Christian County

Community ID #	Community Name	NFIP Participant (Y/N)	Current Effective Map Date	Regular-Emergency Program Entry Date
290847	Christian County	Y	12/17/10(M)	04/01/04
290757	Billings, City of	Y	12/17/10(M)	06/27/76
290600	Clever, City of	Y	12/17/10(M)	03/30/81
290755	Fremont Hills, City of	Y	12/17/10(M)	10/21/10
290773	Highlandville, City of	Y	12/17/10(M)	12/17/10
290078	Nixa, City of	Y	12/17/10(M)	04/22/83
290079	Ozark, City of	Y	12/17/10(M)	02/01/85
290993	Saddlebrooke, City of	Y	12/17/10(M)	08/06/12
290529	Sparta, City of	Y	12/17/10(M)	08/09/11
290988	Spokane, City of	Y	12/17/10	12/17/11

Source: NFIP Community Status Book, 9/26/2013; BureauNet, http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book; M= No elevation determined – all Zone A, C, and X: NSFHA = No Special Flood Hazard Area; E=Emergency Program

Table 3.27. NFIP Policy and Claim Statistics as of 06/30/2015

Community Name	Policies in Force	Insurance in Force	Closed Losses	Total Payments
Christian County	104	$23,053,600	17	$293,924.24
Nixa, City of	15	$2,574,000	4	$37,435.68
Ozark, City of	24	$5,085,900	17	$795,339.02
Clever, City of	8	$800,000	NA	NA
Sparta, City of	1	$125,000	NA	NA

Source: NFIP Community Status Book, [insert date]; BureauNet, http://bsa.nfipstat.fema.gov/reports/reports.html; *Closed Losses are those flood insurance claims that resulted in payment. Loss statistics are for the period from 1/1/1978 to 6/30/2015.

The communities with the most in insurance payments are unincorporated Christian County and the City of Ozark with 17 closed losses amounting to $293,924 and $795,339, respectively.

Repetitive Loss/Severe Repetitive Loss Properties

Repetitive Loss Properties are those properties with at least two flood insurance payments of $5,000 or more in a 10-year period. According to the Flood Insurance Administration, jurisdictions included in the planning area have a combined total of 5 repetitive loss properties as of 9/30/2015 with a total of 15 reported losses. No other information was made available via request for information from SEMA.

Severe Repetitive Loss (SRL): A SRL property is defined it as a single family property (consisting of one-to-four residences) that is covered under flood insurance by the NFIP; and has (1) incurred flood-related damage for which four or more separate claims payments have been paid under flood insurance coverage with the amount of each claim payment exceeding $5,000 and with

cumulative amounts of such claims payments exceeding $20,000; or (2) for which at least two separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property. There are no validated SRL properties in Christian County.

Previous Occurrences

According to the NCDC storm event data, there have been 68 flash flood events recorded in Christian County from 1996 to 2015. Five of these events resulted in property damage. The most recent damaging event occurred during the drafting of this plan when remnants of tropical storm bill slowly moved over the region and produced widespread heavy rainfall during the month of June, 2015. Numerous roads, bridges, and low water crossings were heavily damaged resulting in $100,000 of damages. Historic riverine flooding occurred along the James and Finley Rivers resulting in Christian County being included in presidential disaster declaration 4238 issued by President Obama on August 7, 2015. The NCDC storm event data also includes $100,000 in property damage in Nixa along the Christian/Greene County line. **Table 3.28** summarizes flash flood events by year from 1996 to 2015 in Christian County. The most damaging event occurred in March, 2008 when many homes and a few businesses experienced flood damage near the cities of Ozark and Nixa. All low areas that typically flood during periods of excessive rainfall were flooded.

It should be noted that information in the 2011 Plan includes two fatalities resulting in a flash flood event at a low water crossing at Peck Road and Pedelo Creek in the northeast portion of the county. This event is no longer included in the NCDC storm event database.

Table 3.28. NCDC Christian County Flash Flood Events Summary, 1996 to 2015

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
1996	1	0	0	$0	$0
1997	3	0	0	$0	$0
1998	2	0	0	$0	$0
1999	1	0	0	$0	$0
2000	4	0	0	$0	$0
2001	3	0	0	$0	$0
2002	1	0	0	$0	$0
2003	2	0	0	$0	$0
2004	1	0	0	$0	$0
2005	2	0	0	$0	$0
2006	2	0	0	$0	$0
2007	5	0	0	$0	$0
2008	11	0	0	$5,500,000	$0
2009	6	0	0	$0	$0
2010	7	0	0	$10,000	$0
2011	3	0	0	$1,000,000	$0
2012	0	0	0	$0	$0
2013	10	0	0	$0	$0

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2014	1	0	0	$0	$0
2015	3	0	0	$100,000	$0
Total	**68**	**0**	**0**	**$6,610,000**	**$0**

Source: NCDC, data accessed 9/30/2015

Table 3.29 summarizes riverine flood events listed in the NCDC data in Christian County by year. The NCDC storm event data contains 15 recorded events for riverine flooding in Christian County from 1996 to 2015. The greatest amount of losses from any one event occurred in 2002 when sudden flooding of the Finley River caused a local car dealership to move over 50 cars from the flood waters. The river also shut down a local restaurant on the north side of town. The owners of the restaurant stated that the river was more damaging than the 93' flood which was actually higher. However, this time the river was swifter, more furious, and took longer for the water to go back down. The waters damaged several items in the kitchen, including a salad refrigerator, and a grand piano. A local poultry farm had to transport 100 birds to drier land. The flood waters destroyed three pens and covered about two acres of their farmland. The restaurant, the Riverside Inn, was acquired in a flood buyout in 2010.

Table 3.29. NCDC Christian County Riverine Flood Events Summary, 1996 to 2015

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
2001	2	0	0	$0	$0
2002	3	0	0	$150,000	$0
2003	0	0	0	$0	$0
2004	2	0	0	$10,000	$0
2005	2	0	0	$0	$0
2006	0	0	0	$0	$0
2007	1	0	0	$0	$0
2008	1	0	0	$0	$0
2009	1	0	0	$0	$0
2010	2	0	0	$0	$0
2011	0	0	0	$0	$0
2012	0	0	0	$0	$0
2013	0	0	0	$0	$0
2014	0	0	0	$0	$0
2015	1	0	0	$100,000	$0
Total	**15**	**0**	**0**	**$260,000**	**$0**

Source: NCDC, data accessed 9/30/2015

Probability of Future Occurrence

There have been a total of 83 reported flood events in Christian County from 1996 to 2015 in the NCDC storm event database. Of those, 68 have been flash floods. Using a 20 year period of record, this equates to 3.4 flash flood events per year and a 100% probability of occurrence in the county in any

given year. During this same time period there have been 15 riverine floods reported in the county, this equates to 1.5 riverine flood events every two years or a 75% probability of occurrence in any given year.

Vulnerability

Vulnerability Overview

Flooding has been included in ten of the 13 presidential disaster declarations that have included Christian County. Periods of heavy rain falling at the rate of one inch per hour floods low water crossings throughout the county making many roads impassable. This creates a severe threat to motorists that attempt to drive through flood waters over the roadway. Riverine flooding occurs less frequently than flash flooding, however, there are 5 repetitive loss properties in the county and property damage is likely to continue. Areas in low lying areas outside of the floodplain are frequently flooded. Street flooding over roadways has been reported in all communities in the county. There are no school or special district facilities in SFHAs in Christian County. Increases in development add to surface runoff and can exacerbate flash flooding in areas that previously have not experience flooding.

Potential Losses to Existing Development

Flood loss estimates were developed using a method similar to the one used for dam failure. All parcels situated within 100 feet of the 100 year floodplain were selected to compile building counts by type for each participating municipality and the unincorporated balance of Christian County. It is important to note that this method created building counts for areas well outside the 100 year floodplain but in an effort to depict losses from flash flooding as well. The summed improved valuations for all parcels within 100 feet of the 100 year floodplain would be more prone to flash flooding due to the proximity to natural drainage features in the area. Potential flood losses by building type by jurisdiction are presented in **Table 3.30**.

Table 3.30. Potential Flood Losses for building types by Jurisdiction

Jurisdiction	Residential	Commercial	Agriculture	Total Building Count
Christian County	2,021	68	1,008	3,097
Billings	4	-	1	5
Clever	28	6	-	34
Fremont Hills	39	2	-	41
Nixa	141	16	5	162
Ozark	438	78	14	530

Table 3.31 provides the total exposure for structures and contents by building type and jurisdiction. Estimated losses by applying a 5% damage factor to total exposure.

Table 3.31. Total Flood Exposure and Estimated Losses by Jurisdiction

Jurisdiction	Residential	Commercial	Agriculture	Estimated Exposure	Estimated Loss
Christian County	$264,441,100	$2,285,800	$8,217,100	$274,944,000	$13,747,200
Billings	$174,700	-	$2,900	$177,600	$8,880
Clever	$2,736,100	$2,113,000	-	$4,849,100	$242,455
Fremont Hills	$10,709,200	$1,503,000	-	$12,212,200	$610,610
Nixa	$24,534,400	$10,904,700	$39,600	$35,478,700	$1,773,935
Ozark	$65,234,300	$34,182,600	$124,900	$99,541,800	$4,977,090

Critical facilities in the Floodplain include Nixa and Fremont Hills waste water treatment facilities. Structures and holding ponds in Nixa are elevated above the 100 year floodplain. The Fremont Hills control building was flooded and damaged during historic flooding in June of 2015. The City of Clever has one lift station located in the 100 year floodplain. In addition to these facilities there are 136 low water crossings in the county located in the 100 year floodplain. There are no school or special district facilities in SFHAs in the county.

Impact of Future Development

Future development could impact flash and riverine flooding in the planning area. Development in low-lying areas near rivers and streams or where interior drainage systems are not adequate to provide drainage during heavy rainfall events will be at risk to flash flooding. Future development would also increase impervious surfaces causing additional water run-off and drainage problems during heavy rainfall events. All communities in the county participate in the NFIP and have a designated floodplain administrator. Zoning regulations prohibit development in SFHAs and violations of floodplain management regulations throughout the county are strictly enforced.

Hazard Summary by Jurisdiction

All local governments in the county are at risk to flood hazards, however, as demonstrated in **Table 3.31** exposure of assets near SFHAs varies among jurisdictions. It should be noted that all of these communities can be impacted by flooding of major roads and low water crossings in the areas proximate to their corporate limits. All of the incorporated areas in the county are susceptible to street flooding during periods of heavy rain as evidenced by the previous occurrences by location in Table 3.23. The greatest impact of flooding is in the unincorporated part of the county. Although Christian County is a participant in the NFIP and can substantially regulate development in the floodplain many pre-FIRM structures remain. Due to the topography and many streams in the county, numerous low water crossings are damaged and create a significant hazard to public safety during flood events. This heightens the risk and exposure to the Billings Special Road District and Common Road Districts administrated by the County Commission. There is no heightened risk to school district facilities due to flood. There are no school facilities in SFHAs and no previous damages were reported on the Data Collection Questionnaire for schools. The Christian County Ambulance District and OTC Richwood Valley Campus have no facilities located in SFHAs.

Problem Statement

Floods are frequent events and have been listed in all ten out of 13 presidential disaster declarations that have included Christian County. Historic flooding that occurred during the drafting of this plan produced over $2,461,000 in damages. At least 2 fatalities have resulted from motorists driving across flooded low water crossings and their vehicles being swept away. Numerous water rescues have been performed since 2002. Significant debris accumulation and damages at low water crossings have are a regular occurrence due to flash flooding throughout the county.

All communities in the county participate in the NFIP. These communities have passed floodplain management ordinances and have the ability to substantially regulate development in the floodplain. Their participation in the NFIP enables residents to purchase flood insurance. Street flooding in incorporated areas can be addressed through storm water management projects and enforce stormwater management regulations.

The Billings Special Road District and the Christian County Commission have identified frequently damaged low water crossings at several locations throughout the county and are currently planning on making improvements to make improvements and replace culverts over the next five years. All warning signs and gauges should be installed and replaced at frequently flooded low water crossings to provide warning to motorists. The Billings Special Road District is working on a project to replace all old and damaged road signage with high intensity facing for better visibility for the public. Hazard awareness programs and education, such as “turn around, don’t drowned” messages during and prior to flood events in the county broadcast by the media can mitigate future risks to motorists at low water crossings.

3.4.7 Land Subsidence/Sinkholes

Hazard Profile

Hazard Description

Sinkholes are depressed or collapsed areas formed by dissolution of carbonate bedrock or collapse of underlying caves. They range in size from several square yards to hundreds of acres and may be very shallow or hundreds of feet deep. Sinkholes are part of what is called karst topography, which also includes caves, springs and losing streams. Sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that naturally can be dissolved by ground water circulating through them. As the rock dissolves, spaces and caverns develop underground. The sudden collapse of the land surface above them can be dramatic and range in size from broad, regional lowering of the land surface to localized collapse. Land subsidence may also result from human activities such as, underground mining, groundwater or petroleum withdrawal, and drainage of organic soils.

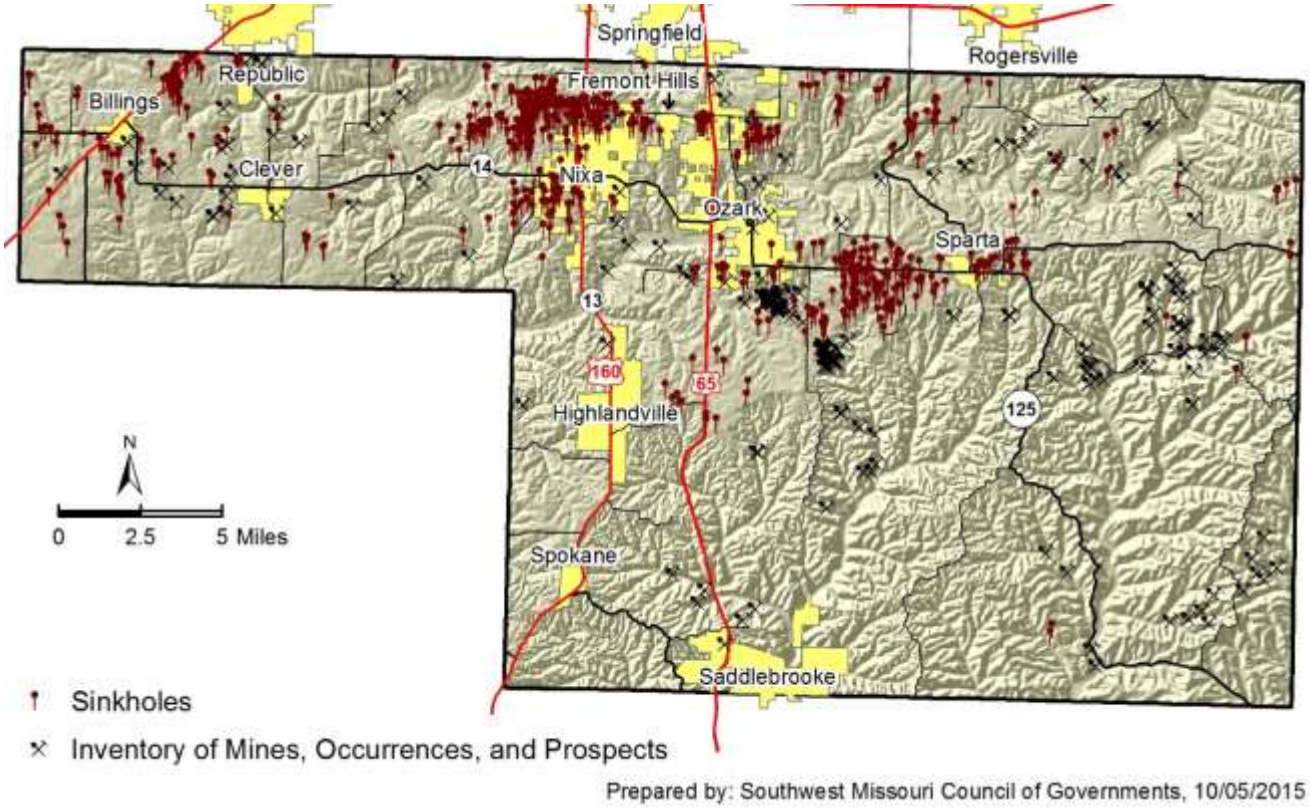
In the case of sinkholes, the rock below the surface is rock that has been dissolving by circulating groundwater. As the rock dissolves, spaces and caverns form, and ultimately the land above the spaces collapse. In Missouri, sinkhole problems are usually a result of surface materials above openings into bedrock caves eroding and collapsing into the cave opening. These collapses are called “cover collapses” and geologic information can be applied to predict the general regions where collapse will occur. Land subsidence occurs slowly and continuously over time, as a general rule. On occasion, it can occur abruptly, as in the sudden formation of sinkholes. Sinkhole formation can be aggravated by a change in stormwater runoff patterns resulting from an increase in impervious surfaces from land development.

According to the U.S. Geological Survey (USGS), the most damage from sinkholes tends to occur in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania. Fifty-nine percent of Missouri is underlain by thick, carbonate rock that makes Missouri vulnerable to sinkholes. Sinkholes occur in Missouri on a fairly frequent basis. Most of Missouri‘s sinkholes occur naturally in the State‘s karst regions (areas with soluble bedrock). They are a common geologic hazard in southern Missouri, but also occur in the central and northeastern parts of the State. Missouri sinkholes have varied from a few feet to hundreds of acres and from less than one to more than 100 feet deep. Sinkholes can also vary is shape like shallow bowls or saucers whereas other have vertical walls. Some hold water and form natural ponds.

Geographic Location

According to spatial data from Missouri Geological Survey, there are 643 sinkhole formations have been identified in Christian County. In addition, according to the MDNR Inventory of Mines, Occurrences, and Prospects, There are 53 underground mines in Christian County. Most of these mines were lead and zinc operations opened in the late 1800s. The only active mining operations in the county are surface operations, such as limestone quarries. **Figure 3.19** depicts the location of sinkholes and mines, occurrences, and prospects within Christian County.

Figure 3.19. Sinkholes and Underground Mines in Christian County



Source: The Missouri Department of Natural Resources, GeoSTRAT

Although the risk of sinkhole formation exist countywide, according to Figure 3.19 unincorporated areas of the county and in particular, the City of Nixa, have an elevated risk to sinkhole formation than other communities in the County.

Severity/Magnitude/Extent

Sinkholes vary in size and location, and these variances will determine the impact of the hazard. A sinkhole could result in the loss of a personal vehicle, a building collapse, or damage to infrastructure such as roads, water, or sewer lines. Groundwater contamination is also possible from a sinkhole. Because of the relationship of sinkholes to groundwater, pollutants captured or dumped in sinkholes could affect a community's groundwater system. Sinkhole collapse could be triggered by large earthquakes. Sinkholes located in floodplains can absorb floodwaters but make detailed flood hazard studies difficult to model.

Previous Occurrences

The 2013 State Plan lists notable sinkhole occurrences in Missouri that have resulted in property damage. One of these was in the City of Nixa in 2006 which was included in the 2011 Plan. This sinkhole severely destroyed a residence and a vehicle and threatened adjacent homes and city utilities. According to a news report, the City of Nixa spent $50,000 remediating this sinkhole. In 2010, a second sinkhole occurred in the same subdivision as the 2006 event.

In 2013, local news reported that a sinkhole that originally was 8 feet deep and 15 feet wide near the Bentwood subdivision in Nixa had grown to nearly 50 feet deep and 50 feet wide. This sinkhole threatened a buried electrical line. The Nixa public works director stated that a study of water drainage near the sinkhole. A homeowner in the area stated that a storm water pipe from U.S. 160 drained into the sinkhole making it bigger and bigger.

In 2015 a sinkhole opened in Christian County at Windsor Court and Raspberry Street near the City of Nixa. This sinkhole was remediated on February of 2015. A section of Tracker Road was closed during the remediation of the sinkhole.

Probability of Future Occurrence

Based on local news reports and information in the 2011 Plan, there have been four (4) documented sinkhole formations or expansions in the county during an eleven year period from 2006 to 2015. This equates to a 36% probability of a sinkhole formation in any given year in the county. Include probability calculations for sinkholes/land subsidence.

Vulnerability

Vulnerability Overview

Sinkholes in Missouri are a common feature where limestone and dolomite outcrop. Dolomite is a rock similar to limestone with magnesium as an additional element along with the calcium normally present in the minerals that form the rocks. While some sinkholes may be considered a slow changing nuisance; other more sudden, catastrophic collapses can destroy property, delay construction projects, contaminate ground water resources, and damage underground utilities. The entire county is underlain with limestone and dolomite bedrock.

Potential Losses to Existing Development

Sinkhole loss estimates were established using GIS processes and appraised valuations. A sinkhole point shapefile acquired from MSDIS was used to generate a half-mile buffer around each feature. The buffer layer was designated as the hazard prone areas for sinkholes. The map layer of the sinkhole hazard prone areas was used as an overlay on the parcel data to generate the loss estimates from this hazard by jurisdiction. **Table 3.32** provides the building count by type and by jurisdiction based on the results of the sinkhole analysis. **Table 3.33** provides a dollar amount for total exposure by jurisdiction and estimated losses. To calculate the losses a damage factor of 0.5% was applied to the total exposure.

Table 3.32. Sinkhole Exposure by Building Type by Jurisdiction

Jurisdiction	Residential	Commercial	Agriculture	Building Count
Christian County	5,273	309	1,345	6,927
Billings	119	12	8	139
Clever	304	16	1	321
Fremont Hills	329	1	-	330
Nixa	6,109	292	14	6,415

Ozark	2,480	204	15	2,699

Table 3.33. Total Sinkhole Exposure and Estimated Losses by Jurisdiction

Jurisdiction	Residential	Commercial	Agriculture	Estimated Exposure	Estimated Loss
Christian County	$674,197,600	$74,511,700	$10,940,500	$759,649,800	$3,798,249
Billings	$8,494,900	$2,027,200	$23,700	$10,545,800	$52,729
Clever	$23,024,400	$6,123,600	$5,400	$29,153,400	$145,767
Fremont Hills	$46,062,200	$1,027,500	$0	$47,089,700	$235,449
Nixa	$662,574,400	$119,871,000	$77,100	$782,522,500	$3,912,613
Ozark	$291,196,100	$116,354,900	$84,500	$407,635,500	$2,038,178

School districts with facilities within sinkhole prone areas include Nixa Public Schools, Ozark R-VI, and Clever R-V. These facilities are listed below:

Nixa Public Schools

- Nixa High School
- Nixa Junior High
- Nixa Early Learning Center
- Espy Elementary
- Nicholas A. Inman Intermediate
- Mathews Elementary
- Summit Intermediate School
- High Pointe Elementary
- John Thomas School of Discovery

Ozark R-VI School District

- South Elementary
- Upper Elementary
- East Elementary
- North Elementary

Clever R-V

- Clever High School

No other participating school districts have facilities within half a mile from sinkholes. Billings Special Road District, has no structures within sinkhole prone areas but numerous county roads within the district lie in these areas. Christian County Ambulance District and OTC Richwood Valley Campus have no facilities within half a mile of an existing sinkhole.

Impact of Future Development

Future development over abandoned mines and in areas of known risk to sinkhole formation in the planning area will increase vulnerability to this hazard. Population and development in these

areas, especially in the cities of Clever, Nixa, Ozark, and unincorporated areas will increase exposure to sinkhole occurrence. Construction within 30 feet of existing sinkholes is prohibited in Christian County, Nixa, and Ozark. This regulation is enforce through subdivision regulations and site plan review in each of these jurisdictions. Future development may also change storm runoff patterns and cause expansion or formation of sinkholes.

Hazard Summary by Jurisdiction

The risk of sinkhole damage for individual communities and school districts is limited to the amount of exposure of buildings and infrastructure. The entire county is at risk for potential sinkhole formation, however, the Cities of Nixa and Ozark, as well as unincorporated parts of the county in highly prone sinkhole areas are at an elevated risk due to the rapid growth in north central Christian County. The City of Clever is also in growth mode and future development in this community may exacerbate sinkhole occurrence. It is unlikely that school and special districts will be affected by sinkholes due to the localized nature of their exposure, however, Nixa R-II, Ozark R-VI, and Clever R-V districts are at an elevated risk due to the location of school facilities within hazard prone areas.

Problem Statement

It is likely that more sinkholes will occur as development occurs within the county. Sinkholes can be remediated with fill material. Once a sinkhole has been remediated building should be prohibited at the site. Existing sinkholes can expand if surface runoff erodes the edges of the sinkhole. Stormwater runoff should be diverted away from known sinkholes. Cities should adopt regulations prohibiting construction at least 30 feet from known sinkholes. Information about identifying potential sinkhole formation and promoting Missouri FAIR plan sinkhole insurance can be included in public outreach and hazard awareness programs.

The City of Nixa owns six acres of land that were unsuitable for building because of a large sinkhole located on the property. The City partnered with a local non-profit organization to create a park space at this location. Communities can acquire areas that are unsuitable for development due to existing sinkholes and incorporate them into open space and recreation plans.

3.4.8 Thunderstorm/High Winds/Lightning/Hail

Hazard Profile

Hazard Description

Severe Thunderstorms

A thunderstorm is defined as a storm that contains lightning and thunder which is caused by unstable atmospheric conditions. When cold upper air sinks and warm moist air rises, storm clouds or 'thunderheads' develop resulting in thunderstorms. This can occur singularly, as well as in clusters or lines. The National Weather Service defines a thunderstorm as "severe" if it includes hail that is one inch or more, or wind gusts that are at 58 miles per hour or higher. At any given moment across the world, there are about 1,800 thunderstorms occurring. Severe thunderstorms most often occur in Missouri in the spring and summer, during the afternoon and evenings, but can occur at any time. Other hazards associated with thunderstorms are heavy rains resulting in flooding (discussed separately in Section 3.4.9) and tornadoes (discussed separately in Section 3.4.6).

High Winds

A severe thunderstorm can produce winds causing as much damage as a weak tornado. The damaging winds of thunderstorms include downbursts, microbursts, and straight-line winds. Downbursts are localized currents of air blasting down from a thunderstorm, which induce an outward burst of damaging wind on or near the ground. Microbursts are minimized downbursts covering an area of less than 2.5 miles across. They include a strong wind shear (a rapid change in the direction of wind over a short distance) near the surface. Microbursts may or may not include precipitation and can produce winds at speeds of more than 150 miles per hour. Damaging straight-line winds are high winds across a wide area that can reach speeds of 140 miles per hour.

Lightning

All thunderstorms produce lightning which can strike outside of the area where it is raining and is has been known to fall more than 10 miles away from the rainfall area. Thunder is simply the sound that lightning makes. Lightning is a huge discharge of electricity that shoots through the air causing vibrations and creating the sound of thunder.

Hail

According to the National Oceanic and Atmospheric Administration (NOAA), hail is precipitation that is formed when thunderstorm updrafts carry raindrops upward into extremely cold atmosphere causing them to freeze. The raindrops form into small frozen droplets. They continue to grow as they come into contact with super-cooled water which will freeze on contact with the frozen rain droplet. This frozen droplet can continue to grow and form hail. As long as the updraft forces can support or suspend the weight of the hailstone, hail can continue to grow before it hits the earth.

At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea sized hail requires updrafts of 24 miles per hour, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 miles per hour. According to the NOAA, the

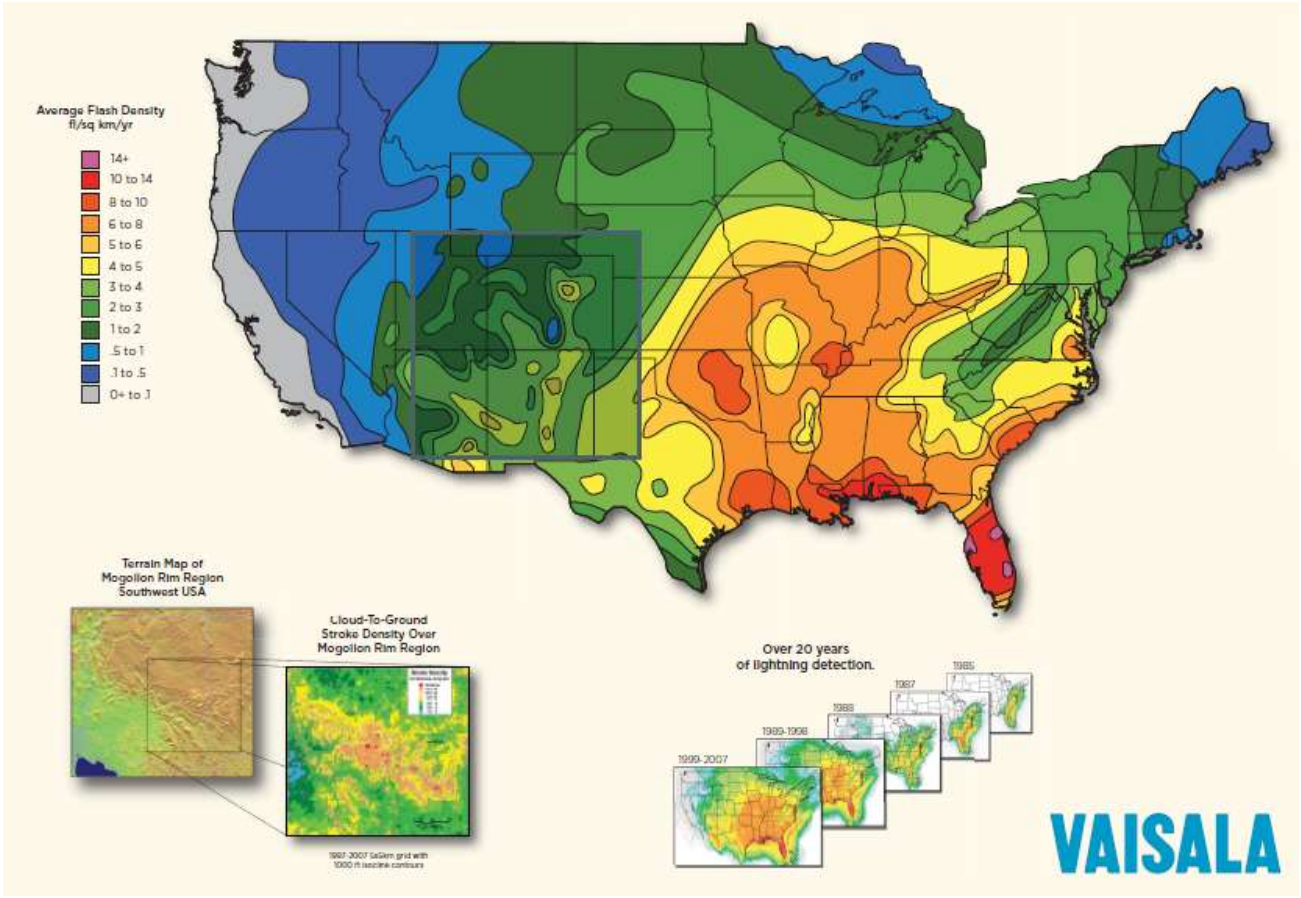
largest hailstone in diameter recorded in the United States was found in Vivian, South Dakota on July 23, 2010. It was eight inches in diameter, almost the size of a soccer ball. Soccer-ball-sized hail is the exception, but even small pea-sized hail can do damage.

Geographic Location

Thunderstorms/high winds/hail/lightning events are an area-wide hazard that can happen anywhere in the county. Although these events occur similarly throughout the planning area, they are more frequently reported in more urbanized areas. In addition, damages are more likely to occur in more densely developed urban areas.

Figure 3.20 shows lightning frequency in the state. Christian County lies in the 4 to 5 flash density zone on the map.

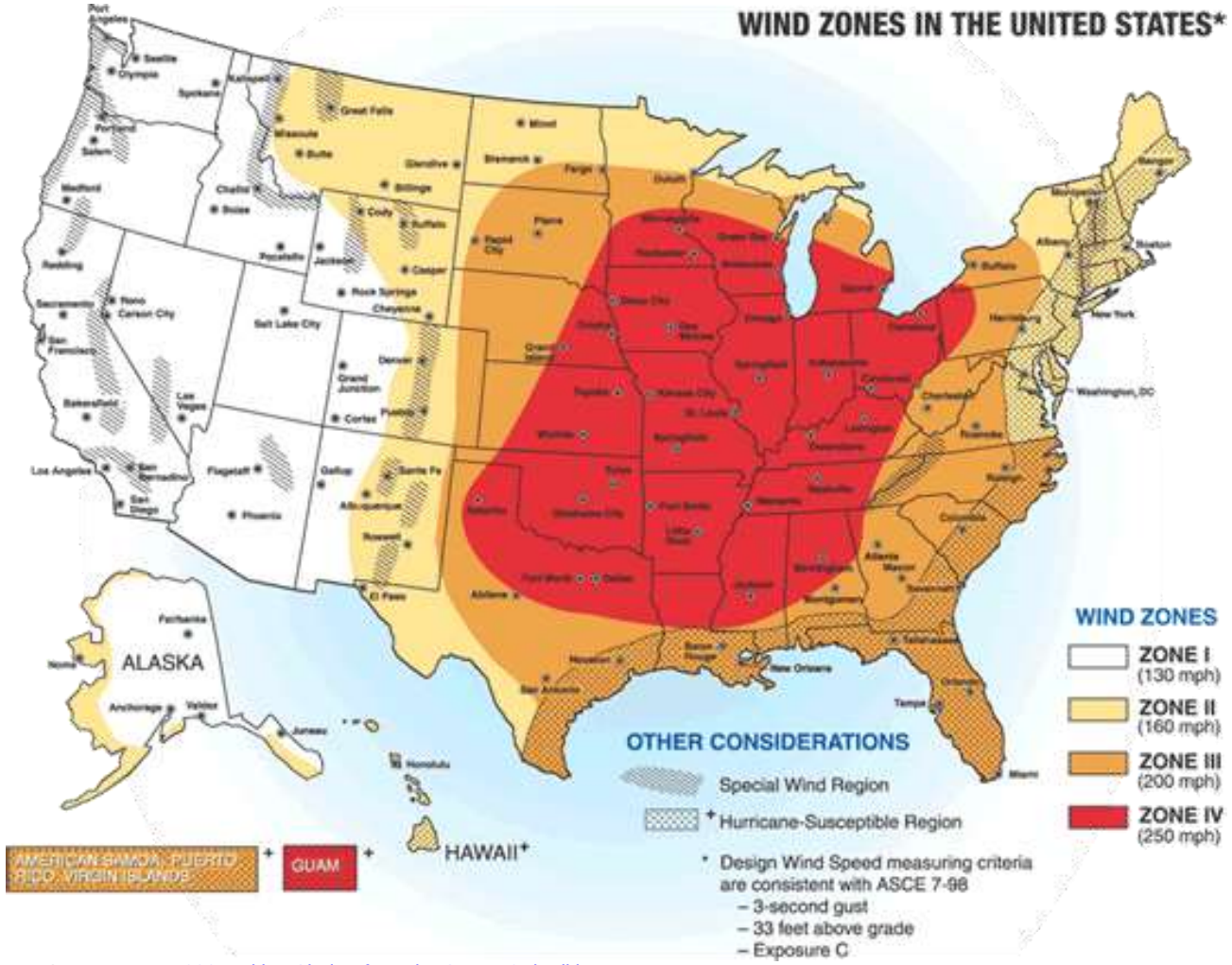
Figure 3.20. Location and Frequency of Lightning in Missouri



Source: National Weather Service

Figure 3.21 shows wind zones in the United States. Christian County is located in Zone IV which can experience wind speeds of up to 250 mph.

Figure 3.21. Wind Zones in the United States



Source: FEMA 320, Taking Shelter from the Storm, 3rd edition

Severity/Magnitude/Extent

Severe thunderstorm losses are usually attributed to the associated hazards of hail, downburst winds, lightning and heavy rains. Losses due to hail and high wind are typically insured losses that are localized and do not result in presidential disaster declarations. However, in some cases, impacts are severe and widespread and assistance outside state capabilities is necessary. Hail and wind also can have devastating impacts on crops. Severe thunderstorms/heavy rains that lead to flooding are discussed in the flooding hazard profile. Hailstorms cause damage to property, crops, and the environment, and can injure and even kill livestock. In the United States, hail causes more than $1 billion in damage to property and crops each year. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings and homes, and landscaping are also commonly damaged by hail. Hail has been known to cause injury to humans, occasionally fatal injury.

In general, assets in the County vulnerable to thunderstorms with lightning, high winds, and hail include people, crops, vehicles, and built structures. Although this hazard results in high annual losses, private property insurance and crop insurance usually cover the majority of losses.

Considering insurance coverage as a recovery capability, the overall impact on jurisdictions is reduced.

Most lightning damages occur to electronic equipment located inside buildings. But structural damage can also occur when a lightning strike causes a building fire. In addition, lightning strikes can cause damages to crops if fields or forested lands are set on fire. Communications equipment and warning transmitters and receivers can also be knocked out by lightning strikes.

Based on information provided by the Tornado and Storm Research Organization (TORRO), **Table 3.34** below describes typical damage impacts of the various sizes of hail.

Table 3.34. Tornado and Storm Research Organization Hailstorm Intensity Scale

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
Hard Hail	5-9	0.2-0.4	Pea	No damage
Potentially Damaging	10-15	0.4-0.6	Mothball	Slight general damage to plants, crops
Significant	16-20	0.6-0.8	Marble, grape	Significant damage to fruit, crops, vegetation
Severe	21-30	0.8-1.2	Walnut	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
Severe	31-40	1.2-1.6	Pigeon's egg > squash ball	Widespread glass damage, vehicle bodywork damage
Destructive	41-50	1.6-2.0	Golf ball > Pullet's egg	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
Destructive	51-60	2.0-2.4	Hen's egg	Bodywork of grounded aircraft dented, brick walls pitted
Destructive	61-75	2.4-3.0	Tennis ball > cricket ball	Severe roof damage, risk of serious injuries
Destructive	76-90	3.0-3.5	Large orange > Soft ball	Severe damage to aircraft bodywork
Super Hailstorms	91-100	3.6-3.9	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
Super Hailstorms	>100	4.0+	Melon	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: Tornado and Storm Research Organization (TORRO), Department of Geography, Oxford Brookes University
Notes: In addition to hail diameter, factors including number and density of hailstones, hail fall speed and surface wind speeds affect severity.

Straight-line winds are defined as any thunderstorm wind that is not associated with rotation (i.e., is not a tornado). It is these winds, which can exceed 100 miles per hour, which represent the most common type of severe weather. They are responsible for most wind damage related to thunderstorms. Since thunderstorms do not have narrow tracks like tornadoes, the associated wind damage can be extensive and affect entire (and multiple) counties. Objects like trees, barns, outbuildings, high-profile vehicles, and power lines/poles can be toppled or destroyed, and roofs, windows, and homes can be damaged as wind speeds increase.

The onset of thunderstorms with lightning, high wind, and hail is generally rapid. Duration is less than six hours and warning time is generally six to twelve hours. Nationwide, lightning kills 75 to 100 people each year. Lightning strikes can also start structural and wildland fires, as well as damage electrical systems and equipment.

Previous Occurrences

Thunderstorm Wind

There are 181 Thunderstorm wind events reported to the NCDC from 1996 – 2015. There were 65 events with reported damages. The total damages from these events include two injuries and $7,762,500 in property damages with average losses per damaging event totaling $119,423. The two injuries occurred in April of 1996 when a thunderstorm complex containing straight-line winds of 80 mph affected the western part of the county. The main damage was in a path from Billings to Clever where over a total of 150 homes and businesses sustained damage. The hardest hit was the town of Clever where 100 homes and businesses were severely damaged, including the First Peoples Bank which had its roof blown off. Two people were injured in Clever when winds hit a mobile home park overturning trailers. This event also resulted in $2,500,000 in property damage.

The costliest event occurred in May of 2009 when Sixty to 90 mph winds created widespread damage to trees, structures, and power poles across much of the county. Roof damage to homes and businesses was significant in and around the communities of Billings, Nixa, Highlandville, and Ozark. Two mobile homes were heavily damaged in Highlandville from large trees falling on them. Several power poles were knocked over in Nixa, causing damage to some of the mobile units of the school district.

Hail

There are 173 Hail events reported to the NCDC from 1996 – 2015. The largest magnitude event was in July of 2008 when hailstones two inches in diameter were reported. No damages are associated with this event. There were 6 events with reported damages. **Table 3.35** provides information about damaging hail events in the county. The costliest event during this period occurred in Nixa when a few vehicles were damaged resulting in $7,000 in property damage. There are no reported instances of death, injury, or crop damage.

Table 3.35. NCDC Reported Events and Damages from Hail.

Location	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Clever	4/21/1996	0.75	0	0	$50	$0
Clever	4/21/1996	1.75	0	0	$500	$0
Nixa	4/21/1996	1.75	0	0	$750	$0
Billings	4/21/1996	1.75	0	0	$500	$0
Ozark	4/21/1996	1.75	0	0	$500	$0
Nixa	6/4/1998	1.75	0	0	$7,000	$0
Total			**0**	**0**	**$9,250**	**$0**

Source: NCDC,2015

Lightning

Limitations to the use of NCDC reported lightning events include the fact that only lightning events that result in fatality, injury and/or property and crop damage are in the NDCD. There are four lightning events recorded in the NCDC data from 1996 – 2015 that have resulted in $330,000 of property damage. The costliest event occurred in Nixa in March of 2011 when a strong thunderstorm produced a destructive lightning strike which hit a house and completely burned it down resulting in $250,000 in property losses. **Table 3.36** provides information on lightning events.

Table 3.36. NCDC Reported Events and Damages from Lightning.

Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Ozark	7/28/2001	0	0	$20,000	$0
Nixa	4/5/2009	0	0	$10,000	$0
Nixa	3/25/2011	0	0	$250,000	$0
Ozark	4/10/2013	0	0	$50,000	$0
Total		**0**	**0**	**$330,000**	**$0**

Source: NCDC,2015.

Probability of Future Occurrence

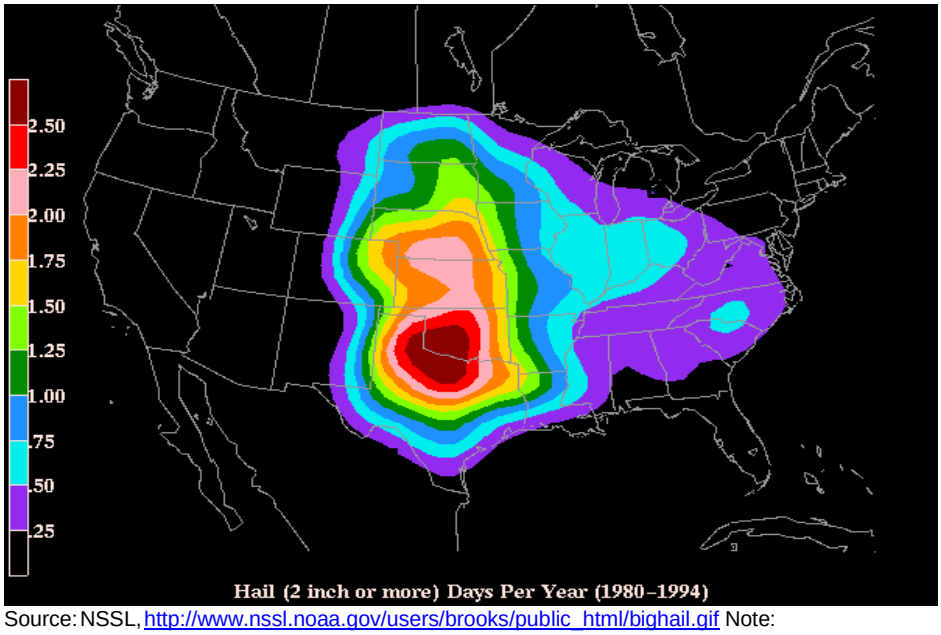
Thunderstorm Wind

There have been 181 recorded thunderstorm wind events over a 19 year period from 1996 to 2015. This equates to nine and a half (9.5) thunderstorm wind occurrences in any given year with a 100% probability of occurrence. There were 65 events that resulted in two injuries and $7,762,500 in property damage. This equates to three and a half (3.5) damaging events per year with annualized losses of $408,552.

Hail

There have been 173 recorded hail events over a 19 year period from 1996 to 2015. This equates to nine (9) hail events in any given year with a 100% probability of occurrence. There were only six (6) events that resulted in $9,250 in property damage. This equates to one damaging event every three years with annualized losses $489. **Figure 3.22** is a map based on hailstorm data from 1980-1994. It shows the probability of hailstorm occurrence (2" diameter or larger) based on number of days per year. Christian County is bisected by the green and blue zones on the map meaning that the county will experience hail greater than 2" in diameter one to 1.25 days per year.

Figure 3.22. Annual Hailstorm Probability (2'' diameter or larger), 1980- 1994



Source: NSSL, http://www.nssl.noaa.gov/users/brooks/public_html/bighail.gif Note:

Lightning

There have been four damaging lightning events in the county from 1996 – 2015 resulting in $330,000 in property damage. This equates to 21% probability of a damaging lightning event in any given year with $17,369 in annualized losses.

Vulnerability

Vulnerability Overview

High wind, hail, and lightning pose varying risk for jurisdictions in Christian County. Downbursts resulting from thunderstorms can be just as damaging as an EF-1 tornado. High winds have resulted in two injuries in Christian County and $7,762,500 in property damage. Poorly built structures, barns, outbuildings are more vulnerable to the impact of high winds during thunderstorms. Both high winds and hail can damage roofs. Hail can also damage crops and dent cars and trucks. Total hail damage recorded in the NCDC database for Christian County from 1996 – 2015 has been $9,250 for an annualized total of $489. Lightning can cause wildfires and structural fires and damage electrical utilities causing power outages. There have been four damaging lightning events in the county from 1996 – 2015 resulting in $330,000 in property damage with annualized losses of $17,369.

Potential Losses to Existing Development

The average annual loss determined from historical losses for high wind and hail are indicators of the potential losses to existing development. High wind events in the County have damaged Critical facilities, schools, local governments, and private property. Potential losses for high wind, hail, and lightning throughout the county are $408,552, $489, and $17,369, respectively.

Future Development

Clever, Nixa, Ozark, and unincorporated areas in the north central portion of the county are currently in growth mode. Additional development in these areas results in the exposure of more households and businesses vulnerable to damages from high winds, hail, and lightning.

Hazard Summary by Jurisdiction

Although thunderstorms/high winds/lightning/hail events are area-wide, communities with a greater percentage of structures built prior to 1939 are considered to be more vulnerable to the impact of high wind and hail damage. The City of Billings is the only community with a percentage of housing units built in 1939 or earlier above 10% at 18.8%. Clever, Nixa, Ozark, and unincorporated areas in the north central portion of the county are increasing exposure and risk to this hazard with population growth and new construction, however, the risk to new development in these areas is somewhat mitigated by IBC 2012 building codes with the exception of Clever which currently has BOCA 2000 building codes.

School and special district facilities are at risk to the damages of high wind, hail and lightning. In May of 2009 some mobile units in Nixa school district were damaged. The District no longer employs mobile units to house temporary classrooms. Temporary units housing student populations are no longer used on the Chadwick R-I and Spokane R-VII campuses. Chadwick R-I

is completing an early childhood education facility on its campus and Spokane R-VII has renovated an addition to the middle school to move the preschool that was formally in a temporary building. Ancillary buildings at other school districts such as storage facilities will continue to be at risk, however, risk to student populations has been mitigated by the construction of saferooms at the Chadwick R-I, Clever R-V, Nixa R-II, and OTC Richwood Valley Campuses. Protective filming of windows and installation of reinforced entryways has been completed at the Spokane R-VII campuses. Billings R-IV, Ozark-VI, and Spokane R-VII school districts are planning to construct FEMA saferooms at their campuses in the next five years. Billings Special Road District maintenance shed and storage buildings are at risk to high wind damages as they are designed to house equipment and not people. Christian County Ambulance District stations are considered to be well built structures and less vulnerable to thunderstorm events.

Problem Statement

Poorly built structures, barns, outbuildings are more vulnerable to the impact of high winds during thunderstorms. High winds can topple utility poles and lead to power outages. Both high winds and hail can damage roofs. Hail can also damage crops and dent cars and trucks. People are also at risk to injury and death during high wind events. Crop insurance mitigates the risk to farmers and the agriculture sector within the county. Lightning events have caused structural fires and can strike electrical utilities leading to power outages.

The risk of property damage, injury, and death in the county can be mitigated by identifying safe refuge areas in public buildings, nursing homes and other facilities that house vulnerable populations that do not have a saferoom. Retrofitting school district facilities with protective filming of windows and installation of blast proof doors will provide more protection for students and staff at school facilities. Additional warnings and alerts will also provide the public and schools more time to take cover during high wind events. In addition, public safety fairs and expos in the county hosted by Nixa and Ozark provide an opportunity to disseminate information to homeowners about individual saferoom construction in homes. Education and hazard awareness programs in public schools would also increase public safety in the event of severe thunderstorm events.

3.4.9 Tornado

HazardProfile

Hazard Description

The NWS defines a tornado as “a violently rotating column of air extending from a thunderstorm to the ground.” It is usually spawned by a thunderstorm and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. Often, vortices remain suspended in the atmosphere as funnel clouds. When the lower tip of a vortex touches the ground, it becomes a tornado.

High winds not associated with tornadoes are profiled separately in this document in **Section 3.4.8,** Thunderstorm/High Wind/Hail/Lightning.

Essentially, tornadoes are a vortex storm with two components of winds. The first is the rotational winds that can measure up to 500 miles per hour, and the second is an uplifting current of great strength. The dynamic strength of both these currents can cause vacuums that can overpressure structures from the inside.

Although tornadoes have been documented in all 50 states, most of them occur in the central United States due to its unique geography and presence of the jet stream. The jet stream is a high-velocity stream of air that separates the cold air of the north from the warm air of the south. During the winter, the jet stream flows west to east from Texas to the Carolina coast. As the sun moves north, so does the jet stream, which at summer solstice flows from Canada across Lake Superior to Maine. During its move northward in the spring and its recession south during the fall, the jet stream crosses Missouri, causing the large thunderstorms that breed tornadoes.

A typical tornado can be described as a funnel-shaped cloud in contact with the earth‘s surface that is “anchored” to a cloud, usually a cumulonimbus. This contact on average lasts 30 minutes and covers an average distance of 15 miles. The width of the tornado (and its path of destruction) is usually about 300 yards. However, tornadoes can stay on the ground for upward of 300 miles and can be up to a mile wide. The National Weather Service, in reviewing tornadoes occurring in Missouri between 1950 and 1996, calculated the mean path length at 2.27 miles and the mean path area at 0.14 square mile.

The average forward speed of a tornado is 30 miles per hour but may vary from nearly stationary to 70 miles per hour. The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Tornadoes are most likely to occur in the afternoon and evening, but have been known to occur at all hours of the day and night.

Geographic Location

Tornadoes can occur anywhere in the planning area.

Severity/Magnitude/Extent

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour and damage paths can be more than one mile wide and 50 miles long. Tornadoes have been known to lift and move objects weighing more than 300 tons a distance of 30 feet, toss homes more than 300 feet from their foundations, and siphon millions of tons of water from water bodies. Tornadoes also can generate a tremendous amount of flying debris or "missiles," which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls. However, the less spectacular damage is much more common.

Tornado magnitude is classified according to the EF- Scale (or the Enhance Fujita Scale, based on the original Fujita Scale developed by Dr. Theodore Fujita, a renowned severe storm researcher). The EF- Scale (see **Table 3.37**) attempts to rank tornadoes according to wind speed based on the damage caused. This update to the original F Scale was implemented in the U.S. on February 1, 2007. The wind speeds for the EF scale and damage descriptions are based on information on the NOAA Storm Prediction Center. The damage descriptions are summaries. For the actual EF scale it is necessary to look up the damage indicator (type of structure damaged) and refer to the degrees of damage associated with that indicator.

Table 3.37. Enhanced F Scale for Tornado Damage

Fujita and Enhanced Fujita Tornado Damage Scale					
FUJITA SCALE			OPERATIONAL EF SCALE		
F #	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF #	3 Second Gust (mph)	Typical Damage
0	40-72	45-78	**0**	**65-85**	**Light damage -** Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
1	73-112	79-117	**1**	**86-110**	**Moderate damage** - Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
2	113-157	118-161	**2**	**111-135**	**Considerable damage** - Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
3	158-207	162-209	**3**	**136-165**	**Severe damage** - Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.

Fujita and Enhanced Fujita Tornado Damage Scale					
FUJITA SCALE			OPERATIONAL EF SCALE		
F #	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF #	3 Second Gust (mph)	Typical Damage
4	208-260	210-261	**4**	**166-200**	**Devastating damage** - Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
5	261-318	262-317	**5**	**Over 200**	**Incredible damage** - Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds.); trees debarked; incredible phenomena will occur.
Source: Enhanced Fujita Tornado Damage Scale					

Source: The National Weather Service, www.spc.noaa.gov/faq/tornado/ef-scale.html

Enhanced weather forecasting has provided the ability to predict severe weather likely to produce tornadoes days in advance. Tornado watches can be delivered to those in the path of these storms several hours in advance. Lead time for actual tornado warnings is about 30 minutes. Tornadoes have been known to change paths very rapidly, thus limiting the time in which to take shelter. Tornadoes may not be visible on the ground if they occur after sundown or due to blowing dust or driving rain and hail.

Previous Occurrences

Table 3.38 includes NCDC reported tornado events and damages since 1993 in the planning area. Prior to that date, only really destructive tornadoes were recorded. There are limitations to the use of NCDC tornado data that must be noted. For example, one tornado may contain multiple segments as it moves geographically. A tornado that crosses a county line or state line is considered a separate segment for the purposes of reporting to the NCDC. Also, a tornado that lifts off the ground for less than 5 minutes or 2.5 miles is considered a separate segment. If the tornado lifts off the ground for greater than 5 minutes or 2.5 miles, it is considered a separate tornado. Tornadoes reported in Storm Data and the Storm Events Database are in segments.

Table 3.38. Recorded Tornadoes in Christian County, 1993 – Present

Date	Beginning Location	Ending Location	Length (miles)	Width (yards)	F/EF Rating	Death	Injury	Property Damage	Crop Damages
4/28/1994	Ozark to	Sparta	7	20	F1	0	0	$500,000	$500
5/4/2003	Billings	Billings	13	880	F3	1	3	$5,100,000	0
11/5/2005	Garrison	Garrison	4	530	F1	0	0	$0	0
3/12/2006	Clever	Clever	17	250	F3	0	3	$50,000,000	0
6/18/2007	Ozark	Ozark	1	75	EF0	0	1	$0	0

6/30/2007	Ozark	Ozark	0.1	50	EF0	0	0	$0	0
9/6/2007	Clever	Clever	0.5	50	EF0	0	0	$2,000	0
1/7/2008	Billings	Billings	0.04	50	EF0	0	0	$0	0
1/7/2008	Riverdale	Riverdale	0.36	100	EF1	0	1	$200,000	0
1/8/2008	Montague	Selmore	4.98	100	EF1	0	0	$250,000	0
4/9/2009	Nixa	Nixa	1.64	150	EF0	0	0	$100,000	0
5/8/2009	Garrison	Garrison	7.19	880	EF1	0	0	$2,000,000	0
5/13/2010	Sparta	Bruner	4.25	200	EF0	0	0	$50,000	0
9/15/2010	Boaz	Boaz	0.43	100	EF0	0	0	$0	0
12/31/2010	Bruner	Abadyl	5.27	250	EF1	0	2	$200,000	0
	Total					**1**	**10**	**$58,402,000**	**$500**

Source: National Climatic Data Center, 2015. http://www.ncdc.noaa.gov/stormevents/

There were 15 tornado events recorded in the NCDC database from 1993 – 2015. The damages from these events resulted in one (1) death, ten (10) injuries, $58,402,000 in property damage, and $500 in crop damage. Some of the most damaging events are summarized below.

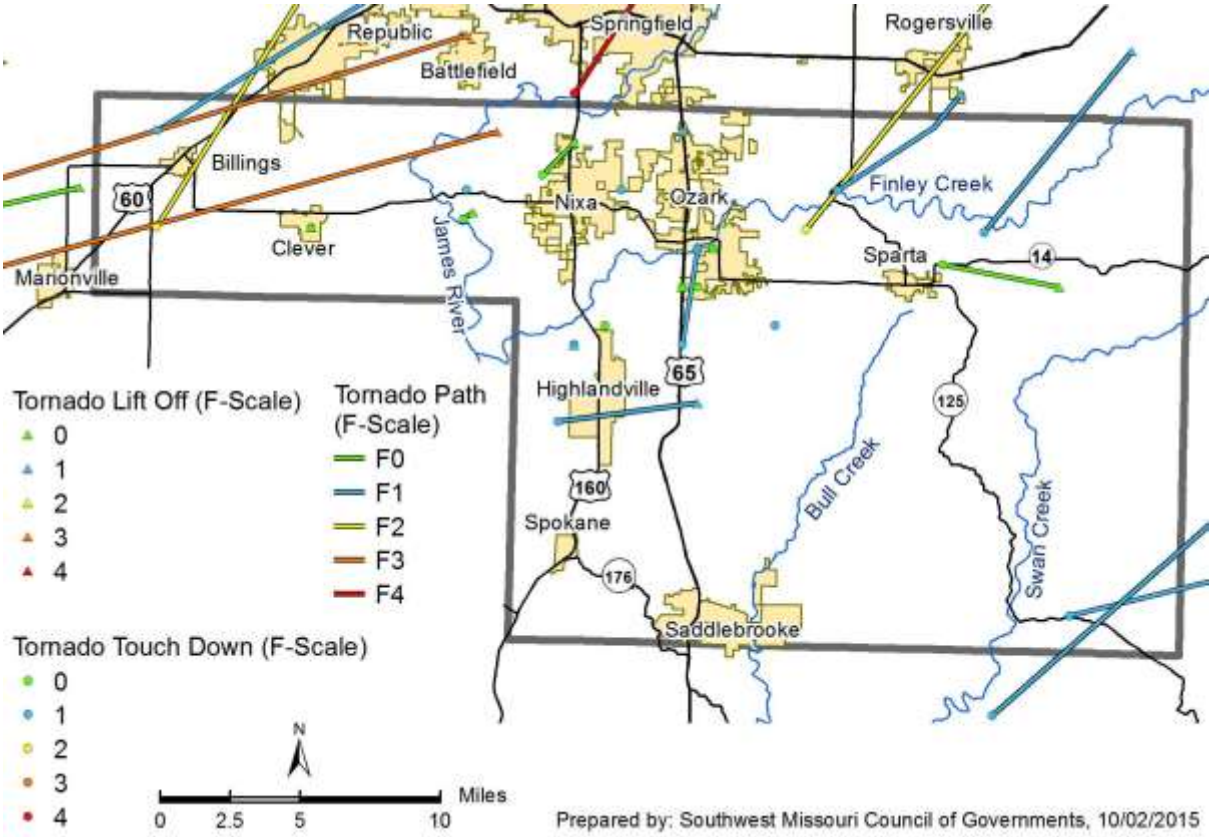
In May 2003, a continuation of the Lawrence County tornado that laid a half mile wide path of destruction across the Christian County panhandle. Populated areas between the communities of Billings and Clever were affected that resulted in one fatality and three injuries. 27 structures were destroyed while 150 were damaged that added up to around 5.1 million dollars of monetary losses. The tornado continued on the ground into southwestern Greene County. A 63 year old woman was taking cover in her frame home with her husband and daughter. As the tornado struck, she was thrown about 50 yards from her location and was deceased from injury. Her husband and daughter survived the event.

In May 2006, significant structural damage occurred across the Christian County panhandle in a rural area between Billings and Clever. This area was also heavily impacted by the 4 May 2003 tornado. A subdivision with solid well built homes northwest of Nixa was directly impacted by the tornadoes destruction. 138 structures were damaged while 127 structures were destroyed. $50,000,000 in property damages were reported.

In May 2009, a National Weather Service storm survey revealed that an EF-1 tornado impacted extreme southeast Christian County. Wind speeds were estimated at 100 mph as the tornado damaged two homes, destroyed a few outbuildings, and downed numerous trees. $2,000,000 in property damages were reported during this event.

Figure 3.23 shows historic tornado paths in the Christian County.

Figure 3.23. Christian County Map of Historic Tornado Events



Source: Missouri Tornado History Project, http://www.tornadohistoryproject.com/tornado/Missouri

Probability of Future Occurrence

According to the NCDC, 15 tornados have occurred during the 22 year period from 1993 to 2015 resulting in a probability percentage of 68% of a tornado of any magnitude event in the planning area in any given year.

Vulnerability

Vulnerability Overview

Christian County is located in a region of the U.S. with high frequency of dangerous and destructive tornadoes referred to as “Tornado Alley” as is the entire state. **Figure 3.24** illustrates areas where dangerous tornadoes historically have occurred.

Figure 3.24. Tornado Alley in the U.S.

Source: http://www.tornadochaser.net/tornalley.html

The 2013 State Plan used a methodology to the vulnerability of each county in the state to determine each county's vulnerability to tornadoes. While this approach attempts to prioritize tornado vulnerable counties, it does not identify any particular geographic patterns to tornado risk. The state's analysis combined annualized losses and frequency of occurrence to determine the greatest likelihood of being impacted by a tornado. The state's vulnerability rating ranged from very high, high, and moderate. The vulnerability rating for Christian County was rated as very high.

Potential Losses to Existing Development

During the 22 year period from 1993 to 2015, a total of $50,402,000 in property losses equates to $2,291,000 in average annual losses countywide. This value indicates that potential future losses in the county will remain significant. The most common tornado events recorded in the county are F0/EF0 magnitude. Seven of the 14 tornado events on record have been EF0 magnitude. There have been six F1/EF1, and two F3/EF3 magnitude tornadoes recorded in the NCDC data. Potential losses for each jurisdiction were estimated based on total exposure with applied damage factor of 1%. **Table 3.39** provides estimates for total losses by Jurisdiction.

Table 3.39. Estimated Potential Tornado Losses by Jurisdiction

Jurisdiction	Potential Earthquake Losses
Christian County	$25,606,906
Billings	$584,918
Clever	$2,039,704
Fremont Hills	$1,322,977
Nixa	$14,886,773
Ozark	$14,172,632
Billings R-IV	$168,515
Chadwick R-I	$106,015
Clever R-V	$428,978
Nixa R-II	$1,712,478
Ozark R-VI	$2,179,517
Spokane R-VII	$383,590
Billings Special Road District	$8,228
Christian County Ambulance District	$37,800
OTC Richwood Valley Campus	$202,897

Future Development

Christian County is one of the fastest growing counties in Missouri. Development is anticipated to continue in the communities of Clever, Nixa, Ozark, and unincorporated areas in the in north central part of the county. Anticipated development and resulting increase in population will increase exposure to damage.

Hazard Summary by Jurisdiction

Although tornado events are area-wide hazard, communities with a greater percentage of structures built prior to 1939 are considered to be more vulnerable to the impact of high wind and hail damage. The City of Billings is the only community with a percentage of housing units built in 1939 or earlier above 10% at 18.8%. Clever, Nixa, Ozark, and unincorporated areas in the north central portion of the county are increasing exposure and risk to this hazard with population growth and new construction, however, the risk to new development in these areas is somewhat mitigated by IBC 2012 building codes with the exception of Clever which currently has BOCA 2000 building codes.

School and special district facilities are at risk to the damages of tornados. Risk to student populations has been mitigated by the construction of saferooms at the Chadwick R-I, Clever R-V, Nixa R-II, and OTC Richwood Valley Campuses. Protective filming of windows and installation of reinforced entryways has been completed at the Spokane R-VII campuses. Billings R-IV, Ozark-VI, and Spokane R-VII school districts are planning to construct FEMA saferooms at their campuses in the next five years. Billings Special Road District maintenance shed and storage buildings are at risk to tornado damages. Christian County Ambulance District stations are considered to be well built structures they are vulnerable to the impact of tornados.

Problem Statement

Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 miles per hour and damage paths can be more than one mile wide and 50 miles long. Significant tornado events in Christian County have resulted in one deaths, 10 injuries, $50,402,000 in property damage, and $500 in crop damage over the last 22 years. Information in the 2013 State Plan indicates that Christian County has an very high vulnerability to tornados based on frequency of occurrence and previous damages.

The risk of property damage, injury, and death in the county can be mitigated by Constructing FEMA saferooms in facilities that house vulnerable populations such as nursing homes government buildings, and schools, In addition identifying safe refuge areas in public buildings, nursing homes and other facilities that house vulnerable populations that do not have a saferoom. Retrofitting school district facilities with protective filming of windows and installation of blast proof doors will provide more protection for students and staff at school facilities. Additional warnings and alerts will also provide the public and schools more time to take cover during tornado. In addition, public safety fairs and expos in the county hosted by Nixa and Ozark provide an opportunity to disseminate information to homeowners about individual saferoom construction in homes.

Cities can adopt or update and enforce IBC 2012 building codes that include construction techniques such as roof tie down straps to mitigate damage to future development.

3.4.10 Winter Weather/Snow/Ice/Severe Cold

Hazard Profile

Hazard Description

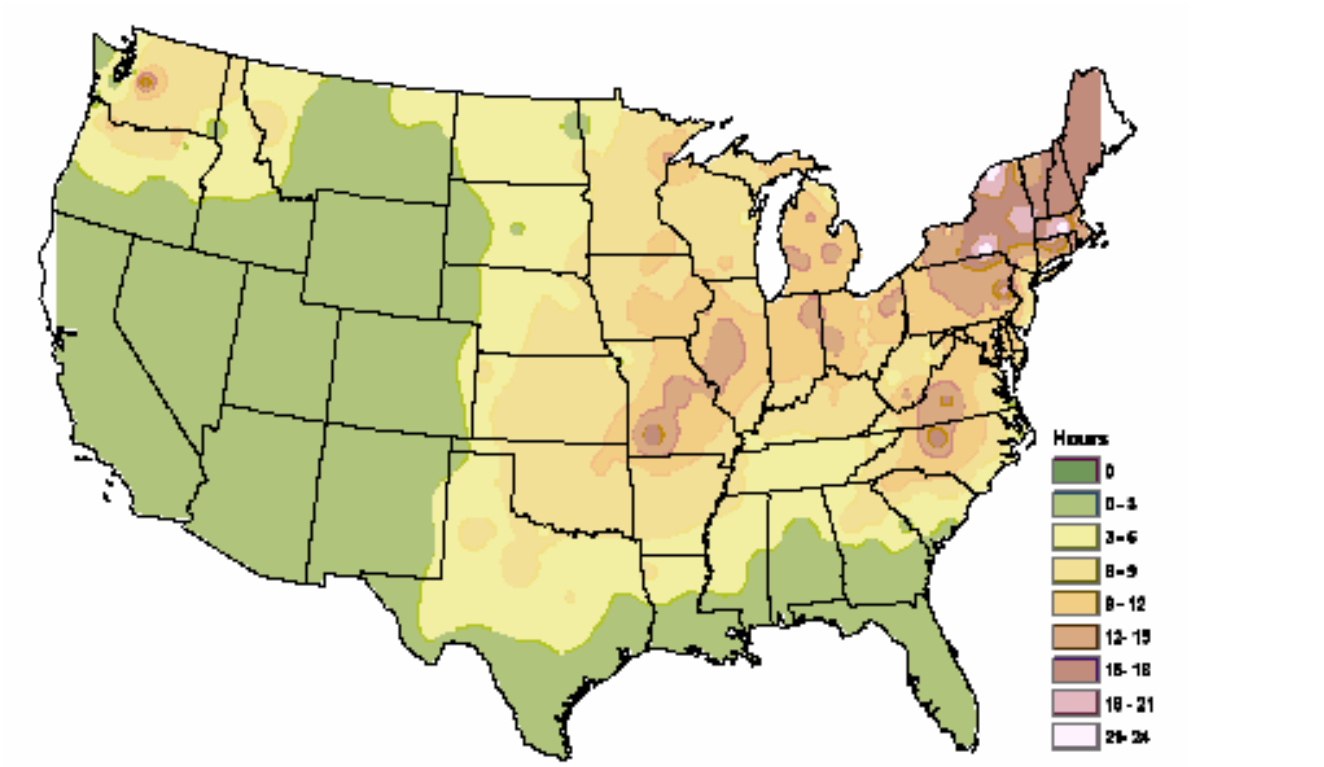
A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. The National Weather Service describes different types of winter storm events as follows.

- **Blizzard**—Winds of 35 miles per hour or more with snow and blowing snow reducing visibility to less than ¼ mile for at least three hours.
- **Blowing Snow**—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- **Snow Squalls**—Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
- **Snow Showers**—Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- **Freezing Rain**—Measurable rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces, such as trees, cars, and roads, forming a coating or glaze of ice. Most freezing-rain events are short lived and occur near sunrise between the months of December and March.
- **Sleet**—Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects.

Geographic Location

The entire county is vulnerable to heavy snow, ice, extreme cold temperatures and freezing rain. **Figure 3.25** depicts the average number of hours per year with freezing rain. Christian County is located in a zone that can expect 15 – 18 hours of freezing rain per year.

Figure 3.25. NWS Statewide Average Number of Hours per Year with Freezing Rain



Source: American Meteorological Society. "Freezing Rain Events in the United States." http://ams.confex.com/ams/pdfpapers/71872.pdf

Severity/Magnitude/Extent

Severe winter storms include extreme cold, heavy snowfall, ice, and strong winds which can push the wind chill well below zero degrees in the planning area. Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough that precipitation falls as freezing rain rather than snow.

Extreme cold often accompanies severe winter storms and can lead to hypothermia and frostbite in people without adequate clothing protection. Cold can cause fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold temperatures can also overpower a building's heating system and cause water and sewer pipes to freeze and rupture. Extreme cold also increases the likelihood for ice jams on flat rivers or streams. When combined with high winds from winter storms, extreme cold becomes extreme wind chill, which is hazardous to health and safety.

The National Institute on Aging estimates that more than 2.5 million Americans are elderly and especially vulnerable to hypothermia, with the isolated elders being most at risk. About 10 percent of people over the age of 65 have some kind of bodily temperature-regulating defect, and 3-4 percent of all hospital patients over 65 are hypothermic.

Also at risk are those without shelter, those who are stranded, or who live in a home that is poorly insulated or without heat. Other impacts of extreme cold include asphyxiation (unconsciousness or death from a lack of oxygen) from toxic fumes from emergency heaters; household fires, which can be caused by fireplaces and emergency heaters; and frozen/burst pipes.

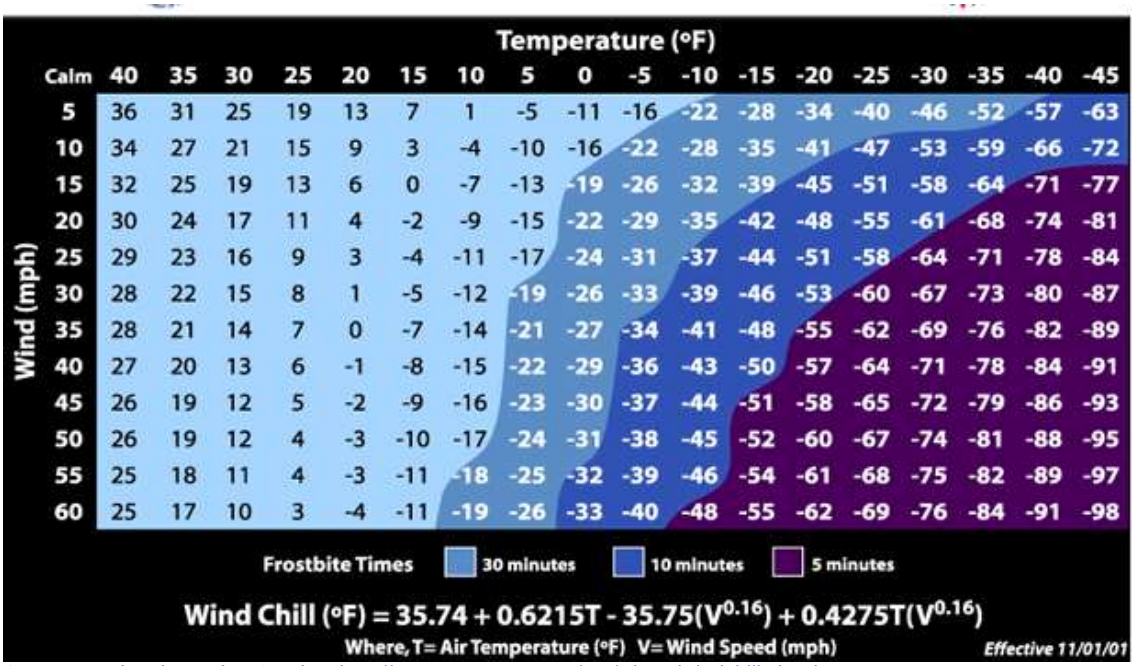
Buildings with overhanging tree limbs are more vulnerable to damage during winter storms when limbs fall. Businesses experience loss of income as a result of closure during power outages. In general heavy winter storms increase wear and tear on roadways though the cost of such damages is difficult to determine. Businesses can experience loss of income as a result of closure during winter storms.

Overhead power lines and infrastructure are also vulnerable to damages from winter storms. In particular ice accumulation during winter storm events damage to power lines due to the ice weight on the lines and equipment. Damages also occur to lines and equipment from falling trees and tree limbs weighted down by ice. Potential losses could include cost of repair or replacement of damaged facilities, and lost economic opportunities for businesses.

Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard. Standard values for loss of service for utilities reported in FEMA's 2009 BCA Reference Guide, the economic impact as a result of loss of power is $126 per person per day of lost service.

Wind can greatly amplify the impact of cold ambient air temperatures. Provided by the National Weather Service**, Figure 3.26** below shows the relationship of wind speed to apparent temperature and typical time periods for the onset of frostbite.

Figure 3.26. Wind Chill Chart



Source: National Weather Service, http://www.nws.noaa.gov/om/winter/windchill.shtml

Previous Occurrences

There are 32 recorded events in the NCDC database for Blizzard, Cold/Wind Chill, Extreme Cold/Wind Chill, Ice Storm, Heavy Snow and Winter Storm in Christian County from 1996 - 2015. **Table 3.40** includes NCDC reported events and damages for at least the past 19 years for Blizzard, Cold/Wind Chill, Extreme Cold/Wind Chill, Ice Storm, and Heavy Snow. Winter Storm is discussed in the following narrative.

Table 3.40. NCDC Christian County Winter Weather Events Summary, 1996 -2015

Type of Event	Date	# Deaths	# of Injuries	Property Damages	Crop Damages
Ice Storm	11/24/1996	0	0	$400,000	$0
Heavy Snow	1/08/1997	0	0	$25,000	$0
Extreme Cold/Wind Chill	12/12/2000	0	0	$25,000	$0
Heavy Snow	12/12/2000	0	0	$10,000	$0
Extreme Cold/Wind Chill	1/1/2001	0	0	$0	$0
Ice Storm	2/21/2001	0	0	$0	$0
Heavy Snow	12/10/2003	0	0	$0	$0
Ice Storm	1/25/2004	0	0	$0	$0
Ice Storm	1/12/2007	0	0	$100,000	$0
Ice Storm	12/11/2008	0	0	$0	$0
Ice Storm	2/21/2008	0	0	$0	$0

Type of Event	Date	# Deaths	# of Injuries	Property Damages	Crop Damages
Heavy Snow	3/4/2008	0	0	$0	$0
Ice Storm	1/26/2009	0	0	$0	$0
Total		**0**	**0**	**$560,000**	**$0**

Source: NCDC, 2015.

Of the 13 events listed in the NCDC data, seven were Ice Storms, three were heavy snow events and two were extreme cold/wind chill events. In addition, there were 21 winter storm events with one event resulting in $150,000 property damage. Including the damage reported during the one winter storm event, there were six severe winter weather events that resulted in property damage totaling $710,000. There are no reported deaths, injuries, or crop damage associated with these events.

Ice Storm

The most significant of these events occurred in 1996 when the worst ice storm in 20 years caused widespread damage across the county due to downed power lines and trees. Ice accumulations of up to two inches were common. Large sections of the county were without power for several days. The hardest town was Highlandville where people were without power for a week.

Extreme Cold/Wind Chill

In December 2000, $25,000 in damages were reported due to an extreme cold/wind chill event as snow cover and cold conditions also made it difficult for farmers and ranchers to feed their animals, which had an adverse effect on livestock and newly born calves.

Heavy Snow

A total of $35,000 was reported for two heavy snow events in in 1997 and 2000, however, there are no specific damages for Christian County included in the narratives for these events.

Probability of Future Occurrence

The probability for all of the different types of winter weather are included as one probability, since one storm generally includes a lot of the different types of events. There were 32 severe winter weather events in Christian County from 1996 to 2015. This equates to a 100% probability of occurrence in any given year with approximately 1.5 events in any given year.

Vulnerability

Vulnerability Overview

Severe winter storms include extreme cold, heavy snowfall, ice, and strong winds which can push the wind chill well below zero degrees in the planning area. Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. People over 65 and

those living in poverty have an increased risk of hypothermia and frostbite due to extreme cold and wind chill.

In the 2013 State Plan, seven factors were considered in determining overall severe winter storm vulnerability as follows: housing density, likelihood of occurrence, building exposure, crop exposure, average annual property loss ratio, average annual crop insurance claims and social vulnerability. The state ranked each of these criteria using a scale from one to five, one being lowest and five being the highest, to rank each county's vulnerability to severe winter weather. Christian County received a vulnerability rating of low with no individual criterion scoring above two.

Potential Losses to Existing Development

During the 19 year period from 1996 to 2015, a total of $560,000 in property losses equates to $29,473 in average annual losses countywide.

Future Development

Increased development and resulting increase in population will increase exposure to damage from severe winter weather. Future commercial development can expect functional downtime and decreased revenues during periods of severe winter weather. Road construction in the county will increase the need for snow removal and salt to keep transportation lifelines open during periods of severe winter weather.

Hazard Summary by Jurisdiction

Severe winter weather can cause power outages and put structures at risk to fires when individuals in homes resort fuel heaters. The risk of extreme cold deaths and frostbite varies among segments of the populations. People over 65 and those living below the poverty level have an increased vulnerability to severe winter weather. **Table 3.41** includes information on populations over 65 and the percent living below the poverty level by jurisdiction.

Table 3.41. Population over 65 and Percent Living Below the Poverty Level by Jurisdiction

Jurisdiction	% of Families Living Below Poverty Level	Population over 65
Christian County	7.9%	10,131
Billings	19.7%	199
Clever	13.9%	213
Fremont Hills	2.9%	159
Nixa	12.6%	2,290
Ozark	15.5%	2,163

Source: MCDC ACS Profiles, ACS five year estimates 2009 - 2013

Billings, Ozark, Clever, and Nixa have the largest percent of families living below the poverty level. The largest populations of people 65 and over reside in the unincorporated areas of the county, Nixa, and Ozark. These jurisdictions would have the greatest risk based on these populations. Fremont Hills has less exposure to vulnerable populations.

School Districts and the OTC Richwood Valley Campus close during periods of extreme winter weather. This minimizes the risk of weather related accidents on roadways. Some school districts have been closed for up to two weeks. The risk to school districts to severe winter weather is limited to structural damages to facilities. There are no reports of damages to school facilities due to severe winter weather in Christian County. Billings Special Road District maintains snow removal equipment to clear roadways during snow and ice events in the District's boundaries. Severe winter weather poses a risk to EMTs of the Christian County Ambulance District and road district personnel that must continue working during periods of extreme cold, snow, and ice elevating risk to employees during periods of severe winter weather.

Problem Statement

Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. People over 65 and those living in poverty have an increased risk of hypothermia and frostbite due to extreme cold and wind chill.

The Christian County EMA maintains a list of heating and cooling centers throughout the county. These locations are promoted on the County's website. This provides individuals who are at risk refuge from periods of extreme cold. Public works departments and road districts can develop snow removal plans and maintain adequate snow removal equipment and salt to quickly open roads after periods of heavy snow and freezing rain. The County and cities can work with local electric coops to develop vegetation management programs in rights of way to minimize damages to falling tree limbs laden with ice resulting from ice storms to minimize power outages throughout the county.

4 MITIGATION STRATEGY

44 CFR Requirement §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section presents the mitigation strategy updated by the Mitigation Planning Committee (MPC) based on the updated risk assessment. The mitigation strategy was developed through a collaborative group process. The process included review of general goal statements to guide the jurisdictions in lessening disaster impacts as well as specific mitigation actions to directly reduce vulnerability to hazards and losses. The following definitions are taken from FEMA's *Local Hazard Mitigation Review Guide (October 1, 2012)*.

- **Mitigation Goals** are general guidelines that explain what you want to achieve. Goals are long-term policy statements and global visions that support the mitigation strategy. The goals address the risk of hazards identified in the plan.

- **Mitigation Actions** are specific actions, projects, activities, or processes taken to reduce or eliminate long-term risk to people and property from hazards and their impacts. Implementing mitigation actions helps achieve the plan's mission and goals.

4.1 Goals

44 CFR Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

This planning effort is an update to Christian County's existing hazard mitigation plan approved by FEMA on June 17, 2011. Therefore, the goals from the 2011 Plan were reviewed to see if they were still valid, feasible, practical, and applicable to the defined hazard impacts. The MPC conducted a discussion session during their third meeting to review and update the plan goals. To ensure that the goals developed for this update were comprehensive and supported State goals, the 2013 State Hazard Mitigation Plan goals were reviewed. The MPC also reviewed the goals from current surrounding county plans.

In the 2011 Plan, the organization of the actions included broad goals and a set of objectives linking the actions the goals. The MPC opted to keep the goals from the 2011 Plan while agreeing with modifications to the objective statements based on language from several surrounding area plans. The Plan update goals and objectives are as follows:

Goal 1 – **Protect the lives and livelihoods of all citizens.**

- **Objective 1.1** – Promote education, outreach, research and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation

- **Objective 1.2** - Provide adequate warning and communications systems to alert the public to severe hazard events

- **Objective 1.3** - Provide and promote safe refuge areas during weather extremes

Goal 2 - **Reduce the potential impact of natural disasters to property, infrastructure, and the local economy.**

- **Objective 2.1** - Protect structures, contents and critical lifelines from the impacts of natural hazard occurrence

- **Objective 2.2** - Ensure that future development in the county is as hazard proof as possible

Goal 3 - **Ensure continued operation of government, emergency functions and critical infrastructure in a disaster.**

- **Objective 3.1** - Improve the efficiency, timing, and effectiveness of response and recovery efforts for natural hazard disasters

- **Objective 3.2** - Design, enhance, or amend policies that will work to limit the impact of natural hazards

- **Objective 3.3** - Increase the capabilities to mitigate the impact of natural hazards

4.2 Identification and Analysis of Mitigation Actions

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

During the second MPC meeting, the results of the risk assessment update were provided to the MPC members for review and the key issues were identified for specific hazards. Changes in risk since adoption of the previously approved plan were discussed. The third meeting concluded with the distribution of a list of possible mitigation actions to prompt discussions within and among the jurisdictions. The list included possible new mitigation actions, as well as actions from the previously approved plan. Actions from the previous plan included completed actions, on-going actions, and actions upon which progress had not been made. The MPC discussed SEMA's identified funding priorities and the types of mitigation actions generally recognized by FEMA.

The MPC determined to include problem statements in the plan update at the end of each hazard profile, which had not been done in the previously approved plan. The problem statements summarize the risk to the planning area presented by each hazard, and include possible methods to reduce that risk. Use of the problem statements allowed the MPC to recognize new and innovative strategies for mitigate risks in the planning area.

The focus of the third MPC meeting was the update of the mitigation strategy. For a comprehensive range of mitigation actions to consider, the MPC reviewed the following information during the third meeting:

- A list of actions proposed in the previous mitigation plan, the current State Plan, and approved plans in surrounding counties,

- Key issues from the risk assessments, including the Problem Statements concluding each hazard profile and vulnerability analysis,
- State priorities established for Hazard Mitigation Assistance grants, and

At the third meeting, jurisdiction representatives, including school and special districts, and representatives from community organizations developed final mitigation strategy for submission to the MPC. They were encouraged to review the details of the risk assessment vulnerability analysis specific to their jurisdiction. They were also provided a link to the FEMA's publication, *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards (January 2013).* This document was developed by FEMA as a resource for identification of a range of potential mitigation actions for reducing risk to natural hazards and disasters.

The MPC reviewed the actions from the previously approved plan for progress made since the 2011 Plan had been adopted at the second MPC meeting. At the second MPC meeting, the list of actions from the 2011 Plan for each jurisdiction was reviewed. Jurisdiction representatives were instructed to provide information regarding the "Action Status" with one of the following status choices:

- Completed, with a description of the progress,
- Not Started/Continue in Plan Update, with a discussion of the reasons for lack of progress,
- In Progress/Continue in Plan Update, with a description of the progress made to date or
- Deleted, with a discussion of the reasons for deletion.

Based on the status updates, there were eight (8) completed actions, 18 deleted actions, and 25 continuing actions. Completed actions include those actions where significant progress has been made but were no longer relevant to include in the Plan update. Significant progress has been made towards many of the actions, such as constructing saferooms and improving low water crossings but the MPC elected to continue these actions due to the fact that many school districts are seeking to add saferooms and numerous low water crossings need improvements. Actions that were not started but the MPC determined that there was a favorable benefit to continuing were revised or combined with other actions to add clarity and specificity to what is to be accomplished. **Table 4.1** provides a summary of the completed and deleted actions from the previous plan.

Table 4.1. Summary of Completed and Deleted Actions from the Previous Plan

Completed Actions	
Action	**Status**
Expand and improve the County's Emergency Communications Network by keeping the reverse 911 database and maps up to date and implementing and maintaining alert messaging technologies, such as; IRIS or others as they become available to alert civil employees and the public of natural hazard events..	The reverse 911 database has been maintained as is being deployed throughout the county and incorporated communities. The IRIS system has been implemented and is being maintained. Interoperable communications programs have greatly improved the county's emergency communication network.
Promote and encourage existing facilities that house vulnerable populations to install transfer switches to their electrical systems to provide for the use of generators during power outages.	Transfer switches and generators have been installed in nursing homes in Ozark and Nixa.
Encourage the adoption of building codes in incorporated areas that currently do not have such regulations.	Building codes are in place in the county and every municipality participating in the Plan.
Identify, review and implement mechanisms to foster collaboration among jurisdictions, agencies and special districts.	The local emergency planning committee in the county is comprised of representatives from each local government, school district, and community organizations.

Completed Actions	
Action	**Status**
Encourage all agencies to adopt and sign mutual aid agreements.	Mutual aid agreements have been adopted between the county EMA and cities, school districts, and public safety.
Develop public and private partnerships to implement mitigation actions.	This is the role of the LEPC. Private enterprises and chambers of commerce are represented.
Communities that do not participate will be encouraged to apply for participation in the NFIP and adopt and enforce floodplain management requirements, including regulating all new and substantially improved construction in the Special Flood Hazard Areas (SPFAs).	The City of Sparta and the Village of Saddlebrooke now participate in the NFIP and have adopted a floodplain management ordinance. Billings is the only community not participating in the NFIP. There are no SFHAs in the City.
Review and update as necessary emergency procedures in the event of any type of manmade or natural hazard.	This is the role of the LEPC. All school district administrators are trained in the National Incident Management System.

Deleted Actions	
Action	**Reason for Deletion**
Develop information programs on flood hazards and encourage citizens to consider flood risk in decision-making on future development.	Floodplain management ordinances and site review requirements ensure that development in the floodplain is strictly enforce in the county and incorporated areas.
Develop “tips” brochures for property owners to identify potential signs of sinkhole formation like closed depressions developing on their property and promote appropriate mitigation measures.	This information is available at the County, Nixa, and Ozark planning and development offices. Construction is prohibited 30 ft. from existing sinkholes even after remediation.
Develop and disseminate information relating to wildfire hazard areas to educate builders and homeowners about mitigation activities and to educate builders and homeowners about mitigation activities and to help guide emergency response services.	It is unclear how this would help guide emergency response. Obstacles to implementing this action are the development and dissemination of this information to residents in wildfire prone areas.
Require all new mobile home park developments to provide for an approved safe room in the development.	Mobile home parks are no longer permissible in the county and municipalities.
Ensure that wastewater treatment plants will function during flood events.	This action was deleted and replaced with a new action to acquire, elevate, or flood proof properties and critical infrastructure within flood hazard areas.
Purchase emergency generators for critical water and sewer system facilities.	Backup generators have been purchased and installed at all wastewater treatment facilities.
Identify water drainage obstructions and make improvements to lessen flooding potential.	Road districts continually clear debris at low water crossings as part of normal operations.
Promote the use of fire-resistant construction materials and building practices.	It is unclear if promotion of these practices would lead to its actual implementation if not included in fire codes.
Encourage property owners to take measures to reduce flooding of homes and businesses.	No action taken. The cost/benefit of encouragement is unclear.
Encourage collaborative planning and compatible regulatory controls between the county and incorporated communities to promote infrastructure development practices that reduce the potential for flooding and property damage.	Compatible regulatory practices exist in the form of floodplain management ordinances in all participating NFIP jurisdictions.
Integrate the goals and actions from the Natural Hazard Mitigation Plan into existing regulatory documents and programs where appropriate.	This is the intent of the mitigation action plan. It does not need to be included as a strategy.
Recommend revisions to requirements for development within the floodplain, where appropriate via zoning ordinances, subdivision regulations, etc.	Substantially regulating development in the floodplain are included in floodplain management ordinances and strictly enforced.
Adopt and amend comprehensive floodplain management regulations that jurisdictions determine are necessary for planning and appropriate to protect public health and safety.	Floodplain management ordinances have been adopted. DFIRMs are amended through the Risk Map process.
Strengthen emergency services preparedness and response by linking emergency services with hazard mitigation programs and enhancing public education.	Emergency services are represented on the LEPC and linked to emergency management. Several actions in the Plan address public awareness and education.

Deleted Actions	
Action	**Reason for Deletion**
Improve the CRS rating for the county.	The county no longer participates in the CRS.
Enhance data and mapping for floodplain information and flood-prone areas outside of designated floodplains.	Floodplain identification and mapping, including any local requests for map updates are requirements of the NFIP. Most frequently flooded areas outside of the floodplain are well known in local jurisdictions.
Identify condition of dams whose failure could be reasonably expected to endanger human life, the maximum area that could be flooded if the dam failed, and public facilities that would be affected by the flooding.	This information is include in the Risk Assessment chapter of the Plan. DNR has completed dam inundation maps for State regulated dams in the county.
Continue to inventory alternative firefighting water sources and encourage the development of additional services.	Fire protection districts did not participate in the Plan. Fire districts are moving away from dry hydrants.

Source: 2011 Plan; Data Collection Questionnaires; Local government websites

4.3 Implementation of Mitigation Actions

44 CFR Requirement §201.6(c)(3)(ii): The mitigation strategy shall include an action strategy describing how the actions identified in paragraph (c)(2)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefits review of the proposed projects and their associated costs.

A cost benefit review of all new and continuing actions in the finalized action plan was conducted at the fourth and final MPC meeting. Throughout the MPC consideration and discussion, emphasis was placed on the importance of a benefit-cost analysis in determining project priority. The Disaster Mitigation Act requires benefit-cost review as the primary method by which mitigation projects should be prioritized. The MPC decided to pursue implementation according to when and where damage occurs, available funding, political will, jurisdictional priority, and priorities identified in the Missouri State Hazard Mitigation Plan. The benefit/cost review at the planning stage primarily consisted of a qualitative analysis, and was not the detailed process required grant funding application. For each action, the plan sets forth a narrative describing the types of benefits that could be realized from action implementation. The cost was estimated as closely as possible, with further refinement to be supplied as project development occurs.

FEMA's STAPLEE methodology was used to assess the costs and benefits, overall feasibility of mitigation actions, and other issues impacting project. During the prioritization process, the MPC used worksheets to assign scores. The worksheets posed questions based on the STAPLEE elements as well as the potential mitigation effectiveness of each action. At the MPC meeting, the new and continuing actions were analyzed for their costs and benefits by consensus. Scores were based on the responses to the following questions and ensuing discussion:

S: Is the action socially acceptable?
T: Is the action technically feasible and potentially successful?
A: Does the jurisdiction have the administrative capability to successfully implement this action?
P: Is the action politically acceptable?
L: Does the jurisdiction have the legal authority to implement the action?
E: Is the action economically beneficial?
E: Will the project have an environmental impact that is either beneficial or neutral?
Will the implemented action result in lives saved?
Will the implanted action result in a reduction of disaster damage?

The final scores are listed below in the analysis of each action. The STAPLEE final score for each action, absent other considerations, such as a localized need for a project, determined the priority. Low priority action items scored of between 0 and 24. Moderate priority actions scored between 25 and 29. High priority actions scored 30 or above. All of the new and continuing actions scored above 30 and considered a high priority. A blank STAPLEE worksheet is shown in **Figure 4.1**.

Figure 4.1. Blank STAPLEE Worksheet

Action Code:	Jurisdiction:	
STAPLEE Criteria	**Evaluation Rating:** **Definitely YES = 3** **Maybe YES = 2** **Probably NO = 1** **Definitely NO =0**	**Score**
S: Is it Socially acceptable?		
T: Is it technically feasible and potentially successful?		
A: Does the responsible entity have the administrative capacity to execute this action?		
P: Is it politically acceptable?		
L: Is there legal authority to implement?		
E: Is it economically beneficial?		
E: Will the project have a positive or neutral impact on the environment? (score a 3 if positive, 2 if neutral)		
Could it be implemented quickly?		

Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in saved lives?	Assign 5-10 points based on the likelihood that lives would be saved	
Will the implemented action result in a reduction of disaster damages?	Assign 5-10 points based on relative reduction of disaster damages	
Mitigation Effectiveness Score:		

In addition to the STAPLEE cost benefit review prioritization at the final MPC meeting, an implementation plan for each action was discussed. An action worksheet was used to develop the implementation plan. The action worksheet fprmat is presented in **Table 4.2**.

Table 4.2. Mitigation Action Worksheet

Action Worksheet	
Name of Jurisdiction:	
Risk / Vulnerability	
Problem being Mitigated:	Provide a brief description of the problem that the action will address
Hazard(s) Addressed:	List the hazard or hazards that will be addressed by this action
Action or Project	
Action/Project Number:	Insert a unique action number for this action for future tracking purposes. This can be a combination of the jurisdiction name, followed by the goal number and action number (i.e. Joplin1.1)
Action or Project Description:	Describe the action or project.
Applicable Goal Statement:	Choose the goal statement that applies to this action
Estimated Cost:	Provide an estimate of the cost to implement this action. This can be accomplished with a range of estimated costs.
Benefits:	Provide a narrative describing the losses that will be avoided by implementing this action. If dollar amounts of avoided losses are known, include them as well.
Plan for Implementation	
Responsible Organization/Department:	Which organization will be responsible for tracking this action? Be specific to include the specific department or position within a department.
Action/Project Priority:	Include the STAPLEE score and Priority (H, M, L)
Timeline for Completion:	How many months/years to complete.
Potential Fund Sources:	List specific funding sources that may be used to pay for the implementation of the action.
Local Planning Mechanisms to be Used in Implementation, if any:	Comprehensive plan, storm water management ordinance, capital improvements plan, subdivision regulations, crisis management plan, etc.
Progress Report	
Action Status	Indicate status as New, Continuing Not Started, or Continuing in Progress)
Report of Progress	For Continuing actions only, indicate the report on progress. If the action is not started, indicate any barriers encountered to initiate the action. If the action is in progress, indicate the activity that has occurred to date.

The following section organizes the actions for each jurisdiction participating in the Plan, the goal statement that they fall under, and completed worksheet for each new and continuing mitigation action.

Goal 1: Protect the lives and livelihoods of all citizens

Action 1.1.1 Work Sheet	
Name of Jurisdiction:	City of Ozark, City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Public awareness of hazard vulnerability and mitigation measures.
Hazards Addressed:	Tornado, flood, sinkhole, wildfire, extreme temperature, winter storm, severe thunderstorm.
Action or Project	
Action or Project Number:	1.1.1
Name of Action or Project:	Ozark and Nixa Expo
Action or Project Description:	Continue collaboration between local government, community organizations, and businesses to host community expos to promote public awareness health and safety during natural hazard events.
Applicable Objective Statement:	Promote education, research, outreach and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation.
Estimated Cost:	$0 - $500
Benefits	Reduction of loss of life, injury, and property during hazard events
Plan for Implementation	
Responsible Organization/Department:	City of Ozark and Nixa Emergency Management Office/EMD
Action/Project Priority:	STAPLEE Score: 35 Priority: High
Timeline for Completion:	Annually
Potential Funding Sources:	Local “no cash” Funding, Local cash
Local Planning Mechanisms Used for Implementation if any:	N/A
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	The Ozark and Nixa Expos are annual events. At these events, local EMDs and city staff promote information on residential saferooms, sinkhole training, severe storm preparedness, and other hazard information for businesses and homeowners.

Action Work Sheet	
Name of Jurisdiction:	Christian County
Risk/Vulnerability	
Problem Being Mitigated:	Public awareness of hazard vulnerability and mitigation measures.
Hazards Addressed:	Dam failure, Drought, Earthquake, Extreme temperatures, Flood, Sinkholes, Severe T-Storm, Severe Winter Weather, Tornado, Wildfire
Action or Project	
Action or Project Number:	1.1.2
Name of Action or Project:	Social Media and Public Information
Action or Project Description:	Encourage the media and leverage social media platforms to publish or broadcast information about natural hazard vulnerability, preparedness plans and mitigation efforts throughout the county.
Applicable Goal Statement:	Promote education, research, outreach and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation
Estimated Cost:	$0
Benefits	Increased public safety during hazard events
Plan for Implementation	
Responsible Organization/Department:	Emergency Management
Action/Project Priority:	STAPLEE Score: 36 Priority: High
Timeline for Completion:	In progress
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	None
Progress Report	
Action Status:	Continuing in progress
Report of Progress:	Christian County Emergency Management Facebook page online. Preparedness in formation and weather alerts posted frequently. Local news media contacts file updated and maintained. EMA point of contact for public information before and after hazard events.

Action Work Sheet	
Name of Jurisdiction:	Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley Campus
Risk/Vulnerability	
Problem Being Mitigated:	Public awareness of hazard vulnerability and mitigation measures.
Hazards Addressed:	Severe T-Storm, Severe Winter Weather, Tornado, Fire Safety
Action or Project	
Action or Project Number:	1.1.3
Name of Action or Project:	Hazard awareness program for schools
Action or Project Description:	Continue to promote and expand educational programs regarding natural hazard mitigation and preparedness in school newsletters and seek to integrate information on natural hazards into school curriculum where feasible.
Applicable Goal Statement:	Promote education, research, outreach and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation
Estimated Cost:	$0 - $1,000
Benefits	Increased public safety for vulnerable populations
Plan for Implementation	
Responsible Organization/Department:	School Administrators and curriculum planners
Action/Project Priority:	STAPLEE Score: 39 Priority: High
Timeline for Completion:	12 months
Potential Funding Sources:	Local “No Cash” Funding, Local Funds
Local Planning Mechanisms Used for Implementation if any:	Curriculum plans
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	Fire and Public Safety training in Clever R-V, Sheltering, and evacuation exercises in all schools, storm preparedness for homes addressed during severe weather week in the spring, Ozark R-VI provides CERT class as an elective.

Action Work Sheet	
Name of Jurisdiction:	Christian County, City of Ozark, City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Structures threatened or damaged during wildfires
Hazards Addressed:	Wildfire
Action or Project	
Action or Project Number:	1.1.4
Name of Action or Project:	Fire resistant construction and landscaping
Action or Project Description:	Increase public awareness on techniques to reduce risk, such as the use of fire resistant materials in construction, landscaping techniques and planting materials that are more resistant to the spread of wildfire.
Applicable Goal Statement:	Promote education, research, outreach and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation
Estimated Cost:	$0
Benefits	$20,000 - $75,000 (cost of one structure)
Plan for Implementation	
Responsible Organization/Department:	Planning and Development Administrators, Building officials
Action/Project Priority:	STAPLEE Score: 30 Priority: High
Timeline for Completion:	6 months
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Site Plan review, Building permit process, Landscaping ordinance
Progress Report	
Action Status:	Continuing not Started
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Property loss
Hazards Addressed:	Flood, Sinkholes
Action or Project	
Action or Project Number:	1.1.5
Name of Action or Project:	Private property hazard insurance
Action or Project Description:	Promote homeowner purchase of flood insurance and Missouri FAIR Plan sinkhole loss policies for dwellings in hazard prone areas
Applicable Goal Statement:	Promote education, research, outreach and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation
Estimated Cost:	$0
Benefits	Unknown
Plan for Implementation	
Responsible Organization/Department:	Planning and Development, Building Official
Action/Project Priority:	STAPLEE Score: 36 Priority: High
Timeline for Completion:	
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Site Plan Review, Building Permit Process, Hazard Awareness Progam
Progress Report	
Action Status:	New
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa, Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley, Christian County Ambulance District
Risk/Vulnerability	
Problem Being Mitigated:	Community Preparedness
Hazards Addressed:	Dam failure, Drought, Earthquake, Extreme temperatures, Flood, Sinkholes, Severe T-Storm, Severe Winter Weather, Tornado, Wildfire
Action or Project	
Action or Project Number:	1.1.6
Name of Action or Project:	Citizen Preparedness
Action or Project Description:	Increase, promote, establish and maintain participation in citizen preparedness activities, such as; Citizen Corps, CERT, COAD, Neighborhood Watch, Fire Corps, Amateur Radio, etc.
Applicable Goal Statement:	Promote education, research, outreach and development programs to improve knowledge and awareness among citizens and industry about hazard mitigation
Estimated Cost:	$0 - $1000
Benefits	Community Resilience, dollar amount unknown
Plan for Implementation	
Responsible Organization/Department:	Public Safety Departments, Emergency Managers
Action/Project Priority:	STAPLEE Score: 40 Priority: High
Timeline for Completion:	Ongoing
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	N/A
Progress Report	
Action Status:	Continuing in progress
Report of Progress:	Fremont Hills conducted community CERT training workshop in 2011, Christian County CERT received a presidential citation in 2014. (Promoted on social media and in local news publications.

Action Work Sheet	
Name of Jurisdiction:	The City of Billings, The City of Clever
Risk/Vulnerability	
Problem Being Mitigated:	Adequate public alert to hazard events
Hazards Addressed:	Tornado, Severe T-Storms
Action or Project	
Action or Project Number:	1.2.1
Name of Action or Project:	Outdoor warning sirens
Action or Project Description:	Increase the number of warning sirens in developing areas and make all warning sirens radio activated and ensure that warning siren coverage remains consistent with current standards.
Applicable Goal Statement:	Provide adequate warning and communications systems to alert the public to severe hazard events.
Estimated Cost:	$10,000 - $20,000 per siren
Benefits	Saved lives and injury reduction, Dollar amount unknown
Plan for Implementation	
Responsible Organization/Department:	Local emergency management, public safety departments
Action/Project Priority:	STAPLEE Score: 32 Priority: High
Timeline for Completion:	18 months – 2 years
Potential Funding Sources:	Local Funding USDA Rural Development CDBG
Local Planning Mechanisms Used for Implementation if any:	Capital improvement plan
Progress Report	
Action Status:	New
Report of Progress:	There is only one siren in Billings and Clever. Both are manually activated.

Action Work Sheet	
Name of Jurisdiction:	Christian County
Risk/Vulnerability	
Problem Being Mitigated:	Adequate public alert to hazard events
Hazards Addressed:	Flood, Extreme Temperature, Severe T-Storm, Severe Winter Weather, Tornado
Action or Project	
Action or Project Number:	1.2.2
Name of Action or Project:	NOAA Radios
Action or Project Description:	Seek and utilize funding mechanisms to establish and maintain programs enabling the distribution of low-cost NOAA all-hazard radios for continuous operation in homes, businesses, schools, nursing homes and all facilities for public accommodation.
Applicable Goal Statement:	Provide adequate warning and communications systems to alert the public to severe hazard events.
Estimated Cost:	$500 - $2,000
Benefits	Dollar amount unknown
Plan for Implementation	
Responsible Organization/Department:	Emergency Management Agency, Local Emergency Planning Committee
Action/Project Priority:	STAPLEE Score: 40 Priority: High
Timeline for Completion:	6 months – 1 year
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	N/A
Progress Report	
Action Status:	Continuing not started
Report of Progress:	NOAA Radios are in operation in schools and local government offices

Action Work Sheet	
Name of Jurisdiction:	Billings Special Road District, Christian County
Risk/Vulnerability	
Problem Being Mitigated:	Adequate public alert to hazard events
Hazards Addressed:	Flood
Action or Project	
Action or Project Number:	1.2.3
Name of Action or Project:	Low water crossing markings
Action or Project Description:	Install, replace and maintain low water markings and gauges in flood prone areas.
Applicable Goal Statement:	Provide adequate warning and communications systems to alert the public to severe hazard events.
Estimated Cost:	$800 per sign
Benefits	$10,000 per auto salvaged, $5,000 - $10,000 per water rescue, Cost of one life saved $6,000,000
Plan for Implementation	
Responsible Organization/Department:	Road District Secretary, Christian County Commission
Action/Project Priority:	STAPLEE Score: 35 Priority: High
Timeline for Completion:	6 months – 2 years
Potential Funding Sources:	Local Funding
Local Planning Mechanisms Used for Implementation if any:	Major road plans, Road Improvement plans
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	Billings Special Road District has begun replacing old roadway signage with high intensity facings for better visibility in 2015.

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa, Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley, Christian County Ambulance District
Risk/Vulnerability	
Problem Being Mitigated:	Loss of life and injury reduction during tornado and high wind events
Hazards Addressed:	Tornado
Action or Project	
Action or Project Number:	1.3.1
Name of Action or Project:	Safe room construction
Action or Project Description:	Integrate safe room construction in new community buildings, schools, large facilities and other establishments serving the public in areas of population concentration where feasible.
Applicable Goal Statement:	Provide and promote safe refuge areas during weather extremes.
Estimated Cost:	$700,000 - $1,500,000
Benefits	Cost of one life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	School, City and County administration and building departments
Action/Project Priority:	STAPLEE Score: 37 Priority: High
Timeline for Completion:	1 – 3 years
Potential Funding Sources:	Local Funding Local “no cash” Funding CDBG USDA Rural Development HMGP
Local Planning Mechanisms Used for Implementation if any:	Master plans, capital improvements plans, crisis management plans
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	The City of Ozark Parks Department has constructed a community saferoom at the City Park. Chadwick R-I, Nixa R-III, and Clever R-V have constructed community saferooms in school buildings since 2011. Billings R-IV and Ozark R-VI school districts passed bond measures to construct saferooms in existing and new facilities. Spokane R-VII schools have submitted a letter of interest to SEMA for HMPG funds to construct safe rooms in the middle school and Highlandville elementary.

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa, Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley, Christian County Ambulance District
Risk/Vulnerability	
Problem Being Mitigated:	Identifying safe refuge areas in existing facilities
Hazards Addressed:	Tornado, High wind events
Action or Project	
Action or Project Number:	1.3.2
Name of Action or Project:	Safe refuge area plan
Action or Project Description:	Create and update tornado/severe storm plans and identify refuge areas that comply with FEMA publication 431 Selecting Refuge Areas in Buildings, in schools, large facilities and other establishments serving the public.
Applicable Goal Statement:	Provide and promote safe refuge areas during weather extremes.
Estimated Cost:	$0 - $500
Benefits	Cost of one life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	Emergency managers and public safety officials
Action/Project Priority:	STAPLEE Score: 36 Priority: High
Timeline for Completion:	6 months – 1 year
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Local emergency operations plan
Progress Report	
Action Status:	Continuing not Started
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County, Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa, Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley, Christian County Ambulance District
Risk/Vulnerability	
Problem Being Mitigated:	Extreme temperature fatalities
Hazards Addressed:	Extreme Temperatures
Action or Project	
Action or Project Number:	1.3.3
Name of Action or Project:	OACAC Programs
Action or Project Description:	Encourage local community organizations to continue and augment programs to provide fans, air conditioners, and winter weatherization for those at risk.
Applicable Goal Statement:	Provide and promote safe refuge areas during weather extremes.
Estimated Cost:	$1,000 - $5,000
Benefits	Cost of one life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	LEPC jurisdiction representatives
Action/Project Priority:	STAPLEE Score: 33 Priority: High
Timeline for Completion:	1 – 2 years
Potential Funding Sources:	Local “no cash” Funding, Local funds
Local Planning Mechanisms Used for Implementation if any:	N/A
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	OACAC has discontinued this program due to grant funding availability. The program currently relies on donations to maintain the program.

Action Work Sheet	
Name of Jurisdiction:	Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley
Risk/Vulnerability	
Problem Being Mitigated:	Tornado, High wind injuries and fatalities
Hazards Addressed:	Tornado, High wind events
Action or Project	
Action or Project Number:	1.3.4
Name of Action or Project:	Protective filming and blast proof doors
Action or Project Description:	Retrofit doors to all vulnerable facilities with metal doors, or place protective film on glass doors and windows.
Applicable Goal Statement:	Provide and promote safe refuge areas during weather extremes.
Estimated Cost:	$30,000 - $50,000 per structure
Benefits	Cost of one life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	School District Superintendents, Building and grounds staff
Action/Project Priority:	STAPLEE Score: 37 Priority: High
Timeline for Completion:	1 – 2 years
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Critical facilities plans, Crisis management plans
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	Spokane R-VII has installed blast proof doors at main entrances and filming windows at entryways and administrative offices. Plans are underway to complete these activities at all schools in the county.

Action Work Sheet	
Name of Jurisdiction:	Christian County, Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Extreme temperature fatalities
Hazards Addressed:	Extreme Temperatures
Action or Project	
Action or Project Number:	1.3.5
Name of Action or Project:	Community extreme temperature refuge areas
Action or Project Description:	Identify and designate heating and cooling refuge areas in community buildings and make these locations available to the public during extreme temperatures events.
Applicable Goal Statement:	Provide and promote safe refuge areas during weather extremes.
Estimated Cost:	$0
Benefits	Cost of one life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	Local Emergency Managers
Action/Project Priority:	STAPLEE Score: 27 Priority: Medium
Timeline for Completion:	6 months – 1 year
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Local Emergency Operations Plan
Progress Report	
Action Status:	Continuing in progress
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County, Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Tornado, High wind injuries and fatalities
Hazards Addressed:	Tornado, High wind events
Action or Project	
Action or Project Number:	1.3.6
Name of Action or Project:	Residential saferoom construction
Action or Project Description:	Promote and distribute FEMA publication 320 which provides information on construction plans and cost estimates for building safe rooms in homes or small business and cost estimates for construction.
Applicable Goal Statement:	Provide and promote safe refuge areas during weather extremes.
Estimated Cost:	$0
Benefits	Cost of one life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	Site Plan Review, Building Permit Process, Hazard Awareness Program
Action/Project Priority:	STAPLEE Score: 35 Priority: High
Timeline for Completion:	6 months – 1 year
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Site Plan Review, Building Permit Process
Progress Report	
Action Status:	New
Report of Progress:	N/A

Goal 2: Reduce the potential impact of natural disasters to property, infrastructure, and the local economy.

Action Work Sheet	
Name of Jurisdiction:	Christian County, Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Power outages during hazard events
Hazards Addressed:	Tornado, Severe T-Storms, Severe winter weather
Action or Project	
Action or Project Number:	2.1.1
Name of Action or Project:	Underground utilities
Action or Project Description:	Encourage electrical utilities to use underground construction methods where possible to reduce disruptions of service due to natural hazard events.
Applicable Goal Statement:	Protect structures, contents and critical lifelines from the impacts of natural hazard occurrence.
Estimated Cost:	Unknown
Benefits	Unknown
Plan for Implementation	
Responsible Organization/Department:	Planning and Development Administrators, Building officials
Action/Project Priority:	STAPLEE Score: 37 Priority: High
Timeline for Completion:	Ongoing
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Site Plan Review, Building Permit Process
Progress Report	
Action Status:	Continuing in progress
Report of Progress:	New subdivisions have been developed underground utilities in the Cities of Clever, Ozark and Nixa.

Action Work Sheet	
Name of Jurisdiction:	Christian County
Risk/Vulnerability	
Problem Being Mitigated:	Potential for dam failure
Hazards Addressed:	Dam Failure
Action or Project	
Action or Project Number:	2.1.2
Name of Action or Project:	Galindo Family Dam Emergency Action Plan
Action or Project Description:	Encourage all high hazard dam owners to maintain existing dams in conformance with the rules and regulations of the Missouri Dam and Reservoir Safety Council.
Applicable Goal Statement:	Protect structures, contents and critical lifelines from the impacts of natural hazard occurrence.
Estimated Cost:	$0
Benefits	Unknown
Plan for Implementation	
Responsible Organization/Department:	Christian County EMD
Action/Project Priority:	STAPLEE Score: 30 Priority: High
Timeline for Completion:	6 months – 1 year
Potential Funding Sources:	Local Funding Local “no cash” Funding CDBG USDA Rural Development HMGP, PDM, FMA
Local Planning Mechanisms Used for Implementation if any:	N/A
Progress Report	
Action Status:	Continuing not Started
Report of Progress:	The newly constructed state regulated Galindo Family dam emergency action plan will be kept on file at Christian County EMA upon completion.

Action Work Sheet	
Name of Jurisdiction:	Billings Special Road District, Christian County
Risk/Vulnerability	
Problem Being Mitigated:	Frequently flooded low water crossings
Hazards Addressed:	Flood
Action or Project	
Action or Project Number:	2.1.3
Name of Action or Project:	Low water crossing improvements
Action or Project Description:	Replace and improve low water crossings where identified as effective.
Applicable Goal Statement:	Protect structures, contents and critical lifelines from the impacts of natural hazard occurrence.
Estimated Cost:	$150,000 - $300,000
Benefits	$10,000 per auto salvaged, $5,000 - $10,000 per water rescue, Cost per life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	Road district commissioners, Christian County Commission
Action/Project Priority:	STAPLEE Score: 36 Priority: High
Timeline for Completion:	18 months – 3 years
Potential Funding Sources:	Local Funding Local “no cash” Funding CDBG USDA Rural Development HMGP, PDM, FMA
Local Planning Mechanisms Used for Implementation if any:	Major road plans, Capital improvement plans
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	The Billings Special Road District has completes 8 low water crossing culvert replacements and bridge improvements over the last five years. Several other projects have been identified and will be addressed in the coming years.

Action Work Sheet	
Name of Jurisdiction:	Christian County, Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Future property losses in hazard prone areas
Hazards Addressed:	Flood, Sinkholes
Action or Project	
Action or Project Number:	2.1.4
Name of Action or Project:	Hazard area property protection
Action or Project Description:	Acquire, elevate or flood-proof properties and critical infrastructure within hazard areas.
Applicable Goal Statement:	Protect structures, contents and critical lifelines from the impacts of natural hazard occurrence.
Estimated Cost:	$10,000 - $140,000
Benefits	Future loss avoidance
Plan for Implementation	
Responsible Organization/Department:	County Commission, city administrators, planning and development staff, building officials
Action/Project Priority:	STAPLEE Score: 31 Priority: High
Timeline for Completion:	1 – 5 years
Potential Funding Sources:	Local Funding Local “no cash” Funding HMGP, FMA CDBG
Local Planning Mechanisms Used for Implementation if any:	Open space and parks plans, floodplain management ordinances, land use plans
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	Christian County acquired repetitive loss property in 2011, The City of Nixa created park space in existing sinkhole areas in 2011. The City of Fremont Hills is currently working on a project to flood proof a control building at the city’s wastewater treatment plant.

Action Work Sheet	
Name of Jurisdiction:	The City of Billings, The City of Fremont Hills
Risk/Vulnerability	
Problem Being Mitigated:	Property damage due to flooding
Hazards Addressed:	Flood
Action or Project	
Action or Project Number:	2.2.1
Name of Action or Project:	Stormwater runoff management
Action or Project Description:	Adopt low impact storm water management policies to control runoff from developing areas outside the floodplain where ordinances have not been enacted.
Applicable Goal Statement:	Ensure that future development in the county is as hazard proof as possible.
Estimated Cost:	$0
Benefits	$10,000 - $50,000 in flood damage avoided
Plan for Implementation	
Responsible Organization/Department:	Mayor, Board of Alderman
Action/Project Priority:	STAPLEE Score: 39 Priority: High
Timeline for Completion:	6 months – 18 months
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Storm water management plans, drainage ordinances, subdivision regulations
Progress Report	
Action Status:	New
Report of Progress:	The City of Clever is currently updating their storm water management ordinance

Action Work Sheet	
Name of Jurisdiction:	Christian County, Christian County, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Property protection
Hazards Addressed:	Flood
Action or Project	
Action or Project Number:	2.2.2
Name of Action or Project:	NFIP Participation
Action or Project Description:	The NFIP communities of Christian County, Clever, Fremont Hills, Highlandville, Nixa, Ozark, Saddlebrooke and Sparta will enforce floodplain management requirements, including regulating all new and substantially improved construction in the Special Flood Hazard Areas (SPFAs), floodplain identification and mapping, including local requests for map updates.
Applicable Goal Statement:	Ensure that future development in the county is as hazard proof as possible.
Estimated Cost:	$0
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	Planning and development staff, building officials, floodplain administrators
Action/Project Priority:	STAPLEE Score: 40 Priority: High
Timeline for Completion:	Ongoing
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Floodplain management ordinance
Progress Report	
Action Status:	Continuing in progress
Report of Progress:	The County and all municipalities have maintained participation in the NFIP with the exception of Billings. There are no SFHAs within the City of Billings

Action Work Sheet	
Name of Jurisdiction:	Christian County, Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Vulnerability to severe weather events
Hazards Addressed:	Tornado, Severe T-Storm, Severe Winter Weather
Action or Project	
Action or Project Number:	2.2.3
Name of Action or Project:	Storm Ready
Action or Project Description:	Maintain countywide Storm Ready status with the National Weather Service.
Applicable Goal Statement:	Ensure that future development in the county is as hazard proof as possible.
Estimated Cost:	$0
Benefits	Cost of one life saved ($6,000,000)
Plan for Implementation	
Responsible Organization/Department:	Local emergency managers
Action/Project Priority:	STAPLEE Score: 11 Priority: Low
Timeline for Completion:	1 – 5 years
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Local Emergency Operations Plan
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	The County and The City of Ozark maintain storm ready status.

Action Work Sheet	
Name of Jurisdiction:	The City of Clever, The City of Fremont Hills
Risk/Vulnerability	
Problem Being Mitigated:	Integrating mitigation measures in construction of structures
Hazards Addressed:	Tornado, High wind events, Earthquake
Action or Project	
Action or Project Number:	2.2.4
Name of Action or Project:	Hurricane straps and structural integrity
Action or Project Description:	Adopt the International Building Code (IBC) and International Residential Code (IRC).
Applicable Goal Statement:	Ensure that future development in the county is as hazard proof as possible.
Estimated Cost:	$0
Benefits	$10,000 - $100,000 of property damage to future structures
Plan for Implementation	
Responsible Organization/Department:	Mayor, Board of Alderman, building officials
Action/Project Priority:	STAPLEE Score: 41 Priority: High
Timeline for Completion:	6 months – 1 year
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Building codes
Progress Report	
Action Status:	New
Report of Progress:	Christian County, The City of Nixa and The City of Ozark have adopted 2012 IBC codes, The City of Billings currently has IBC 2009 code. The cities of Clever and Fremont Hills currently have BOCA 2000 and 2006 codes on the books. The City of Fremont Hills does contract with the County for Building inspection and permitting and effectively conforms to IBC codes but not formally in City ordinances.

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills
Risk/Vulnerability	
Problem Being Mitigated:	Construction and development in hazard prone areas
Hazards Addressed:	Flood, Sinkholes
Action or Project	
Action or Project Number:	2.2.5
Name of Action or Project:	Natural area preservation in hazard prone areas
Action or Project Description:	Develop an open space acquisition, reuse, and preservation plan targeting hazard areas.
Applicable Goal Statement:	Ensure that future development in the county is as hazard proof as possible.
Estimated Cost:	$0 - $10,000
Benefits	$10,000 - $100,000 in future property losses
Plan for Implementation	
Responsible Organization/Department:	Planning and Development staff, Mayor/Board of Alderman
Action/Project Priority:	STAPLEE Score: 30 Priority: High
Timeline for Completion:	18 months – 3 years
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Comprehensive plan, land use plan, parks and recreation plans
Progress Report	
Action Status:	New
Report of Progress:	N/A

Goal 3: Ensure continued operation of government, emergency functions and critical infrastructure in a disaster

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa, Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley, Christian County Ambulance District, Billings Special Road District
Risk/Vulnerability	
Problem Being Mitigated:	Community preparedness and response
Hazards Addressed:	Flood, Tornado, Severe T-Storm, Severe Winter Weather
Action or Project	
Action or Project Number:	3.1.1
Name of Action or Project:	NIMS training
Action or Project Description:	Encourage all elected officials, public administrators, community stakeholders and responders to participate in National Incident Management System (NIMS) training and compliance programs.
Applicable Goal Statement:	Improve the efficiency, timing, and effectiveness of response and recovery efforts for natural hazard disasters.
Estimated Cost:	$0 - $100
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	Local Emergency Planning Committee
Action/Project Priority:	STAPLEE Score: 42 Priority: High
Timeline for Completion:	0 – 18 months
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Local Emergency Operations Plan
Progress Report	
Action Status:	New
Report of Progress:	School districts require NIMS training for all administrative staff and are working to integrate the Incident Command Structure into district departments in coordination with a Christian County EMA initiative for schools.

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Emergency response capability
Hazards Addressed:	Flood, Tornado, Severe T-Storm, Severe Winter Storm, Wildfire
Action or Project	
Action or Project Number:	3.1.2
Name of Action or Project:	911 addressing for structures
Action or Project Description:	Enforce highly visible 911 addressing for residences and businesses through building and business permitting as well as public education of existing ordinances.
Applicable Goal Statement:	Improve the efficiency, timing, and effectiveness of response and recovery efforts for natural hazard disasters.
Estimated Cost:	$0
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	Planning and development staff, building officials
Action/Project Priority:	STAPLEE Score: 40 Priority: High
Timeline for Completion:	6 – 18 months
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Subdivision regulations, building permitting process
Progress Report	
Action Status:	New
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County
Risk/Vulnerability	
Problem Being Mitigated:	Emergency response and recovery capability
Hazards Addressed:	Flood, Tornado, Severe T-Storm, Severe Winter Storm
Action or Project	
Action or Project Number:	3.1.3
Name of Action or Project:	Debris disposal plan
Action or Project Description:	Identify debris disposal and burning locations in the county to facilitate recovery from large scale hazard events.
Applicable Goal Statement:	Improve the efficiency, timing, and effectiveness of response and recovery efforts for natural hazard disasters.
Estimated Cost:	$0
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	Christian County EMA
Action/Project Priority:	STAPLEE Score: 32 Priority: High
Timeline for Completion:	6 – 18 months
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Local Emergency Operations Plan
Progress Report	
Action Status:	Continuing not Started
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever
Risk/Vulnerability	
Problem Being Mitigated:	Utility disruptions due to hazard events
Hazards Addressed:	Tornado, Severe T-Storm, Severe Winter Storm
Action or Project	
Action or Project Number:	3.2.1
Name of Action or Project:	Tree ordinance
Action or Project Description:	Enhance strategies and coordinate with utility providers to manage encroachment of vegetation in easements and rights of way.
Applicable Goal Statement:	Design, enhance, or amend policies that will work to limit the impact of natural hazards.
Estimated Cost:	$0
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	County Commission, Mayor/Board of Alderman, Public works officials
Action/Project Priority:	STAPLEE Score: 28 Priority: Medium
Timeline for Completion:	6 – 18 months
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Tree trimming ordinance
Progress Report	
Action Status:	Continuing not Started
Report of Progress:	Tree and tree trimming ordinances are in effect in the cities of Fremont Hills, Nixa, and Ozark.

Action Work Sheet	
Name of Jurisdiction:	Billings Special Road District, Christian County, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Functional integrity of critical lifelines
Hazards Addressed:	Flood, Severe Winter Storm
Action or Project	
Action or Project Number:	3.2.2
Name of Action or Project:	Snow and debris clearing
Action or Project Description:	Plan for and maintain adequate snow and debris clearing capabilities.
Applicable Goal Statement:	Design, enhance, or amend policies that will work to limit the impact of natural hazards.
Estimated Cost:	$50,000 - $100,000
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	Road district secretary, Christian County Commission, Public works director
Action/Project Priority:	STAPLEE Score: 38 Priority: High
Timeline for Completion:	Annually
Potential Funding Sources:	Local Funding Local “no cash” Funding HMGP
Local Planning Mechanisms Used for Implementation if any:	Road maintenance plans
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	Road districts and public works routinely clear debris after flood events and maintain plows and salt for roadway clearance.

Action Work Sheet	
Name of Jurisdiction:	Christian County
Risk/Vulnerability	
Problem Being Mitigated:	Debris burning during hazardous conditions
Hazards Addressed:	Wildfire
Action or Project	
Action or Project Number:	3.2.3
Name of Action or Project:	Burn Bans
Action or Project Description:	Implement burn restrictions during time of weather conditions conducive to the spread of wildfire.
Applicable Goal Statement:	Design, enhance, or amend policies that will work to limit the impact of natural hazards.
Estimated Cost:	$0 - $10,000
Benefits	$20,000 - $75,000 (cost of one structure)
Plan for Implementation	
Responsible Organization/Department:	Christian County Commission
Action/Project Priority:	STAPLEE Score: 34 Priority: High
Timeline for Completion:	6 -18 months
Potential Funding Sources:	Local Funding Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Nuisance ordinance
Progress Report	
Action Status:	Continuing not started
Report of Progress:	Recent state legislation has enabled local governments to institute and enforce burn bans in Missouri.

Action Work Sheet	
Name of Jurisdiction:	The City of Billings, The City of Clever, The City of Ozark, The City of Nixa
Risk/Vulnerability	
Problem Being Mitigated:	Water shortages during severe drought events
Hazards Addressed:	Drought
Action or Project	
Action or Project Number:	3.2.4
Name of Action or Project:	Water conservation
Action or Project Description:	Develop an ordinance to restrict the use of public water resources for non-essential usage, such as landscaping, washing cars, filling swimming pools, etc.
Applicable Goal Statement:	Design, enhance, or amend policies that will work to limit the impact of natural hazards.
Estimated Cost:	$0
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	Public Works Director, Water and Sewer Department
Action/Project Priority:	STAPLEE Score: 34 Priority: High
Timeline for Completion:	6 – 18 months
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	Public safety ordinances
Progress Report	
Action Status:	New
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Billings, The City of Clever, The City of Fremont Hills, The City of Ozark, The City of Nixa, Billings R-IV, Chadwick R-I, Clever R-V, Nixa R-II, Ozark R-VI, Spokane R-VII, OTC Richwood Valley, Christian County Ambulance District, Billings Special Road District
Risk/Vulnerability	
Problem Being Mitigated:	Adequate funding sources for mitigation activities
Hazards Addressed:	Drought, Extreme temperatures, Flood, Sinkholes, Severe T-Storm, Severe Winter Weather, Tornado, Wildfire
Action or Project	
Action or Project Number:	3.3.1
Name of Action or Project:	Monitor funding programs
Action or Project Description:	Continue to monitor and identify funding from state and federal programs for hazard mitigation activities.
Applicable Goal Statement:	Increase the capabilities to mitigate the effects of a natural hazard.
Estimated Cost:	$0
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	Public Works directors, facilities managers, school administrators
Action/Project Priority:	STAPLEE Score: 41 Priority: High
Timeline for Completion:	Ongoing
Potential Funding Sources:	Local “no cash” Funding
Local Planning Mechanisms Used for Implementation if any:	N/A
Progress Report	
Action Status:	Continuing in Progress
Report of Progress:	N/A

Action Work Sheet	
Name of Jurisdiction:	Christian County, The City of Nixa, The City of Ozark
Risk/Vulnerability	
Problem Being Mitigated:	Hazard area vulnerability awareness
Hazards Addressed:	Dam failure, Flood, Sinkhole, Wildfire
Action or Project	
Action or Project Number:	3.3.2
Name of Action or Project:	Geographic information
Action or Project Description:	Continue development of Geographic Information Systems (GIS) to further identify, analyze, map and track the impact of natural hazards to enhance decision making and facilities management for agencies and stakeholders.
Applicable Goal Statement:	Increase the capabilities to mitigate the effects of a natural hazard.
Estimated Cost:	$0
Benefits	Unknown dollar amount
Plan for Implementation	
Responsible Organization/Department:	County EMA, County Assessor, GIS staff
Action/Project Priority:	STAPLEE Score: 31 Priority: High
Timeline for Completion:	Ongoing
Potential Funding Sources:	Local Funding Local “no cash” Funding CDBG
Local Planning Mechanisms Used for Implementation if any:	Capital improvements, Major street plans, Online mapping
Progress Report	
Action Status:	Continuing not Started
Report of Progress:	Christian County Assessor includes sinkhole and floodplain layers in the online parcel map viewer. Hazard layers are maintained and utilized by planning and zoning staff and public works directors.

5 PLAN MAINTENANCE PROCESS

This chapter provides an overview of the overall strategy for plan maintenance and outlines the method and schedule for monitoring, updating and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

5.1 Monitoring, Evaluating, and Updating the Plan

44 CFR Requirement 201.6(c)(4): The plan maintenance process shall include a section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

5.1.1 Responsibility for Plan Maintenance

The MPC is not a standing committee, with oversight by a responsible agency or elected body. The MPC representatives and stakeholders are represented on the Local Emergency Planning Committee (LEPC) in Christian County. The LEPC is responsible for developing and implementing the Local emergency Operations Plan and is a standing committee that meets quarterly and administrated through the Christian County Emergency Management agency. The goals and actions and representation are aligned with the mission of the LEPC, which is a standing committee. As such, the LEPC will be responsible for plan monitoring, evaluation and maintenance. Maintenance by the LEPC will involve agreement of the participating jurisdictions, including school and special districts, to:

- Meet annually, and after a disaster event, to monitor and evaluate the implementation of the plan;
- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high priority, low- or no-cost recommended actions;
- Maintain vigilant monitoring of multi-objective, cost-share, and other funding opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Report on plan progress and recommended changes to the County Commission and governing bodies of participating jurisdictions; and
- Inform and solicit input from the public.

The LEPC is an advisory body and can only make recommendations to county, city, town, or district elected officials. Its primary duty is to see the plan successfully carried out and to report to the community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, hearing stakeholder concerns about hazard mitigation, passing concerns on to appropriate

entities, and posting relevant information in areas accessible to the public.

5.1.2 Plan Maintenance Schedule

The LEPC agrees to meet annually and after a state or federally declared hazard event as appropriate to monitor progress and update the mitigation strategy. The Christian County Emergency Management Director will be responsible for initiating the plan reviews and will invite members of the LEPC to the meeting.

In coordination with all participating jurisdictions, a five-year written update of the plan will be submitted to the Missouri State Emergency Management Agency (SEMA) and FEMA Region VII per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule.

5.1.3 Plan Maintenance Process

Progress on the proposed actions can be monitored by evaluating changes in vulnerabilities identified in the plan. The LEPC during the annual meeting should review changes in vulnerability identified as follows:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions,
- Increased vulnerability due to hazard events, and/or
- Increased vulnerability as a result of new development (and/or annexation).

Future 5-year updates to this plan will include the following activities:

- Consideration of changes in vulnerability due to action implementation,
- Documentation of success stories where mitigation efforts have proven effective,
- Documentation of unsuccessful mitigation actions and why the actions were not effective,
- Documentation of previously overlooked hazard events that may have occurred since the previous plan approval,
- Incorporation of new data or studies with information on hazard risks,
- Incorporation of new capabilities or changes in capabilities,
- Incorporation of growth data and changes to inventories, and
- Incorporation of ideas for new actions and changes in action prioritization.

In order to best evaluate any changes in vulnerability as a result of plan implementation, the participating jurisdictions will adopt the following process:

- Each proposed action in the plan identified an individual, office, or agency responsible for action implementation. This entity will track and report on an annual basis to the jurisdictional LEPC member on action status. The entity will provide input on whether the action as implemented meets the defined objectives and is likely to be successful in reducing risk.
- If the action does not meet identified objectives, the jurisdictional LEPC member will determine necessary remedial action, making any required modifications to the plan.

Changes will be made to the plan to remedy actions that have failed or are not considered feasible. Feasibility will be determined after a review of action consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will be reviewed as well during the monitoring of this plan. Updating of the plan will be accomplished by written changes and submissions, as the LEPC deems appropriate and necessary. Changes will be approved by the County Commission and the governing boards of the other participating jurisdictions.

5.2 Incorporation into Existing Planning Mechanisms

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

Where possible, plan participants, including school and special districts, will use existing plans and/or programs to implement hazard mitigation actions. Those existing plans and programs were described in Community Profiles and Capabilities chapter of this plan. Based on the capability assessments of the participating jurisdictions, communities in Christian County will continue to plan and implement programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through the following plans:

- Comprehensive or land use plans of participating jurisdictions;
- Ordinances of participating jurisdictions;
- Christian County Emergency Operations Plan;
- Capital improvement plans and budgets;
- Other community plans within the County, such as water conservation plans, storm water management plans, and parks and recreation plans;
- School and Special District Plans and budgets; and
- Other plans and policies outlined in the capability assessment sections for each jurisdiction in Chapter 2 of this plan.

The LEPC members involved in updating these existing planning mechanisms will be responsible for integrating the findings and actions of the mitigation plan, as appropriate. The LEPC is also responsible for monitoring this integration and incorporation of the appropriate information into the five-year update of the multi-jurisdictional hazard mitigation plan.

Additionally, after the annual review of the Hazard Mitigation Plan, the Christian County Emergency Management Director will provide the updated Mitigation Strategy with current status of each mitigation action to the County Commission as well as all Mayors, City Clerks, and School District Superintendents. The Emergency Manager Director will request that the mitigation strategy be incorporated, where appropriate, in other planning mechanisms.

5.3 Continued Public Involvement

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

The hazard mitigation plan update process provides an opportunity to publicize success stories resulting from the plan's implementation and seek additional public comment. Information about the annual reviews will be posted in the local newspaper as well as on the Christian County website following each annual review of the mitigation plan. When the MPC reconvenes for the five-year update, it will coordinate with all stakeholders participating in the planning process. Included in this group will be those who joined the LEPC after the initial effort, to update and revise the plan. Public notice will be posted and public participation will be actively solicited, at a minimum, through available website postings and press releases to local media outlets, primarily newspapers.